CHAPTER 16

ANALYSIS OF THE EVACUATION

16.1 The start of the evacuation

Many passengers, especially in cabins on deck 1 and in forward cabins on other decks, heard, during about 10 minutes, metallic sounds which they gradually found abnormal and alarming. These sounds frightened some of,them. A few witnesses left their cabins, certain that something was amiss. Some left to investigate and others for the open deck 7.

The majority of passengers and crew members, however, were not alarmed until the more powerful blows before the first heel. The noise and the subsequent list obviously made them immediately recognise the situation as life-threatening. Many then escaped hastily and without taking the time to put on proper clothing. The reaction pattern varied, however, and some passengers, although alarmed, did not seem to believe or grasp the seriousness of the situation, or could find no options for rational action.

Most passengers and crew members were thus alarmed by the accident itself and started to seek the open decks spontaneously and, in most cases, individually. Alarm signals seem not to have had any significance for the passengers or for most of the crew.

16.2 The mobilisation of the command group on the bridge

The officers on watch after 0100 hrs were the second officer A and the fourth officer. The master arrived at the bridge 5 to 10 minutes prior to the first heel and is believed to have stayed because of the ongoing inquiry about sounds from the visor and the ramp area. The complete command group did not gather on the bridge.

The chief purser was awakened by the list and went directly to the open deck. The chief officer's voice was identified from the distress radio traffic together with the voices of the second officer A and the third officer. These two officers climbed out from the bridge when the ESTONIA had a list of approximately 80°. The Commission has no information about the chief engineer or the purser's assistant.

Except for the chief purser, no member of the command group survived.

16.3 Alarms and activities by the bridge

The bridge sent out alarm signals approximately five minutes after the list and when the situation had already become aggravated. The alarm they first used, *Mr Skylight to number one and two*, was a fire alarm which was coded so as not to disturb the passengers, but was, as most "Mr Skylight" alarms, also a signal for mustering the command group and the lifeboat groups simultaneously.

This alarm, which was not so well suited to the situation, came on at a time when there were already people wearing lifejackets below the bridge wing and when the list was around 30°. One of the two fire groups, to which this alarm was directed, was instructed to muster on the car deck which at about that time contained approximately 1,500 t of water.

According to the safety manual the bridge could use a "Mr Skylight" alarm if they wanted to prepare and organise the crew for an evacuation before alarming all the passengers. To muster the lifeboat groups, the command group should, according to their safety manual, use the "Mr Skylight" alarm without any suffix. To muster the lifeboat groups and evacuation groups simultaneously they should have used "Mr Skylight Evac" followed by the digits for each evacuation group.

Approximately two minutes after the "Mr Skylight" alarm, the lifeboat alarm came on.

A possible explanation for the use of a "Mr Skylight" alarm before the lifeboat alarm is that the bridge had not yet understood the seriousness of the situation but wanted to prepare the crew for evacuation. The use of this alarm was, however, inappropriate and late and suggests that there was confusion on the bridge and that the bridge was without a clear understanding of the situation. Since the lifeboat alarm came later it is reasonable to assume that this alarm and the distress radio call came close after one another and not before the bridge had fully perceived the situation as both life-threatening and irreversible.

Some survivors have reported hearing the alarms, but others report not having heard any alarm at all. Other survivors only heard parts of these alarms over the noise in the ship and most passengers did not understand what the alarms meant. No additional information was sent from the bridge.

The rapid development of the accident made organised efforts by the rest of the crew impossible.

16.4 Activities by crew members

The "Häire, häire laeval on häire" (Alarm, alarm there is alarm on the ship) message which came on prior to the alarms was probably not authorised from the bridge but sent on the initiative of the crew member at the information desk. This message might have had some effect upon the evacuation but it was mostly understood by Estonians only. Evidently it was interrupted at the very moment it was to be repeated in English.

Some individual crew members, however, took responsibility and initiative for alarming, and organised the evacuation locally by guiding passengers, helping, arranging human chains, distributing life-jackets and releasing liferafts. Divers' findings of ropes and a lifeboat rope ladder down the staircase aft at deck 6 are further evidence of efforts led by crew members to rescue those inside. A witness statement concerning individuals, probably crew members, keeping passengers back in a staircase may be referring to an attempt to organise the escape. It is understandable that crew members, before being ordered to evacuate or hearing any alarm signals, might try to neutralise spontaneous escape.

The chief task of the crew was to take responsibility for and organise the evacuation of the passengers. The Commission understands, however, that this became almost impossible as the situation later developed into imminent deadly peril to all, irrespective of category.

Taking responsibility implies risk-taking and risks during the accident were evenly distributed among both crew and passengers. The crew members' responsibilities were to see to passengers' well-being, to help and to use their knowledge and training actively in the rescue efforts. Passengers are justified in expecting that crew members should be aware of their responsibilities and at least be active. The reported passivity of some crew members, the delay in alarming and the lack of guidance from the bridge suggest that training and preparations were not sufficient.

A further indication of this was that members of the catering staff apparently did not play any specific role in the evacuation. Their duties were to form a first aid group, a guard group and 11 evacuation groups. When not involved in other duties, they were assigned to man the lifeboat and liferaft rescue stations. Individual members of the deck and engine crew, however, took responsibility for passengers and fellow crew members. Some of these crew members, including two who did not survive, made heroic contributions and were very active, apparently disregarding their own safety. Passengers also helped and supported each other, often sticking together in twos or in small groups. A few especially energetic and active passengers also helped to organise and to direct others.

16.5 Obstructions to the evacuation

Besides the increasing list, the architecture of the ESTONIA made the evacuation difficult. Most corridors and staircases in the cabin areas were 1.2 m wide. This was probably sufficient space for two normally-built people to pass each other but when people were crowding, standing still or lying and crawling on the floor, movement in such a limited space became difficult with reasonable consideration and without forcing one's way. Such narrow longitudinal corridors were also apparently difficult to move in when the list exceeded 30°. At about 45°, effective movement along the corridors became almost impossible for any adult of normal build.

Deck 1 contained cabins for 358 passengers. All the transverse corridors ended in the only longitudinal, and almost equally narrow, central corridor where there were six staircases. The limited width of this corridor, combined with the crowding and the disorganised behaviour of many passengers, probably created an insurmountable obstacle when the evacuation started.

It is believed that the narrow width of the corridors in combination with the list contributed to the crowding and the irrational behaviour.

Although the width of the corridors and evacuation staircases complied with the SOLAS Convention the Commission considers that this limited width constituted a major evacuation obstacle for most of the passengers. The Commission concludes that the applicable regulation in SOLAS was not appropriate, as demonstrated in this accident.

Only a few witness reports are from people who escaped through the forwardmost port staircase. One of these stated that there was no crowding. The divers' investigation revealed, however, that a large number of people got stuck in this staircase on all decks and landings inspected. A possible interpretation is therefore that this staircase was more difficult to climb because of its transverse direction and that those few who did manage to reach the open deck did so when the list was still minor.

Other obstacles to evacuation were objects which came loose and blocked the escape ways or struck people who were trying to escape. Heavy objects such as vending machines, gambling machines, flowerpots and some furniture in passageways and foyers should have been fixed to either deck or bulkheads. Some objects slid away, others came loose when the list was still small and heavy fixed objects later broke loose from their fastenings when the list increased. Also sliding carpets and slippery flooring material prevented some from evacuating and created obstacles that slowed others down.

The Commission has noted that some decorative objects were not properly fastened and also that heavy fixed objects broke loose within an angle of heel at which people still had possibilities to evacuate. These objects injured some or otherwise prevented the movement of others. It is therefore evident that more people could have reached the open deck had they not been hampered by the loose or sliding objects.

The Commission considers that all objects along evacuation routes such as passageways, staircases and foyers should be fixed and properly fastened with no possibility to break loose within a range of list where people are still able to move and have the possibility to evacuate. Flooring material should also be fastened and, especially in open areas like foyers, slippery material should be avoided so as to facilitate movement on moving and sloping floors.

16.6 Passengers' and crew members' reactions

The large number of people and their various reaction patterns also created an obstacle to the evacuation. During the evacuation, people had, because of the increasing list, increasing difficulties to move. A number of people fell or slid, thereby creating obstacles for others. Others were standing but not moving, thereby preventing others from passing them. Many were seen just holding on without moving; yet others appeared paralysed and seemingly unable to understand what was happening. From the very start of the list many were reported to be passive and still, despite reasonable possibilities for escaping.

A few of those who survived behaved in an irrational way, but most did not. A number of people reacted incredulously to the very early signs. They slowly realised that the sounds they heard were abnormal, or rather, they failed to persuade themselves that the situation was still normal. When they became clear about the situation, they acted promptly and with a clear goal: to get out to deck 7. They were the first to evacuate.

A majority of those rescued, however, seem to have grasped the seriousness of the situation when the blows and the list came. They also promptly understood what to do and thus reacted clearly and appropriately. Not without fear they yet managed to remain rational and to move effectively.

Many elderly people were seen making no or only faint efforts to escape. A great number of people were panicking, i.e. behaving without control, and screaming. Some of these were moving but not in a rational or purposeful way. Others were apathetic and some only held on to something without making further efforts to save themselves.

A number of people were shocked and seemingly unable to understand what was going on or what to do. Some of these seem to have been incapable of rational thought or behaviour because of their fear, and screamed or moaned helplessly; others appeared petrified and could not be forced to move. Some panicking, apathetic and shocked people were beyond reach and did not react when other passengers tried to guide them, not even when they used force or shouted at them. Other people tried to escape but lacked the strength to continue climbing, became exhausted and held onto handrails, blocking the way for others.

The Commission considers that information from the bridge over the public address system could have affected peoples' behaviour, especially if the system had been used to give orders to the passengers and the crew. Authoritative instructions could have saved many bewildered people, and should have been sent during the first few minutes in the development of the accident.

Spontaneous altruistic behaviour during the evacuation seems to have been more prevalent in the early stages where many people helped and took responsibility for each other or urged each other to move and climb. The building of human chains involved many, both crew members and passengers, but these efforts ceased when it became difficult to hold on and when people became afraid. Collective and co-operative efforts then broke down into individual efforts. Some collective and spontaneous attempts were made later on when people felt more secure. Those who had reached the open deck helped each other again and also tried to help those still trapped on the staircases. There are also indications that constructive communication between the escaping people broke down when they started to flee individually.

Many of the survivors forced their way, whereas others seem to have ceased struggling at some stage, as if giving themselves up for lost. Some have stated that they also, at some time, felt a strong urge to give up although they still possessed some strength. This strong feeling came over them when they suddenly felt their situation was hopeless. Overwhelmed, they lost all mental and physical strength and became passive. They regained their strength and willpower after coming to think of their loved ones, especially of children. Then they immediately decided to continue their struggle with great force and try to live on, as if needing an outside reason for staying alive.

During the struggle people became injured or forced out of the way by others. Consideration for others and rules of behaviour ceased at moments when individuals perceived themselves to be in a death-trap. A situation arose where many took care of themselves only. More primitive behaviour was revealed and some were apparently rescued at the expense of others.

16.7 The limits for evacuation and the outcome

The Commission has estimated that the possibilities for escape to the ESTONIA's open decks ceased when the list was between 45 and 50 degrees. Around these angles there might perhaps still be some possibilities to get out for the few who were agile enough, who also had suitable footwear and who received help from others inside or out on deck. The time span for the evacuation to the open decks, from the time people started to the 45-to 50-degree list, was thus between 15 and 20 minutes. For the majority, who were not alarmed until the first heel, the time span was about 10 minutes. Bearing the narrow corridors and the great number of people in mind, this time span was extremely short.

During this time at least 237 reached the open decks. This includes people who were seen on deck 7 and 8 but are still missing, 138 rescued, one of whom died in hospital, and 70 of the 94 bodies found. Next day 24 bodies were found near the wreck and it is very likely that they had come up from inside the wreck. This figure of 237 tallies with witnesses' statements that between 200 and 300 people were seen out on deck.

16.8 The rescue equipment

Crew members were seen working methodically releasing liferafts and distributing lifejackets. Passengers out on deck, however, had difficulties to understand how to put on the lifejackets. Instructions were in most cases not looked for, not found, not read or not understood correctly. This was sometimes due to passengers being overwhelmed by emotions and also to a stress-related narrowing of consciousness and perception. Passengers even struggled to release liferafts on their own although this task was intended for crew members only. In other cases, planless and highly stressed attempts were made by many passengers simultaneously, with nobody able to take the lead or have the time to work more methodically. Some individual passengers who were quite competent, active and rational also failed in their attempts.

At least one container with lifejackets came loose and fell into the sea. Many survivors have stated that the lifejackets appeared old-fashioned while a common opinion among those rescued was that it was difficult to understand how to use them and how to put them on. Many lifejackets were tied together in threes and were difficult to separate. Lifejackets were also torn off when people hit the water. Survivors reported that the lifejackets appeared incomplete, with missing straps or straps that seemed too short. People had to help each other both to understand how to use the jackets and also to put them on.

The reports from witnesses are in line with reports from rescue units and personnel searching the water during the days after the accident. They found several drifting bundles of lifejackets tied together. Members of various rescue units also confirmed that they found very few people wearing lifejackets that had been put on correctly.

It is therefore the Commission's opinion that the design of lifejackets should be simplified so that their proper use appears self-evident even for untrained people, and also that instructions on liferafts and liferaft containers should be very short, distinct, easy to find and to understand.

No one left the ship in an orderly fashion. Some were forced to jump, but most were swept into the sea by waves or slid into the sea inside or outside liferafts.

CHAPTER 17

THE RESCUE OPERATION

17.1 Introduction

The ESTONIA sank only about an hour after the first observations that presaged the accident and only about 30 minutes after the *1st Mayday call*.

About 680–750 people were trapped inside the vessel while at least 237 but probably 310 reached the outer decks. Lifejackets were distributed and liferafts were inflated and launched by the crew and by passengers. None of the ten lifeboats could be launched, but nine broke free and floated up to the surface when the vessel sank.

The people who fell or jumped into the sea without lifejackets, and those who were badly injured, drowned or otherwise succumbed so quickly that no rescue organisation or unit could have reached them in time.

Some 160 people succeeded in climbing onto liferafts or lifeboats. Of them, about 20 succumbed to hypothermia or hypothermia-induced drowning. At least two persons were lost during the rescue operation.

The MARIELLA reached the accident scene 50 minutes after the *1st Mayday call*, i.e. 20 minutes after the vessel sank. Four passenger ferries and the first rescue helicopter were on the scene within one hour and 10 minutes of the sinking. During the next three hours six more vessels and six more helicopters arrived.

Thirty-four people were rescued by the vessels and 104 by the helicopters in the time period between 0330–0900 hrs. Considering the circumstances a high percentage of people on the liferafts could be rescued. Almost all of those missing were trapped inside the vessel or were not able to get on a liferaft.

In the plans and exercises considerable reliance had been placed on rescue vessels and lifeboats from passenger ferries and other vessels. The first rescue vessel, the TURSAS, arrived at the scene of the accident about three hours after the ESTONIA foundered. No lifeboats or MOB boats were lowered by the vessels on the scene.

17.2 The distress traffic

The ESTONIA addressed her distress calls to the passenger vessels in the vicinity. Also the form of the distress calls did not comply with the formal requirements of the radio regulations. The Commission has learned with regret that in this area distress messages nowadays are very seldom transmitted in the correct form.

However, since the ESTONIA started the traffic by using the Mayday distress signal, the Commission considers that those receiving the message should have been in no doubt that the ESTONIA was requesting immediate assistance and that there was a distress situation on board.

Almost the entire distress traffic was conducted in Finnish. This language was understood by the MRCCs and coast stations in the area, and on board the nine vessels nearest to the ESTONIA.

The ESTONIA was asked for, but could not give, her position immediately due to the list and "black-out". It took about seven minutes from the *1st Mayday call* until the position was reported. No subsequent distress traffic was received from the ESTONIA.

Several minutes passed before any station tried to re-establish radio contact. At 0139 hrs, i.e. 10 minutes after receiving the ESTONIA's position, the SILJA EUROPA called the ESTONIA very briefly and without result. No other station tried to contact the ESTONIA.

MRCC Turku did not acknowledge receipt of the distress message from the ESTONIA, thus not confirming that the centre was conducting the rescue operation. Therefore it was not known by the SILJA EUROPA and the MARIELLA whether the distress calls had been received by the coast radio stations, and both vessels spent a considerable time trying to contact Helsinki radio for information on the distress messages received. It is the opinion of the Commission that MRCC Turku should have acknowledged the distress message even though the message was addressed to the ferries.

According to rescue instructions issued by the Finnish Ministry of the Interior, distress traffic should be handled by Helsinki Radio or Mariehamn Radio. This arrangement did not function as intended and, the Commission considers, contributed to information delays during the initial phase of the rescue operation.

In the event, Helsinki Radio did not hear the ESTONIA's distress calls. Nor did Helsinki Radio respond to calls from the MARIELLA or the SILJA EUROPA on VHF channel 16 and on MF distress frequency 2182 kHz. The MARIELLA succeeded in contacting Helsinki Radio by mobile telephone (NMT) at 0142 hrs and reported the distress calls from the ESTONIA. After unsuccessful attempts to contact Helsinki Radio the SILJA EUROPA notified MRCC Helsinki of the distress calls also at around 0142 hrs. Two minutes later Helsinki Radio contacted the SILJA EUROPA on VHF channel 16, and at 0145 hrs Helsinki Radio responded to the MRCC Turku call on channel 16 without problems.

The Commission finds no other explanation of the fact that Helsinki Radio did not hear the distress traffic than that the distress frequencies were not kept watch continually. With only one officer on duty for many hours there must be, for natural reasons, periods when the watchkeeping will be interrupted. This was also noted and accepted in the agreement between the National Maritime Administration and Telecom Finland regarding the conduct of distress radio traffic.

After contacting Helsinki Radio the SILJA EUROPA and the MARIELLA had good reasons to believe that Helsinki Radio would control the distress traffic. There was discussion on channel 16 between the vessels about transmitting a Mayday Relay but it was assumed that Helsinki Radio would do this.

The Commission's opinion is that a Mayday Relay should have been transmitted, primarily by the vessels, immediately after the ESTONIA had reported her position to the SILJA EUROPA and, when they did not do this, by MRCC Turku and Helsinki Radio. Both the pre-GDMSS and the GDMSS procedures, as well as VHF and MF distress frequencies, could and should have been used. Had this been done, the coast stations and other vessels could have received the distress information simultaneously and without delay.

Finnish rescue instructions for radio traffic separate the controller of the distress traffic from the actual rescue organisation. In the ESTONIA case this was a contributing factor to the omission to transmit a Mayday Relay. The Commission considers this omission to be very serious.

At 0145 hrs the operator at Helsinki Radio intended to transmit a Pan-Pan message. This was discussed with the duty officer at MRCC Helsinki and agreed to by him.

When MRCC Turku was informed by MRCC Helsinki that Helsinki Radio was going to transmit a Pan-Pan message, MRCC Turku contacted Helsinki Radio on VHF channel 16 and requested that a Mayday Relay should be transmitted. The Helsinki Radio operator responded that he was just preparing such a message. Notwithstanding this, the Helsinki Radio operator went ahead and transmitted the Pan-Pan message on channel 16 and 2182 kHz, reporting the ESTONIA's list and her Mayday calls. This was done at 0150 hrs, five minutes after MRCC Turku had requested a Mayday Relay to be transmitted, and some 20 minutes after the distress traffic from the ESTONIA had come to an end.

The Commission considers it remarkable that the Helsinki Radio operator neglected a request from the conductor of the rescue operation and that MRCC Turku did not take any corrective measures.

It is the opinion of the Commission that the alarms during the initial phase of the accident were late. The prime reason for this is believed to be the manning of the MRCCs and the radio stations, with only one man on duty. It was also too much for one person at MRCC Turku to initiate the alarms required in a major accident and at the same time follow the situation and take part in the distress traffic.

Consequences of the reduced manning at the MRCCs and the coast radio stations had been discussed in the organisation, and fears that the cost savings had resulted in insufficient resources for handling major accidents had been brought to the bodies responsible prior to the ESTONIA accident.

The manning had been decided in anticipation of conventional maritime accidents, when MRCCs were expected to be able to receive distress messages around the clock and to initiate rescue operations. The duty officer at MRCC Turku fulfilled these requirements, even though in the ESTONIA disaster the manning proved to be inadequate. The system was underdimensioned for a major maritime accident.

As noted in 8.11 the ESTONIA's emergency beacons (EPIRBs) were not switched on when put in their housings. The only reason that they were found switched off is that they were not properly activated.

17.3 Responses to the Mayday calls

17.3.1 Vessels

Almost all the vessels that participated in the rescue operation arrived after hearing the ESTONIA's distress call or receiving information from another vessel in the vicinity. Only the vessels of the Finnish coast guard and navy were alerted by the coast stations.

The positions of the vessels around the ESTONIA on 28 September 1994 at 0130 hrs are shown on the map in Figure 7.1.

There were five passenger ferries in the Northern Baltic around the ESTONIA. Closest was the MARIELLA at a distance of about 9 NM and furthest was the SILJA SYMPHONY, 23 NM away. Within a 35-nautical-mile radius from the ESTONIA there were three more vessels that received her Mayday calls.

On hearing the *1. Mayday call*, the MARIELLA tried twice to answer it but the ESTONIA did not reply. The officer of the watch saw the ESTONIA's lights and her radar image. According to a shore-based radar the MARIELLA started to turn towards the ESTONIA at 0132 hrs. The MARIELLA reached the scene of the accident at about 0210 hrs.

The SILJA EUROPA's was the only radio station that had contact with the ESTONIA. The information given from the ESTONIA reported only a severe list, a "black-out", that the situation looked serious and that assistance was needed. The extent of the accident and the assistance required were not known at this stage.

Figure 17.1 shows tracks of some vessels during the accident. The tracks are based on radar observations.

About 10 minutes elapsed between receipt of the *1st Mayday call* and 2 minutes between receipt of the ESTONIA's position and the MARIELLA's change of course towards the accident site. Corresponding times for the SILJA EUROPA were 16 and 8 minutes. The Commission is of the opinion that a Mayday call from a large passenger ferry is in itself so alarming that the vessels should have changed course immediately. The rough position of the ESTONIA must have been known.

The MRCC appointed the master of the SILJA EUROPA On-Scene Commander (OSC) at 0205 hrs.

The two other passenger ferries near the ESTONIA, the SILJA SYMPHONY and the ISABELLA, approached the ESTONIA from the west at full speed. Three other vessels approached the scene of the accident from the east. They reported to the OSC and took part in the search and rescue. Three vessels further west of the ESTONIA continued their voyage southwest. Two of them reported to the OSC and were released from the obligation to render assistance. The master of the third vessel considered that his ship in the circumstances was unable to provide assistance and he entered in the radio log the reason for this. The Commission considers that it was a reasonable judgement to let these three vessels proceed.

The Commission considers that vessels in the vicinity, despite some delays in reaction, acted correctly.

17.3.2 MRCCs and MRSCs

The accident took place within the rescue region of MRCC Turku. The rescue plan for major maritime accidents at that time included the alerting schedule shown in Figure 17.2.

At the time of the accident there was only one officer on duty in MRCC Turku. According to the rescue plan for major maritime accidents the duty officer was responsible to:

- order the most rapid operational maritime rescue units to the scene of the accident to conduct the rescue operation at the scene and obtain a detailed assessment of the situation,
- alert the stand-by duty officer and the emergency duty officer,
- start general alerting according to the alerting schedule.

The duty officer's first action was to call MRSC Turku to confirm the distress message and to alert the coast guard patrol vessel TURSAS which was at anchor in the archipelago. This was done at 0126 hrs, or two minutes after the beginning of the *2nd Mayday call*. The duty officer listened to the distress traffic until its end at 0130 hrs. At 0133 hrs he alerted the stand-by officer. After receiving the ESTONIA's exact position at 0129 hrs, at 0135 hrs he alerted the stand-by maritime rescue helicopter, which in the circumstances was the most rapid operational rescue unit. Between 0135 hrs and 0145 hrs he responded to telephone calls from crew members of the alerted helicopter.

The stand-by duty officer arrived at 0140 hrs. On arrival he assumed responsibility for the operation of the centre. After assessing the situation, he spent five minutes contacting MRCC Helsinki and Helsinki radio in order to get a Mayday Relay transmitted.

The emergency duty officer was not alerted until 0146 hrs. He arrived at 0203 hrs.

The first contact from MRCC Turku with vessels at sea took place somewhat before 0200 hrs, when the stand-by duty officer asked whether the master of the SILJA EUROPA agreed to lead the rescue operation at the scene of the accident.

At 0152 hrs MRCC Stockholm was informed of the accident by MRSC Mariehamn which, in accordance with normal practice, contacted MRCC Stockholm to check whether they knew about the accident. After first calling MRCC Helsinki, at 0157 hrs MRCC Stockholm called MRCC Turku and offered helicopter assistance.

At 0218 hrs MRCC Turku ordered MRCC Helsinki to alert the stand-by rescue helicopter in Helsinki. The crew was called at 0221 hrs. At 0252 hrs MRCC Turku alerted the Aeronautical Rescue Co-ordination Centre (ARCC) at Tampere to obtain military helicopters from the Transport Flight at Utti. At 0258 hrs the ARCC called the Air Force control centre and requested as many Air Force helicopters as possible. All these alerts of helicopters were late.

By 0200 hrs the seriousness of the accident had been realised and the MRCC Turku commander and deputy commander were alerted. It was not until 0230 hrs, or about ten minutes after the arrival of the deputy commander, that MRCC Turku determined formally that the situation was a major accident and began to summon the members of the maritime rescue expert group to MRCC Turku. The members of the group, in turn, alerted their own organisations, informed them of the situation and passed on assignments, and received from them reports on their action and on the situation.

As the Commission states above, a Mayday call from a large passenger ferry must be considered a most alarming situation and immediately assessed as a major accident. Clearly, the instructions

Figure 17.1 Vessel's tracks during the accident and rescue operation.

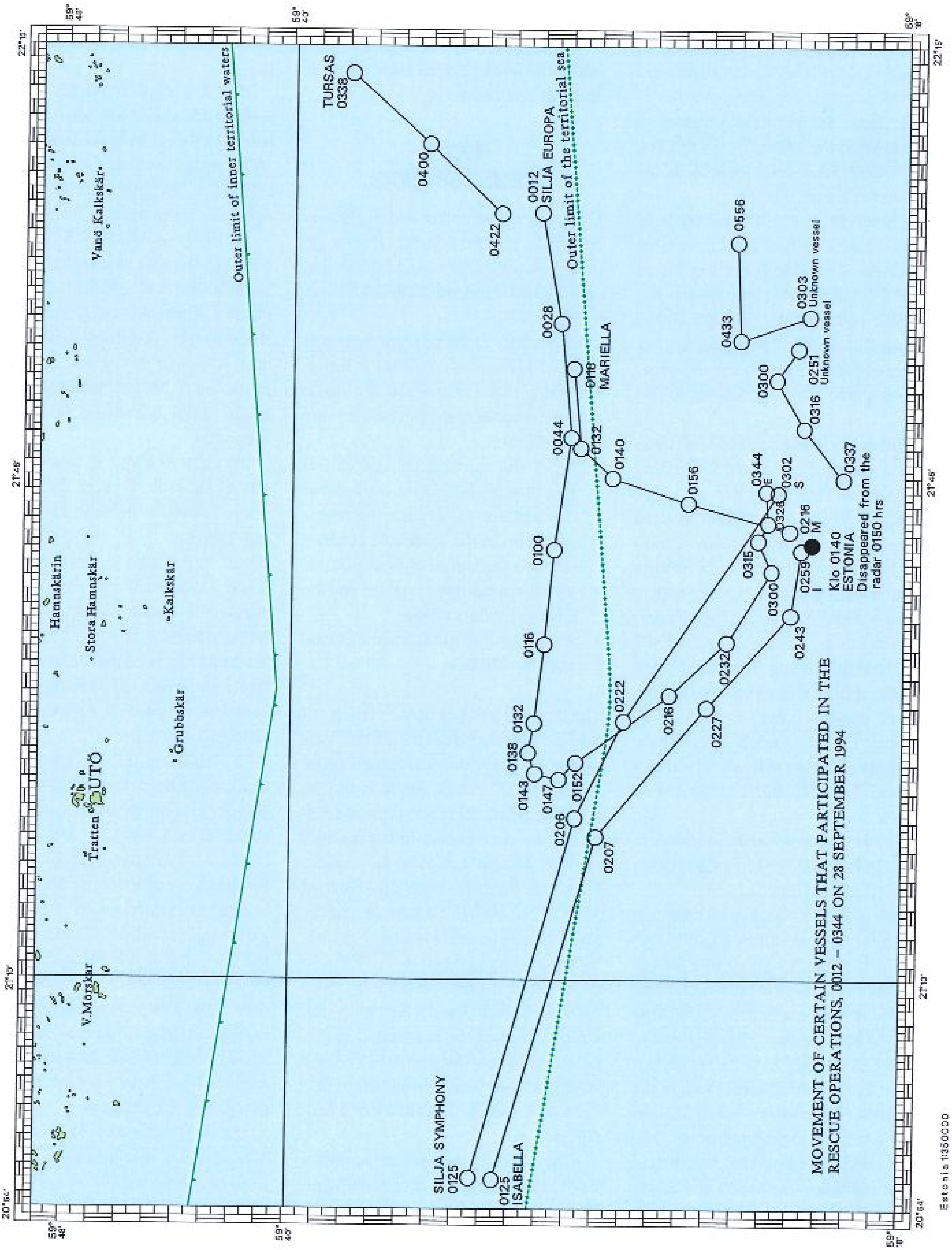
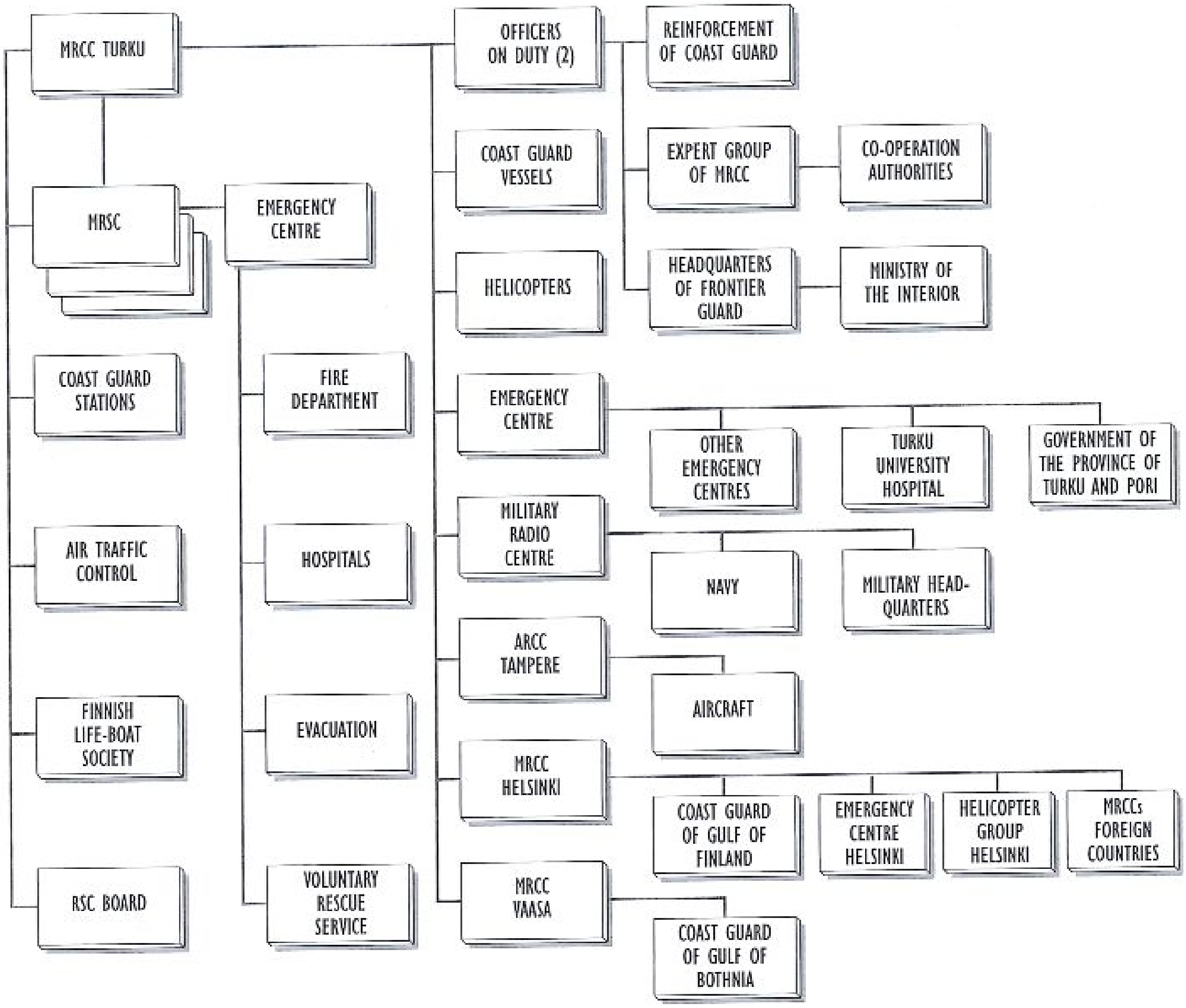


Figure 17.2 Alerting plan for Major Maritime Accident at MRCC Turku at the time of the accident.



and the manning were inappropriate for coping with an accident of this magnitude. For this reason the rescue plan for major maritime accidents was not fully complied with. Among other things the summoning of MRCC Turku personnel was delayed. Further, MRCC Turku did not announce on the radio that they were conducting the rescue operation.

Another shortcoming was that no mission co-ordinator, as recommended in the SAR Convention, was designated. This function was at first performed by the duty officer. The stand-by duty officer took over on his arrival and was relieved by the emergency duty officer on his arrival. He in turn was relieved by the deputy commander, and lastly by the commander. Continuity was maintained through briefings at each change. A system with so many changes is not considered efficient, since so much time and energy is required to ensure continuity.

With the deputy commander's arrival at 0220 hrs there were four rescue officers working at MRCC Turku. Even this group proved to be far too small for a rescue operation of this magnitude and it was not until the members of the maritime rescue expert group arrived that capacity was sufficient.

The personnel at MRCC Turku was divided into four groups. The operational group of three officers and two warrant officers maintained an overview of the situation, considered and ordered action and assisted the commander. The communication group was responsible for radio and telephone communications. It consisted of three warrant officers trained in communications. The maritime rescue expert group consisted of experts from various fields of importance for rescue operations. Each member of the group had his own area of responsibility. The public information group, finally, took care of information functions, and arranged briefings for the media and various official delegations. In spite of the work of this group these briefings also tied up a considerable amount of the commander's working capacity.

It is the opinion of the Commission that despite initial difficulties the work improved after the first hour and functioned well. Decisions were made and accomplished quickly under the commander's overall control.

17.4 Readiness of the rescue units

The Gulf of Finland and the Northern Baltic form a significant focus for maritime rescue services since on the average 34,000 passengers cross this small sea area every day. The Helsinki, Turku and Berga helicopter bases are on the fringes of this area (Figure 17.3). Any passenger vessel using the main ship routes can be reached from these bases in less than two hours. The location of the Turku base at the half-way point of the main route is considered appropriate, although the best accessibility and the shortest flight time would be from the Hanko peninsula.

Three Finnish helicopters were on stand-by at various bases. The crews were on one-hour alert, meaning that they should be assembled within that time. Three of the Swedish stand-by helicopters should be ready to depart within one hour, and one should be ready to depart within two hours. All stand-by helicopters fulfilled the requirements. The first helicopters took off earlier than their alert times required.

It is of utmost importance in an accident like this one that rescue helicopters reach the accident scene fast, as survival time in cold water is short. It is the view of the Commission that stand-by times can be shortened, with minimum costs, through:

- more efficient ways of alerting helicopter crews and other personnel required for take off, e.g. by using more modern technology,
- briefing the crews during transport to the helicopter bases and during the initial phase of the flight,
- speeding up transport times to the bases, especially for crew members living far from the bases.

The contribution of maritime rescue vessels remained small. Some arrived late at the scene of the accident because of the delay in alerting them and their slow speed in the prevailing weather with strong head wind. Some smaller rescue vessels on stand-by a few hours' sailing time away from the scene of the accident were not alerted, which the Commission considers an acceptable decision in the circumstances.

17.5 Management

17.5.1 MRCC Turku

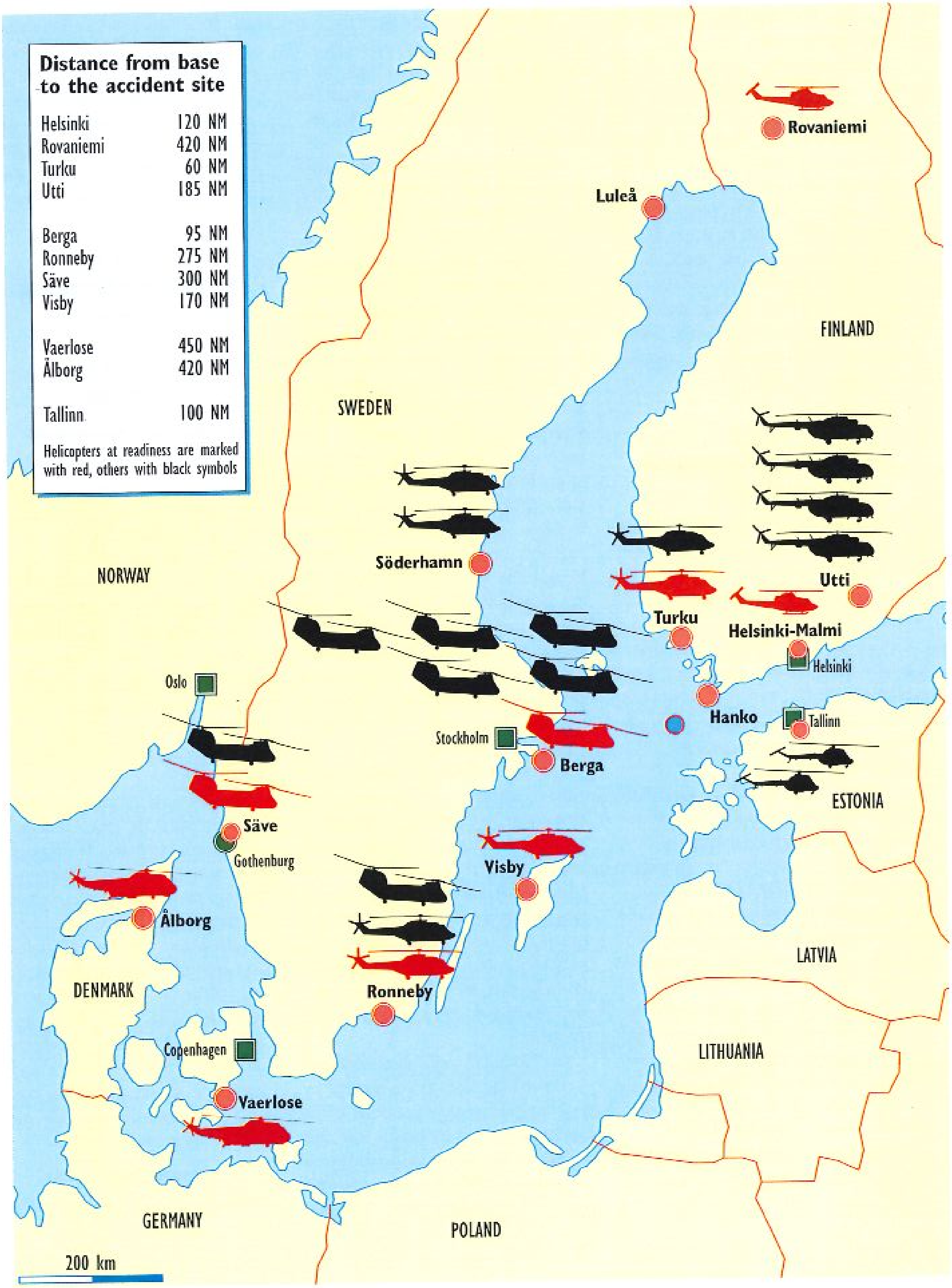
The organisation and chain of command of the maritime SAR services of Estonia, Finland and Sweden were established on the principles outlined by the IMO. The northern part of the Baltic Sea was divided into regions of responsibility of three MRCCs, Turku, Stockholm and Tallinn. The basic principle was for the MRCC responsible for the region to conduct the operation, while the others provided support as requested. Exceptional arrangements could be made as necessary.

As stated above, MRCC Turku assumed the responsibility for the rescue operation on receiving the Mayday calls. MRCC Turku had recently been restructured, and its organisation and communications equipment had been modernised.

The internal chain of command was clear and simple. The commander was ultimately responsible for rescue operations, and he had at his disposal the staff and the maritime rescue expert group. The work of the expert group had been practised, and procedures for alerting the members were in working order.

Co-operation between the different national rescue services was governed by a 1985 Finnish Ministry of the Interior instruction on conducting and maintaining maritime rescue services. The instruction stated that "the Headquarters of the Frontier Guard conducts, co-ordi-

Figure 17.3 Bases of helicopters participating in the rescue operation.



nates and oversees the co-operation among maritime rescue services, assisted as necessary by the maritime rescue division of the National Consultative Board for Rescue Services".

Contrary to the instruction, the tasks were carried out by the Security and Safety Management Group, headed by the Minister of the Interior. This body provided no practical assistance in the operative conduct of the rescue action. In the event of a major accident like the ESTONIA accident all measures should have been taken to support MRCC Turku.

Already before the ESTONIA accident there had been criticism among the personnel of the Finnish Frontier Guard, pointing out that insufficient attention was given to the SAR service.

17.5.2 The On-Scene Commander (OSC)

The master of the SILJA EUROPA was appointed OSC although this was not in line with the SAR Convention. The decision was a logical consequence of the fact that the SILJA EUROPA managed the distress traffic and thus served as control station for the traffic. The master of the SILJA EUROPA was also personally known to those at MRCC Turku, and was deemed capable of carrying out these demanding duties.

Although the master of the SILJA EUROPA carried out his duties and responsibilities as OSC in exemplary fashion without proper training or earlier experience, it is the opinion of the Commission that it is appropriate to provide selected masters of vessels in this traffic with the training needed to conduct such operations.

During the first hours the entire rescue operation was conducted by the OSC himself, assisted only by his own crew. On his instructions the vessels searched for and rescued survivors. When a vessel located a liferaft that was believed to contain survivors, this was reported to the OSC who either called on a helicopter to check this raft or broadcast a general message. The participating vessels sometimes also contacted the helicopters directly.

The helicopters arriving on the scene of the accident reported to the OSC and were assigned a mission. With the increasing number of helicopters the OSC had difficulties in overseeing their operations.

At 0650 hrs additional resources were flown out to assist the OSC. An air operation co-ordinator was then landed on board the SILJA EUROPA. He took over control of the air operation in the area. A co-ordinator surface search, appointed by MRCC Turku, with an assistant and an air traffic controller left Nauvo by helicopter at 0700 hrs but did not reach the vessel until 0945 hrs, since the helicopter that they first used could not land on the vessel or winch them on board.

At the beginning of the operation, when there were many liferafts in a small area, the helicopters acted independently. When the air operation co-ordinator took over the control of the air operation, he gave the incoming helicopters their instructions and informed them of other helicopters in the area. He also gave them instructions and orders regarding the rescue operation management, e.g. regarding refuelling possibilities. Later on he assigned search areas, and in practice managed the air operation.

The safety of the helicopters engaged in the rescue operations depended mainly on radio communications on the overloaded distress frequencies, since the air traffic radars were unable to follow the helicopters at low altitudes and there was no supervision and tracking system over the sea. The Commission's opinion is that the professional skill and experience of the helicopter crews contributed in a positive way to the outcome of the rescue operation.

In this kind of major air operation, it is essential that the OSC is assisted by personnel with experience of air traffic control. The air operation co-ordinator was not in place during the critical hours of darkness and the air traffic controller needed for supervising the air traffic and for ensuring flight safety did not arrive until 0945 hrs.

When the co-ordinator surface search and the air operation co-ordinator and his assistant had arrived on board the SILJA EUROPA, the staff of the OSC is considered to have reached a standard sufficient for conducting an operation of this magnitude. However, this did not happen until about 45 minutes after the last survivors were found.

17.6 Action at the accident site

17.6.1 Vessels

On-board preparations

While proceeding to the scene of the accident the assisting vessels made necessary preparations for the rescue operation and for taking care of survivors.

The helicopter pads were prepared for landings. Reception and treatment facilities for the survivors were readied and nursing staffs prepared. Voluntary medical experts among passengers were alerted to assist the permanent staffs. The preparations on board and the professionalism and willingness of people to help were afterwards highly appreciated by the survivors.

No lifeboats or rescue boats were launched from the vessels participating in the rescue operation. The possibilities of launching boats were discussed between some of the masters, but in the prevailing weather the operation was considered too risky. Instead liferafts were prepared for use and in some ferries the possibilities of using evacuation slides were discussed and the slides prepared.

The masters realised that the rescue operations would be difficult and the possibilities of rescuing people from the water were limited when lifeboats and rescue boats could not be used.

Rescues from vessels

On the MARIELLA an inflated liferaft

was placed at each end of the vessel's flat side. The vessel was manoeuvred with that side towards the wind and caught drifting rafts from the ESTONIA in between them. Another raft was lowered and used as a hoistable platform. People from the ESTONIA's liferafts moved over to the lowered raft and were winched up. The winches on the liferaft davits were manually operated, but during operations electric drilling machines were converted and used to improve the winching speed.

Two volunteers from the MARIELLA were lowered to a liferaft from which they managed to rescue two exhausted persons in another liferaft.

The ISABELLA also lowered a liferaft with volunteer rescuers on board.

They succeeded in getting about 20 people from one of the ESTONIA's rafts over to their own raft. The weight of the people and the water in the liferaft caused its bottom to rip during hoisting. At least five people fell into the sea, among them the three rescuemen. Four of these people were lifted up by a helicopter. One or more persons were lost during this operation.

To save the 16 persons hanging onto the damaged liferaft, the evacuation slide was inflated and the raft lowered back to the sea. A rescueman was lowered down to the slide platform and assisted people in getting from the raft to the platform and up the slide. The evacuation slide proved to be a good means of rescuing people from the rafts and from the sea. From the platform people were pulled up the slide itself to safety.

The decision to inflate the evacuation slide was quite extraordinary in the circumstances and testifies to good creative thinking.

Although the participating vessels contributed to the rescuing of many lives, it is established that their suitability for rescue operation in these severe weather conditions was limited. The safe launching of rescue boats or lifeboats was considered impossible, and rescuing people directly onto the vessels proved very difficult. The boat deck on the ferries, in most cases the only open deck, was situated more than 15 m above the water and lifting the survivors on board proved both risky and difficult. The experience of the rescue highlights the importance of having appliances permitting large ferries to recover people and liferafts from the surface. It also points out the need for liferafts to be strong enough to withstand lifting from the sea with full load.

17.6.2 Helicopters

The helicopter operation

When the first helicopter, OH-HVG, arrived at the scene of the accident at 0305 hrs, no one was yet able to give its crew an exact description of the situation. The crew assumed that people who had been able to leave the vessel were floating on liferafts or were in the sea. On the way to the scene of the accident the crew had decided that they would first try to rescue those who were in the water, and only then begin to rescue people from liferafts and lifeboats. On arrival the helicopter flew at a height of about 20 m, the crew searching for survivors in the light of the searchlights. The crew saw a number of lifejackets and liferafts but no people in the water. For this reason, some ten minutes after arrival, they began to examine the liferafts and rescue survivors from these. At this stage the helicopter had not yet received any rescue instructions from those responsible for conducting the operations (the OSC or MRCC Turku); so the crew had to make the decisions on its own.

When the two following helicopters Q 97 and Y 65 arrived on the scene at about 0400 hrs, they reported to the OSC and received instructions from him to concentrate on rescuing the survivors and for the time being leave those who were clearly dead.

Because of large wave-induced motions, landing on the vessels was very difficult. Few crews were trained for landing on vessels in heavy weather. Only the Finnish helicopters OH-HVG and OH-HVD made successful ship landings, setting down 36 people. The ability of helicopters to land on large passenger ferries in adverse weather conditions during rescue operations should be improved.

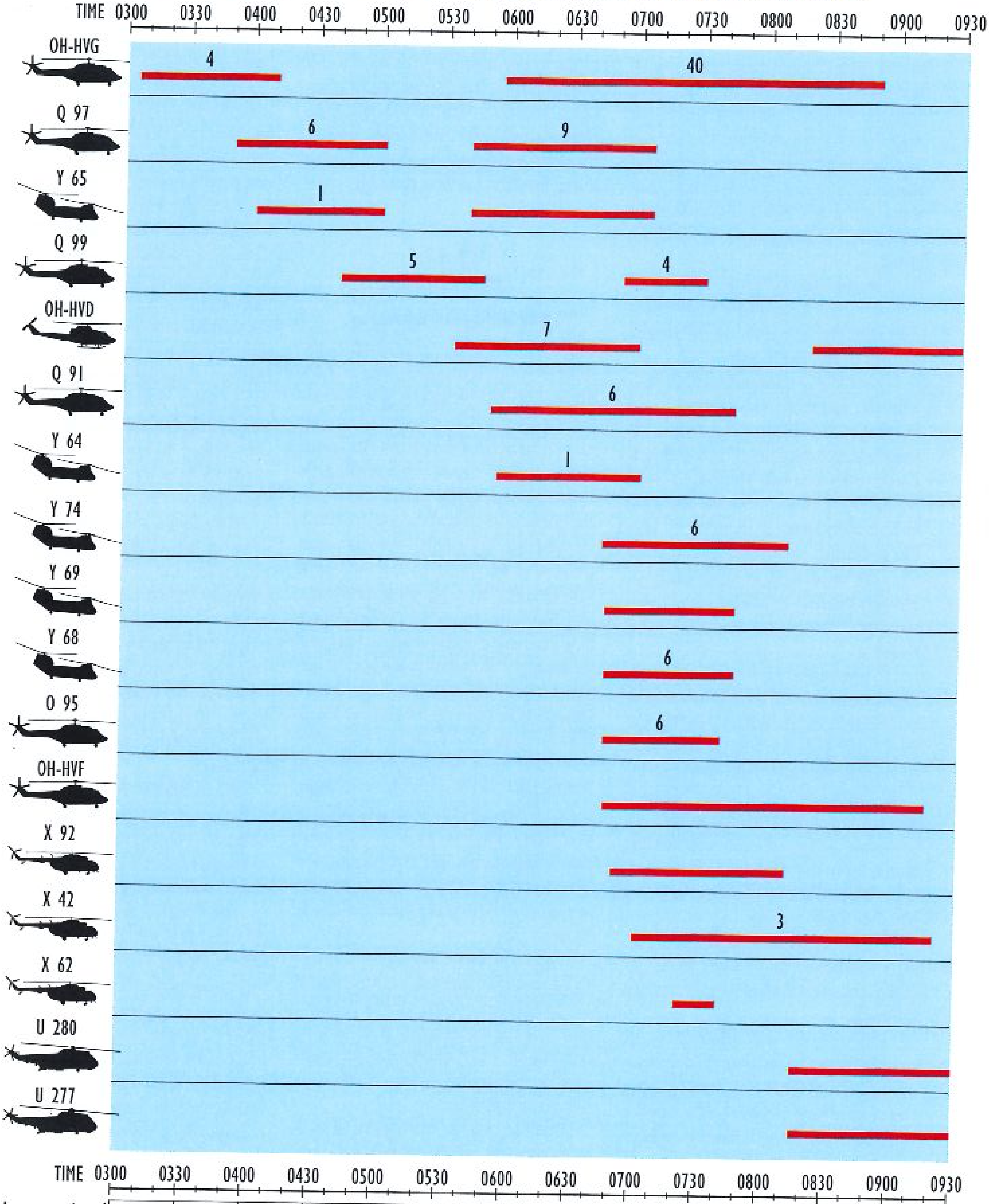
The Swedish helicopters took survivors primarily to Utö, but also to Hanko, Mariehamn or Huddinge Hospital in Sweden. The justification for these flights could be found in technical problems (e.g. a failed winch, an engine failure warning lamp). The pilot of the Q 97 had noted even on the first rescue flight that the survivors were in such bad condition that they had to be transported directly to the mainland for immediate hospitalisation. For this reason he flew directly to Hanko and landed on a sports field. No arrangements had been made in Hanko for receiving the patients, but local citizens helped in quickly transferring the survivors from the helicopter for treatment and care.

The medical specialists of the expert group at MRCC Turku, beginning work soon after 0300 hrs, decided that the survivors should be brought to the vessels or to Utö without delay to lessen the risk of hypothermia. The flight from the scene of the accident took five to ten minutes to the vessels, 10 to 15 minutes to Utö, 20 to 25 minutes to Mariehamn, Nauvo and Hanko, and 25 to 30 minutes to Turku.

When MRCC Turku was informed that it was considered dangerous to land helicopters on the vessels it was decided to use primarily Utö, where medical personnel and facilities were available.

The diagram in Figure 17.4 shows the number of helicopters at the scene at different times, and the numbers of survivors rescued. The diagram is partly based on estimates. Since the times at which survivors were winched were not logged, the numbers rescued during an individual flight have been distributed evenly over the entire flight time. Helicopters are considered to have been in the area of the accident even when they were transporting survivors to a vessel or to Utö. Helicopters flying survivors further than this are deemed to have left the

Figure 17.4 Summary of the rescue operation by helicopters, number of persons rescued and time.



Average number of helicopters	1	1.3	2.3	2.7	1	4	6	10.3	10	6.3	4.5	5.7	4.1
Number of persons rescued per half hour	—	4	4	5	2	5	13	23	21	15	6	5	1

scene of the accident at the estimated time of departure.

Problems in action

At a time when survivors could still have been rescued, the winch wires on three Boeing Kawasaki helicopters malfunctioned, and the winch mechanism on one of these broke down. These helicopters had to interrupt the rescue operation for several hours, and one was transferred to transport duties. The survivors and rescue men who were left on the rafts or the sea when the winches malfunctioned were rescued by other helicopters, and one rescue man was transported, hanging onto the wire, to the deck of a vessel. These operations reduced the resources available for the rescue work. The unreliable operation of these winches had been identifield prior to this accident and had also been reported to responsible parties as constituting a hazard to the rescue men. Unfortunately, however, no action had been taken. The fourth helicopter, a Super Puma, had an indicated engine problem and had to return to base.

The helicopters operational period was limited by fuel and the fatique of the rescue men. Using two rescue men made it possible to continue as long as fuel lasted. The rescue work was very exhausting both physically and mentally. Already on the first helicopter on the scene the pilot noted that one rescue man was not enough. The man became quickly exhausted and thus the limiting factor of the operation.

Many of the rescue men were also injured, more or less seriously, by hooks and by objects in the water such as lifeboats.

It has subsequently been noted by many rescue men that in such conditions, with violent movements of the rafts causing the wires to jerk severely, the NATO harness, in which the rescue man is in a sitting position, would have been more appropriate.

The rescue men had had varying training and experience, since the group included soldiers and border guard men on active duty, firemen and, in the helicopters of the Swedish Air Force, conscripts. There is no indication that the training of the rescue men was insufficient, but it is the opinion of the Commission that in rescue operations when more than a few persons are expected to be recovered from the water the participating helicopters should carry at least two rescue men.

At the beginning of the operation, the rafts that had been searched were not marked in any way. As a result, the same raft could have been searched several times. Later during the operations, instructions were given to mark searched rafts by ripping open the roof with a knife.

At about 0630 hrs the helicopter fuel

Figure 17.5 ESTONIA's lifejacket for adults.

Figure 17.6 A waterlogged ESTONIA lifeboat after the accident.

supply at Utö ran out. After this, the helicopters flew the survivors and the deceased to Hanko or Nauvo, where refuelling took place. The fuel supply at Hanko, in turn, ran out at about 1000 hrs, and five helicopters had to wait for half an hour for a new supply.

17.7 Other observations

17.7.1 Rescue equipment

Lifejackets

The ESTONIA's lifejackets were of an approved type common in passenger vessels (Figure 17.5). They were not equipped with lights since this was not required. There were donning instructions in cabins and at various locations on the boat deck, but many passengers had nevertheless difficulties, as described in 16.8, in putting them on properly.

Many of those who were rescued from liferafts have stated that they had heard calls for help in the dark in the water nearby, but because there were no lights they were unable to locate the persons calling for help.

Self-lighting lights on the lifejackets would have been vital during this rescue operation.

Lifeboats

The crew did not manage to launch any of the ten lifeboats. Nine broke loose when the vessel sank, and the tenth is still attached to its davits. The rapidly increasing list and the lack of time for organising the crew are considered to be the main reasons for this shortcoming. The lifeboats found drifting during the rescue operation had either capsized or were waterlogged (Figure 17.6).

Three lifeboats were found near the place where the ESTONIA sank. A crew member had managed to climb into one of them and on each of the other two, which were floating upside down, six persons were hanging onto the bottom. One person from each was later washed away by the sea.

Once again traditional lifeboats proved to be useless in distress.

Figure 17.7 ESTONIA's Viking 25-K type liferaft.

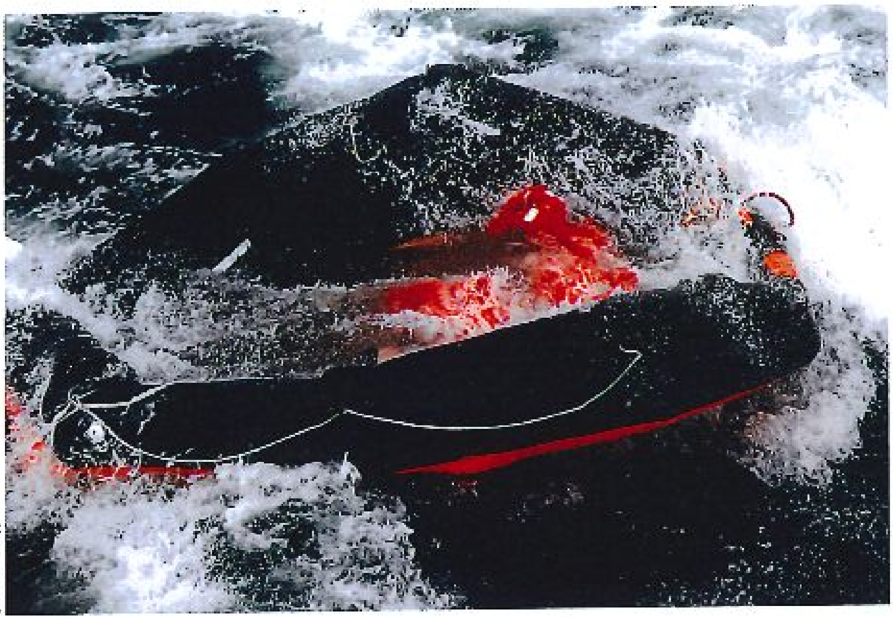
Liferafts

The liferafts (Figure 17.7) were launched partly by crew members and passengers and partly by automatically release and inflation when the vessel sank. The rafts were found very difficult to use in the severe sea conditions partly for the following reasons:

- Many rafts capsized due to the wind pressure and drifted upside down, and many did not fully inflate.
- Some of the upside-down drifting rafts were later righted by the waves (Figure 17.8). When this happened, however, those who were on the raft were again thrown into the sea and had great difficulties in climbing back.
- Capsized rafts with the canopy under water provided no shelter for those on board.
- The canopies of the rafts did not raise themselves automatically, and the openings could not be closed properly.
- Much water accumulated on the bottom of the rafts. In the worst case reported, there was 20 cm of water on the bottom of the raft. The bale scoops were so small that they were ineffective, and many survivors used their shoes to bale with.
- The knives on board the rafts proved to be useless.
- When the rafts were drifting the various lines for inflation and for keeping the raft in position for boarding constituted obstacles for people trying to board. The rope ladder went underneath the raft, swinging the feet of those who were trying to climb on, and thus affording practically no help (Figure 17.9).
- The operating head was not properly tightened to the CO_2 pressure cylinder in many rafts found after the accident. This may be a reason why many rafts were not fully inflated.
- Entangled painter lines were also found around the operating heads.

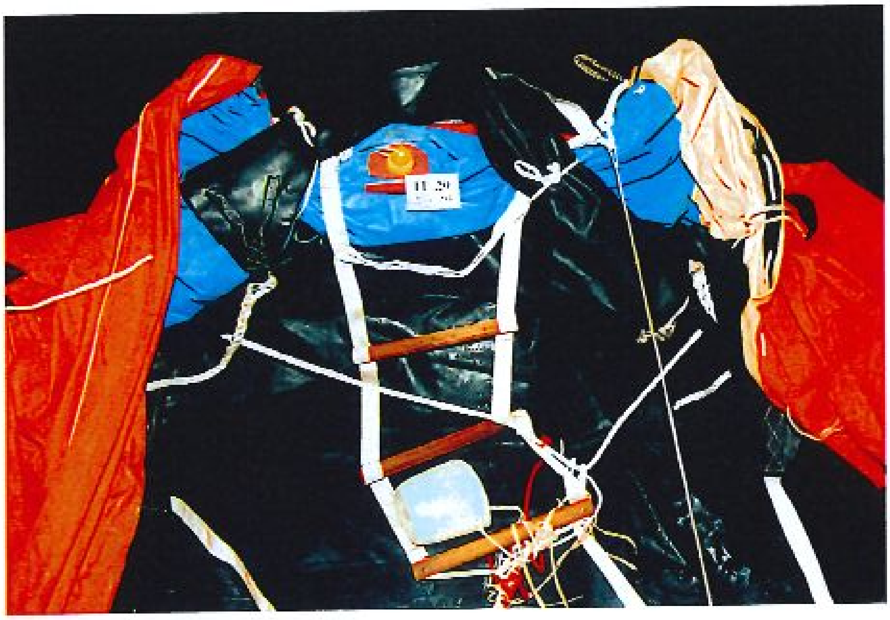
As mentioned earlier the liferafts had no individual identification and were therefore not distinguishable. The helicopter crews and the mariners were unable to keep track of which rafts had already been searched. Many are believed to have been searched many times, thereby delaying the search of others.

Figure 17.8 ESTONIA liferaft drifting upside-down.



(Lehtikuva Oy)

Figure 17.9 Ropes and the rope ladder in an ESTONIA liferaft as found after the accident.



Another problem was that the black colour of the liferafts' bottoms made the rafts difficult to detect when floating upside down.

Examination of the recovered liferafts shows that almost all the drift anchors and their ropes were missing. Likewise, many emergency packs were missing. The missing equipment may have been lost during the rescue operation or later.

Liferafts were under these circumstances useful rescue equipment but the serious deficiencies listed above diminish their value in heavy seas and when people have to climb into them from the water.

17.7.2 Journalists in helicopters

On the morning of the accident, from 0812 to 1137 hrs, a Swedish Boeing Kawasaki helicopter carried two TV reporters. Between 1300 and 2025 hrs that afternoon, three Swedish Boeing Kawasaki helicopters each carried two reporters. A Finnish Super Puma helicopter flew journalists to Utö island from 1325 to 1530 hrs on the same day. On the next day, both Finnish and Swedish rescue helicopters flew journalists into the area.

The Swedish Defence Forces justified flying in journalists by noting the importance of public relations and by referring to the positive feed-back received. The helicopter crews were told that they had the right to refuse to carry journalists. The commander who gave permission further justified this decision by noting that he, before the 0812 hrs flight, had been told by the pilots that no more survivors had been found at the scene of the accident.

Representatives of the Finnish Frontier Guard noted that the journalists were flown in more than four hours after the last survivors had been found, and after a decision to reduce the numbers of helicopters in the area. The Finnish helicopter crew protested against their assignment, and flew the journalists around as quickly as possible to be able to return to search duties.

Carrying passengers on board helicopters engaged in rescue duties is not allowed without approval by the rescue leader, and is inappropriate in particular during such a large and difficult operation. In critical situations the carrying of passengers reduces transport capacity. Furthermore, it is questionable whether the privacy of the survivors should have been jeopardised immediately after their rescue by exposing them to cameras and journalists.

CHAPTER 18

COMPLIANCE WITH COLLISION BULKHEAD REQUIREMENTS

18.1 History of compliance with requirements

The SOLAS Convention has since its inception contained a requirement for an upper extension of the collision bulkhead in passenger ships with long forward superstructures. The rules of the classification societies did not at the time reflect the SOLAS requirements.

In the 1981 Amendments to SOLAS 1974 the requirements were extended to apply also to cargo vessels. Previously cargo ro-ro ferries had been developed with a ramp, located far enough forward to reach ashore. This location was generally further forward than that permitted by SOLAS for passenger vessels if the ramp was to form part of the upper extension of the collision bulkhead.

In Finland and Sweden the arrangement of the forward ramp in ro-ro passenger ferries seems to have been inherited from the cargo ferries. The Commission has not found any formal document showing approval, exemption or disapproval of any such design under the SOLAS requirements. The first reference that the SOLAS regulations for an upper extension of the collision bulkhead need not be fully applied is a letter of January 1979 concerning two passenger ferries for the Gotland traffic. An exchange of telexes in March 1981 between the ship owner and the Swedish Maritime Administration also exists, where the placing of the KRONPRINSESSAN VICTORIA's ramp too far forward (1800 mm too far forward under SOLAS 1974 and about 500 mm under 1981 draft Amendments) was accepted with a reference to "international and Swedish practice". No such documentation has been found for the VIKING SALLY/ESTONIA or the DIANA II. A letter dated 20.4.1977 from the Finnish Maritime Administration to the shipyard, however, states that an excessively forward-placed ramp could not be accepted as an upper extension of the collision bulkhead in the TURELLA. Partial collision doors where thus built in e.g. the TURELLA and the ROSELLA (see 18.2).

Some of the first passenger ferries built at the beginning of the 1960s with bow visors had an "equivalent" upper extension of the collision bulkhead in the right place but only on the sides, leaving free access to the car deck aft of the bow ramp. The first passenger ferries were used in sheltered waters near land so that the SOLAS regulation on an exemption if the voyage remains within 20 nautical miles of the nearest land may have been in the background when the decisions were made.

It thus became common amongst the Finnish and Swedish Maritime Administrations to accept the forward-located bow ramp arrangement. Many ferries built for Baltic ferry operations from 1961 up to about 1985 had a forward-located bow ramp that did not meet the SOLAS requirement for passenger vessels regarding the location of the collision bulkhead upper extension.

A reason for reluctance to apply the regulations regarding position of the forward ramp fully may have been the IMO work throughout the 1970s on this subject, eventually leading up to the 1981 Amendments. The practical problems in fully applying the SOLAS requirements to ro-ro cargo ferries constituted one of the items considered during this work. The IMO work also resulted in an alternative set of requirements regarding subdivision and stability of passenger ships, in which an upper extension of the collision bulkhead was only required under certain conditions. It may be that the Administrations were awaiting the outcome of this work before they started to change a long-established practice.

The 1981 Amendments permitted the upper extension of the collision bulkhead in vessels with a bulbous bow to be positioned further forward than the SOLAS 1974 regulations did. The availability of the text already at the end of the 1970s may at that time have supported the practice of forward-located bow ramps.

It has thus not been possible to find any formal steps taken in the affected countries regarding approval of the position of the forward ramp in any ship built during the period. There may have been a lenient attitude from the Administrations at the time as they had very limited staffs and relied heavily on the classification societies. These, in turn, did not in most cases have the authorisation to verify compliance with the SOLAS requirements.

Only when the 1981 Amendments to SOLAS 1974 came into force on 1 September 1984 specifying in further detail the requirements for the collision bulkhead in passenger ships as well as in cargo ships, did shipyards, administrations and classification societies start to follow the regulations in full.

18.2 Effects of non-compliance with requirements

Using the ramp in the ESTONIA as an extended collision bulkhead in compliance with SOLAS 1960 or 1974 would have required a more aft positioning and thus a considerably longer ramp. For housing the longer ramp on the car deck the ramp must have been divided into sections. An alternative would have been to add a second, movable barrier in the proper position and reaching up to deck 4. Both these solutions would have been more expensive and more complicated than the alternative chosen.

The 1981 Amendments to SOLAS 1974 accepted the ramp as a part of an extended collision bulkhead provided there was a second barrier of a minimum height of 2.3 m in the proper position. This solution was common in ro-ro passenger ferries built for the Finland–Sweden traffic at the same time and subsequent to the ESTONIA, among others the TURELLA and the ROSELLA (see Table 10.2). This solution was also considered in the building specification of the ESTONIA. It was, however, rejected since it was "for the intended service not required by F.B.N" (Finnish Board of Navigation). The Commission has not found any information on participation of representatives of the Finnish Maritime Administration in formulating this sentence.

It is the opinion of the Commission that an extended collision bulkhead, built in compliance with either SOLAS 1974 or the 1981 Amendments, would have increased the ESTONIA's chances of surviving the loss of the visor. The 2.3-m-high barriers built in the TURELLA and the ROSELLA in 1979 and 1980, respectively, had however a rather low design load of about 2 m static water head and were not designed to withstand hydrodynamic impact loads which may arise if the ramp is fully open in heavy head or bow seas.

18.3 The role of the administration

The Finnish Maritime Administration was, according to a national decree, originally issued in 1920 (3.6.4), exempted from carrying out a hull survey as part of the basis for issuing the passenger ship safety certificate, if a vessel had a valid class certificate. The Administration did not therefore survey the hull construction during the building of the ESTONIA.

The Bureau Veritas regulations for the initial hull survey included compliance with all applicable requirements specified in the rules of the society and valid at the time. These rules did not include requirements for an upper extension of the collision bulkhead, and hence no reference to the position of such an extension.

According to the Finnish Administration, the problem concerning the deviation of the ramp location from the SOLAS requirement for an upper extension of the collision bulkhead was not known to its inspectors. Anyhow, according to the same information, the Administration would have accepted the deviation in line with previous practice, applied also by the Swedish Maritime Administration.

The Commission has noted that full responsibility for enforcing compliance with the Conventions nevertheless, according to SOLAS, remains with the Administration. The Commission has also noted that the unrestricted right of the Finnish Maritime Administration to rely on classification society hull surveys in this respect was withdrawn in the new decree on surveys of ships issued in 1983.

It seems obvious to the Commission that the interpretation of the SOLAS Convention's collision bulkhead regulations common at the time did not ensure satisfactory compliance with applicable rules and made it possible to design the ESTONIA in a way which may have contributed to her capsizal. The Commission finds it unacceptable that practice is developed that makes it possible to deviate from a Convention with no documentation or exemptions in the certificate.

CHAPTER 19

DEVELOPMENT OF REGULATIONS AFTER THE ACCIDENT

A Panel of Experts was set up within the International Maritime Organisation (IMO) shortly after the accident, with the task of investigating all aspects of safety related to ro-ro passenger vessels.

The Panel reported to the Maritime Safety Committee (MSC) meeting in May 1995 and work proceeded further in preparation for a SOLAS Conference to be held at IMO headquarters in the last week of November 1995.

The extensive proposals made to the Conference included controversial issues such as a requirement that all ro-ro passenger ships should be capable of maintaining positive stability in damaged condition with a quantity of water on the car deck corresponding to half a metre over the entire deck area.

Compliance with this requirement would involve extensive modifications to existing ferries and was found unacceptable to several IMO member states. The requirement was therefore not adopted.

The November 1995 Conference adopted a number of amendments to the SOLAS 1974 Convention. They entered into force on 1 July 1997. The amendments were based on proposals put forward by the Panel.

The most important of the amendments are concerned with requirements for the bow doors and the stability of ro-ro passenger ships. The Conference agreed to significantly upgrade the damage stability requirement to be applied to all existing ro-ro passenger ships.

A new regulation II-1/8-1 will require existing ro-ro passenger ships to comply fully with SOLAS 90 in accordance with an agreed phase-in programme, which will depend on the ship's damage stability index (A/Amax value).

A new regulation II-1/8-2 was also adopted which contains special requirements for ro-ro passenger ships carrying 400 passengers or more. This is intended either to require that new ships to be built, and existing ships already built, to a one-compartment-flooded standard should be phased out; or to ensure that they can survive with two compartments flooded following damage.

Other amendments to Chapter II-1 deal with such issues as extending the collision bulkhead, keeping doors that do not comply with Convention provisions closed during navigation, the strength of ventilation trunks penetrating the bulkhead deck, and the positions of the ends of air pipes. The upper extension of a collision bulkhead must be so arranged as to preclude the possibility of a bow door causing damage to it in the case of damage to, or detachment of, the door.

Three new regulations added to Chapter II-1 deal with watertight integrity from the ro-ro deck (bulkhead deck) to spaces below, access to ro-ro decks when the ship is under way (when they are to be banned to passengers) and closure of bulkheads on the ro-ro deck.

Regulation II-1/23-2, which deals with the integrity of the hull and superstructure, damage prevention and control, has been completely replaced.

Indicators shall be provided on the navigation bridge for all shell doors, loading doors and other closing appliances for doors which, if left open, could lead to flooding of ro-ro cargo space.

Television surveillance and water leakage detection systems shall be arranged to provide an indication to the navigation bridge and to the engine control station of any leakage through inner and outer bow doors, stern doors or any shell doors which could lead to flooding of ro-ro cargo spaces.

Amendments have also been made to Chapter II-2. A new regulation II-2/28-1 deals with escape routes on ro-ro passenger ships. It introduces requirements for handrails in corridors along escape routes. The routes must not be obstructed. For ships constructed on or after 1 July 1997 the lower part of bulkheads along escape routes must be strengthened so that the bulkheads can be walked upon safely when the ship is at a large angle of heel.

The amendments to Chapter III, which deals with life-saving appliances and arrangements, include a number of important additions. Requirements for liferafts are more stringent. Liferafts must be served by marine evacuation systems and must be automatically self-righting, or be of the canopied reversible type capable of operating safely whichever way up.

Ro-ro passenger ships will be required to carry at least one fast rescue boat. The ships must also be fitted with means for recovering survivors from the water and transferring them from rescue units to the ship.

Sufficient numbers of lifejackets will have to be provided near the assembly station. Each lifejacket shall be fitted with a light. Some of the above mentioned amendments to Chapter III will not be required on existing ships until 1 July 2000.

New regulation III/24-2 covers information to passengers.

By regulation III/24-3, all ro-ro passenger ships shall be provided with a helicopter pick-up area, on ships constructed before 1 July 1997 to apply latest from the first periodical survey after that date. Passenger ships of 130 m of length and upwards, constructed by or after 1 July 1997, shall from 1 July 1999 be fitted with a helicopter landing area.

A number of amendments have been made to Chapter IV dealing with radio communications. A distress panel is to be fitted at the conning position. This is to enable a distress alert to be given by pressing a single button. All passenger ships are to be provided with means for two-way, on-scene radio communications for SAR purposes using the aeronautical frequencies. At least one properly qualified person will have to be assigned to perform only radio communication duties during distress incidents.

Chapter V (safety of navigation) has also been amended.

Obligations and procedures in the event of emergencies have been clarified, a working language is to be established on passenger ships and ships trading on fixed routes must carry a plan for cooperation with appropriate SAR services.

A new regulation 23 deals with operational limitations, such as restrictions in operating areas, weather restrictions, sea state conditions, limits on permissible loads, speed and other factors. The list of all such limitations shall be documented and kept on board readily available to the master.

Chapter VI (carriage of cargoes) has been amended to require cargo units to be loaded, stowed and secured in accordance with a Cargo Securing Manual.

In addition to the amendments, the Conference adopted 13 resolutions. Many of them are designed to assist implementation of the amendments adopted by the Conference.

Five resolutions concerning the safety of ro-ro passenger ships were adopted by the IMO Assembly in November 1995, which was run prior to the SOLAS Conference.

Resolution A.793(19) is concerned with the strength and the securing and locking arrangement of shell doors on ro-ro passenger ships. It notes that the International Association of Classification Societies (IACS) Unified Requirement for Bow Doors (as amended in 1995) will apply not only to new ro-ro passenger ships but retrospectively to existing ships as well.

In 1996 IACS reviewed its Unified Requirement for Side Shell Doors and Stern Doors with retrospective application to existing ro-ro passenger ships.

As seven countries were dissatisfied with the Conference rejection of the proposed new stability requirements dealing with water on car deck, two meetings of parties requiring more stringent regional regulations were held in Stockholm in January and February 1996. Nineteen countries participated.

The meetings agreed on specific requirements for the capability of the ferry to maintain stability with water on the car deck. The quantity of water on deck is dependent on residual freeboard after damage, on significant wave height and on variable angle of list at the damaged side of the ferry.

The Stockholm meetings adopted a proposed Agreement. By 25 September 1996 seven states had become parties and the Agreement entered into force on 1 April 1997.

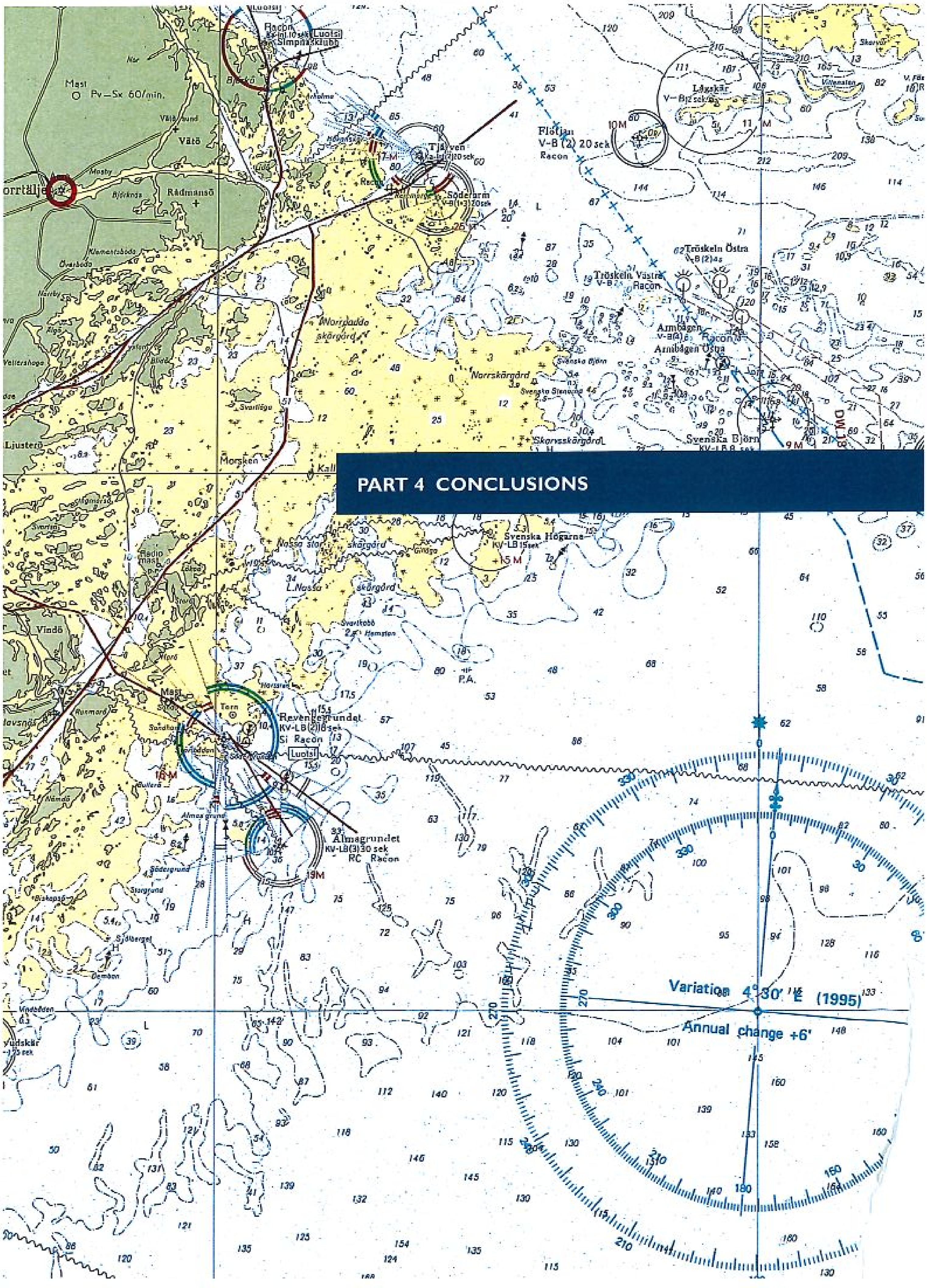
In accordance with this Agreement, specific stability requirements shall apply to all ro-ro passenger ships undertaking regular scheduled international voyages between designated ports in North West Europe and the Baltic Sea, irrespective of flag. No more favourable treatment should be given to ships entitled to fly the flag of states non-parties to the Agreement. Ro-ro passenger ships shall comply with the provisions of the Agreement not later than dates varying from 1 April 1997 to 1 October 2002 depending on the ship's damage stability index (A/Amax).

In July 1995 the Conference of Parties to the International Convention on Standards of Training, Certification and Watchkeeping of Seafarers (STCW) 1978, adopted amendments to the STCW Annex.

The 67th session of the MSC in December 1996 approved additional amendments to the STCW Convention and Code.

These amendments require crisis management and human behaviour training for masters, officers, ratings and other personnel on ro-ro passenger vessels.

PART 4 CONCLUSIONS



CHAPTER 20

FINDINGS

Accident

- The ro-ro passenger ferry ESTONIA sank in the northern Baltic Sea during the early hours of 28 September 1994. Of the 989 people on board, 137 survived. All 95 victims recovered from the sea have been identified and 757 people are still missing.

Weather

- The wind at about 0100 hrs at the site of the accident was south-westerly, 18-20 m/s, and the significant wave height was about 4 m.
- At the time of the accident the ESTONIA was encountering the waves on her port bow.
- The wave-induced motion made several passengers seasick but the situation on board was not exceptional.

Ship's condition

- The vessel was seaworthy and properly manned.
- The cargo was secured to normal standard and the visor was properly closed and secured on departure.
- The vessel had a starboard list of about one degree when she gained the open sea.

Failure

- The failure sequence may have started at about 0055 hrs when the AB seaman heard a metallic bang at the bow ramp.
- The locking devices and the hinges of the bow visor failed fully under one or two wave impact loads on the visor shortly after 0100 hrs.
- The visor worked its way forward and forced the ramp partly open due to mechanical interference between the visor and the ramp, inherent in the design. Water started entering the car deck at the sides of the partly open ramp.
- The ramp rested for a while within the visor before the visor at about 0115 hrs fell into the sea, pulling the ramp fully open.

Capsize

- Large amounts of water entered the car deck and in a few minutes a starboard list of more than 15° developed.
- The main engines stopped at about 0120 hrs, one after the other, due to lubricating oil pressure loss caused by a list of about 30°.
- The vessel drifted with her starboard side towards the waves.
- At about 0125 hrs the list was more than 40°. By then, windows and a door had broken in the aft part on the starboard side, allowing progressive flooding of the accommodation. The main generators stopped.
- As the list increased the ESTONIA started to sink stern first. At about 0135 hrs the list was about 80°.
- The vessel disappeared from the surface at about 0150 hrs.

Action by the crew

- Two reports of unusual sounds from the bow area were given to the officers of the watch, the first about 20 minutes prior to the loss of the visor.
- Attempts were made to find the reason for the sounds.
- The master arrived at the bridge and was present when the second attempt was initiated shortly after 0100 hrs.
- The speed setting was maintained until the list developed. At about 0100 hrs the speed was about 14 knots, with all four main engines running at full service speed setting.
- The visor indicator lamps on the bridge did not show when the visor was detached, and the visor was not visible from the conning position. Nor did the lamps show when the ramp was forced open.
- The ingress of water at the sides of the partly open bow ramp was observed on a monitor in the engine control room, but no information was exchanged with the bridge.
- As the list developed the officers of the watch reduced the speed and initiated a turn to port. They also ordered the engineer to compensate for the list by pumping ballast, but

the pump sucked air and, furthermore, the tank was almost full. The officers of the watch also closed the watertight doors.

- The first known Mayday call from the ESTONIA was transmitted at 0122 hrs, and at about the same time the lifeboat alarm was given. Shortly before that, a brief alarm in Estonian was given over the public address system. Just after this, the crew was alerted by a coded fire alarm. No general information was given to the passengers during the accident.
- Besides the master and the two officers of the watch, at least the chief officer and the third officer were on the bridge at the time of the distress traffic.

Technical matters

- There were no detailed design requirements for bow visors in the rules of Bureau Veritas, the classification society concerned, at the time of the building of the ESTONIA.
- The Finnish Maritime Administration was, according to a national decree, exempt from doing hull surveys of vessels holding valid class certificates issued by authorised classification societies.
- The visor locking devices were not examined for approval by the Finnish Maritime Administration, nor by Bureau Veritas.
- The visor design load and the assumed load distribution on the attachments did not take realistic wave impact loads into account.
- The visor locking devices installed were not manufactured in accordance with the design intentions.
- No safety margin was incorporated in the total load-carrying capacity of the visor attachment system.
- The attachment system as installed was able to withstand a resultant wave force only slightly above the design load used.
- A long series of bow visor incidents on other ships had not led to general action to reinforce the attachments of bow doors on existing ro-ro passenger ferries, including the ESTONIA.
- Wave impact loads generated on the night of the accident exceeded the combined strength of the visor attachments.
- Wave impact loads on the visor increased very quickly with increasing significant wave height, while forward speed had a smaller effect on the loads.
- The SOLAS requirements for an upper extension of the collision bulkhead were not satisfied.
- The general maintenance standard of the visor was satisfactory. Existing minor maintenance deficiencies were not significant factors in the accident.

Evacuation

- The time available for evacuation was very short, between 10 and 20 minutes.
- There was no organised evacuation.
- The evacuation was hampered by the rapid increase in the list, by narrow passages, by transverse staircases, by objects coming loose and by crowding. About 300 people reached the outer decks. Most victims remained trapped inside the vessel.
- The lifesaving equipment in many cases did not function as intended. Lifeboats could not be lowered.

Distress traffic

- Mayday calls were received by 14 radio stations including MRCC Turku. At the beginning the SILJA EUROPA took the role of control station for the distress traffic.
- The distress traffic was not conducted in accordance with the procedures required by the radio regulations.
- The ESTONIA's two EPIRBs were not activated and could therefore not transmit when released.
- MRCC Turku did not announce on the radio that they were conducting the operation.
- Helsinki Radio did not hear the ESTONIA's distress calls or the distress traffic.
- Helsinki Radio transmitted a Pan-Pan call (urgent message) at 0150 hrs instead of the distress message requested by MRCC Turku

Rescue operation

- Initially the accident was not treated as a major accident. It was formally designated as such at 0230.
- MRCC Turku started alerting rescue units at 0126 hrs. One standby helicopter was alerted at 0135 hrs, another at 0218 hrs, and the military helicopters at 0252 hrs.
- Assistance by Swedish helicopters was agreed at 0158 hrs.
- The master of the SILJA EUROPA was appointed On-Scene Commander (OSC) at 0205 hrs.
- The first rescue unit, the MARIELLA, arrived on the scene of the accident at 0212 hrs, 50 minutes after the first distress call.
- MRCC Tallinn was informed of the accident at 0255 hrs by MRCC Helsinki.
- The first helicopter arrived at 0305 hrs.
- Two Finnish helicopters landed survivors on the passenger ferries. Other helicopters carried rescued persons to land.
- An air co-ordinator arrived to assist the OSC at 0650 hrs and a surface search co-ordinator arrived at 0945 hrs.
- The participating vessels did not launch lifeboats or MOB boats due to the heavy weather. Their rescue equipment was not suitable for picking up people from the water or from rafts.
- Winch problems in three Swedish Navy helicopters seriously limited their rescue capacity.
- Some helicopters carried journalists during the later rescue flights.
- Of the approximately 300 people who reached the open decks, some 160 succeeded in climbing onto liferafts, and a few climbed onto capsized lifeboats. Helicopters rescued 104 people, and vessels rescued 34.

CHAPTER 21

CONCLUSIONS

Failure

- The ESTONIA's bow visor locking devices failed due to wave-induced impact loads creating opening moments about the deck hinges.
- The ESTONIA had experienced sea conditions of equivalent severity to those on the night of the accident only once or twice before on a voyage from Tallinn to Stockholm. The probability of the vessel encountering heavy bow seas in her earlier service had been very small. Thus, the failure occurred in what were most likely the worst wave load conditions she ever encountered.
- The visor attachments were not designed according to realistic design assumptions, including the design load level, load distribution to the attachments and the failure mode. The attachments were constructed with less strength than the simplistic calculations required. It is believed that this discrepancy was due to lack of sufficiently detailed manufacturing and installation instructions for certain parts of the devices.
- The bow visor locking devices should have been several times stronger to have a reasonable level of safety for the regular traffic between Tallinn and Stockholm.
- At the time of the ESTONIA's construction, despite scattered information, the industry's general experience of hydrodynamic loads on large ship structures was limited, and the design procedures for bow doors were not well-established.
- The classification society design requirements for bow doors became more clearly defined and the design load levels were in general increased after the ESTONIA had been built but, according to established practice, the new rules did not apply to existing vessels.
- Numerous bow visor incidents occurred prior to the accident on vessels built before and after the ESTONIA for the Finland–Sweden traffic. These included an incident on the DIANA II, a near-sister vessel to the ESTONIA, but the experience did not lead to systematic inspection and requirements for reinforcement of visor attachments on existing vessels.
- Information on bow visor incidents was not systematically collected, analysed and spread within the shipping industry. Thus masters on board had, in general, very little knowledge of the potential danger of the bow visor closure concept.

Capsize

- The ESTONIA capsized due to large amounts of water entering the car deck, loss of stability and subsequent flooding of the accommodation decks.
- The full-width open car deck contributed to the rapid increase in the list. The turn to port – exposing first the open bow and later the listed side to the waves – shortened the time until the first windows and doors broke, which led to progressive flooding and sinking.
- The design arrangement of bow ramp engaging with visor through the box-like housing had crucial consequences for the development of the accident.
- Non-compliance with the SOLAS regulations regarding the upper extension of the collision bulkhead, accepted originally by the national administration, may have contributed to the vessel's capsizing.

Action by the crew

- The initial action by the officers on the bridge indicates that they did not realise that the bow was fully open when the list started to develop.
- The bridge officers did not reduce speed after receiving two reports of metallic sounds and ordering an investigation of the bow area. A rapid decrease in speed at this time would have significantly increased the chances of survival.
- The visor could not be seen from the conning position, which the Com-

mission considers a significant contributing factor to the capsize. In all incidents known to the Commission where the visor has opened at sea due to locking device failure, the opening was observed visually from the bridge and the officers of the watch were able quickly to take appropriate action.

- There are indications that the crew did not use all means to seek or exchange information regarding the occurrence at a stage when it would still have been possible to influence the development of the accident. The bridge crew apparently did not look at the TV monitor which would have shown them that water was entering the car deck; nor did they ask those in the control room from where the ingress was observed, or get information from them.
- The position sensors for signal lamps showing locked visor were connected to the side locking bolts in such a way that the lamp on the bridge showed locked visor even after the visor had tumbled into the sea. The indirect information on the status of the visor was thus misleading. The signal lamp for locked ramp was most likely not on because one of the locking bolts was not fully extended. There was thus no lamp warning when the visor had forced the ramp partly open and it was resting inside the visor.
- It is most likely that the crew were unaware of visor incidents involving other vessels, in particular the DIANA II.

Evacuation

- The rapid increase in the list contributed to the large loss of life.
- The lifeboat alarm was not given until about five minutes after the list developed, nor was any information given to the passengers over the public address system. By the time the alarm was given, the list made escaping from inside the vessel very difficult. This together with problems in using lifesaving equipment contributed to the tragic outcome.

Rescue operation

- The alarming of helicopters was late.
- The helicopters had a key part in the rescue operation by rescuing most of the people who had succeeded in climbing onto liferafts or lifeboats.
- One rescue man per helicopter was not enough due to the very exhausting rescue work.
- It is deemed inappropriate for helicopters to carry journalists in critical situations and where they may encroach on the privacy of survivors.
- The main reasons for the delay in issuing alarms in general were that the distress traffic was conducted separately from MRCC Turku, and that there was only one person on duty at MRCC Turku, at MRCC Helsinki and at Helsinki Radio, respectively.
- In the Finnish MRCCs the instructions regarding distress traffic were inadequate.
- The lifesaving equipment of vessels participating in the rescue operation proved unsuitable for rescuing people from the water in the prevailing heavy weather conditions.

CHAPTER 22

RECOMMEN-DATIONS

Introduction

The Commission notes that work has started on development of regulations in line with the three recommendations given in the Part-Report. This work includes IACS' new, stricter requirements on the strength of locking arrangements for shell doors. The requirements will apply retroactively to existing ships. New amendments to SOLAS require that damage to, or detachment of, a bow door may not cause damage to the upper extension of the collision bulkhead. IMO has also decided on full enforcement of the SOLAS 90 damage stability regulations. Several countries in Northern Europe have agreed on more stringent regional regulations on damage stability for ro-ro passenger ferries in regular traffic. These regulations address the effects of water trapped on a car deck. The work by IMO after the ESTONIA accident is reviewed in Chapter 19 of the present report. It is the opinion of the Commission that application of the new regulations will significantly improve the safety of ro-ro passenger vessels. However, based on the ESTONIA experience, the Commission finds reason to present the following further recommendations.

Ship design and construction

The installed bow visor locking devices were not thoroughly designed and manufactured, and were not inspected for approval by any external authority. The installation did not incorporate a sufficient safety margin with regard to the design load level used. Further, the consequence of mechanical interference between visor and ramp was not realised before this accident. For these reasons,

- formal safety assessments and strict quality assurance procedures must be applied in design, manufacturing, assembly and approval of components critical for the safety of passenger vessels. The design basis for elderly tonnage must be reviewed in the light of new knowledge and standards of safety. A clearer relationship and division of responsibility between the shipyard, ship owner, classification society and administration needs to be established in this context.

The visor lock indicator on the bridge was accepted by the national maritime administration according to the SOLAS amendments after the HERALD OF FREE ENTERPRISE accident. However, it did not show that the visor was detached. Therefore,

- alarm systems should be constructed so that the actual and complete status of entire functions is supervised, rather than only parts thereof. Alarms should be limited to critical functions and should always lead to defined operational actions.

Operation

Upgrading of design requirements and a series of visor incidents in the Baltic area had not led to strengthening of locking devices, nor to operative instructions. The extent of previous visor incidents was not generally known among operators at the time of the ESTONIA accident. Hence,

- procedures for collecting and analysing incident data must be improved and upgrading of existing vessels as regards the safety of human life must become regular. Ways of distributing this information efficiently and internationally must be established. The responsibility for following up the status of existing ships must be taken by the national authorities, supported by the classification societies.
- Operational guidelines and limits for manoeuvring in heavy weather should be issued to all passenger ferries. The safety limits should be based on shipbuilders' original design levels and on the level of upgrading of the vessel with respect to increased design requirements after building. Documentation of operational limits must be included in ship certificates, and,

- the crews of ro-ro passenger ferries should have clear instructions on maximising their vessels' chances of survival in cases of water ingress to the car deck. Possible corrective action should be simulated and practised.

Evacuation

A significant factor in the ESTONIA accident was the very quick increase in the list to an angle exceeding 30°, leading to the loss of manoeuvrability, to difficulties in getting out from inside the vessel and to the start of progressive flooding. Investigations have shown that relatively small changes in construction could have had a significant effect on the outcome of the evacuation. Therefore,

- all existing passenger vessels should be re-assessed with regard to evacuation and all reasonable measures taken to increase the time available and possibilities for evacuation.

Rescue

Serious shortcomings in the effectiveness of the on-board rescue equipment became apparent during the ESTONIA accident and the rescue operation. The equipment fulfilled the requirements and is of standard type common on comparable vessels.

- The Commission recommends urgent action to develop new lifesaving concepts and equipment, especially for passenger vessels where large numbers of untrained people are to be rescued.
- Systems should be developed for enhancing the ability of passenger ferries to rescue people from the sea in heavy weather.
- All-weather systems should be developed for enhancing co-operation between ferries and helicopters in sea rescue.

Distress traffic

No station conducted the distress traffic according to the procedures required by the radio regulations. In the normal work of deck officers and radio operators it is understandably difficult to maintain very firm routines for distress communications. However, good simulators for training in maritime radio systems and communications are available. Therefore,

- certain key persons, such as deck officers on large passenger vessels and rescue centre radio operators, should regularly update their practical knowledge of distress and safety traffic using a maritime radio simulator.

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