

BNS Message of 07.10.94

Enclosure 37.2.451

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04 10/10 18:58

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+46 8 7375052 From: UD Stockholm 1 Page 2
0002/002

Bil + fax 474
 1994-10-10 fr
 Amb. Tallinn

ESTONIAN GOVERNMENT WINDS UP INVESTIGATION COMMISSION

TALLINN, Oct 07, BNS - The Estonian Cabinet on Thursday dissolved the national investigation commission it had set up to look into the cause of the ferry Estonia's sinking and appointed an Estonian cooperation commission to work within the international board of inquiry.

Government spokesman Ain Saarna said the work of the commission was finished because the Cabinet had delegated the immediate tasks related to the disaster to relevant ministries and departments. He told reporters the newly formed cooperation commission's primary task would be to find out the cause of the catastrophe.

The commission is headed by Transportation and Communications Minister Andi Meister and its members are harbor master Eduard Hunt of the state-owned Port of Tallinn company; Border Guard Department Director General Tarmo Kouts; Uno Laur, chairman of the AS CMM company; Waterways Department Director General Kalle Pedak; Foreign Ministry Chancellor Indrek Tarand; Kalev Timberg, deputy director of the Rescue Department; and Mati Jarvis, labor inspectorate's supervision director.

The government charged the ministries involved to evaluate in cooperation with the Finance Ministry the amount of money needed for rescue and salvage operations and for assistance to the families of the victims, as well as explore possible sources of financing.

The Cabinet supported the idea of erecting a monument to those lost in the ferry Estonia's accident.

Second JAIC Interim Report

Enclosure 37.2.452

October 17, 1994

The MV ESTONIA Accident - Second Interim Report of the Joint Accident
Investigation Commission

At its meeting in Tallinn on 17th October 1994 the Joint Accident Investigation Commission reviewed new information available to it as a result of additional video films taken from the sunken ship and confirmed the following conclusions of the First Interim Report:

I The bow visor was lost underway.

II Water entered the car deck at the forward ramp.

The Commission also assumed the following positions regarding the details and one of the most probable causes of the accident:

1. The bow door (visor) has separated from the ship as a result of failure of all three locking mechanisms. According to the observations made by members of the crew this happened at about 01.15 when water was simultaneously observed on the TV-monitor, entering the car deck from openings along the vertical sides of the forward ramp. The failures have taken place, in case of the two side locks, in the welding of the locking eye plates to the bow visor and in case of the centre lock (as previously shown) by failure of the lugs carrying the locking plunger unit.
2. Following the failure of the locking arrangements the bow visor has opened up under the wave loads. The deck mounted hinge points have eventually failed as a result of the uncontrolled movement of the 55 tons visor, leaving it attached only by the hydraulic actuating cylinders.
3. During the subsequent unrestrained movement of the bow visor it hit the bow ramp in several modes, including hits from the rear to the upper protrusion of the ramp, causing it to become dislodged from its locking arrangements and to move to a partly open position. The bow visor has ultimately separated from the ship and disappeared overboard.
4. Partial opening of the ramp had allowed water to enter the car deck due to the heavy sea. Collection of water on the car deck eventually led to loss of stability and capsizing of the vessel.
5. After the vessel had turned over to almost 90 degrees starboard list, which is estimated to have taken place in less than twenty minutes after the damage to the forward ramp, it started to sink with the stern first. The ship disappeared from the radar screen of a Finnish surveillance station at 01.48.

AN 2/94 16:48 JOHNSON & JOHNSWEDEN

478 POS 19. 10. 94 12:36

6. The vessel turned during the phase of losing stability and landed on the seabed with an almost easterly heading. It is assumed at this stage that this movement was partly the result of an attempt by the officers on the bridge to turn the ship around and partly by the wave action after the ship had lost propulsion power.
7. The locations of the EPIRB-s have not been found during the video documentation and their status is therefore not known at the present time.
8. Emergency MAYDAY signals were sent by ESTÓRIA at 01.24 and were received by ships in the area and the MRCC at Turku.

On behalf of the Joint Investigation Commission

Andi Meister

Olaf Forsberg

Kari Lehtola

Copy to:

The Government of Estonia
 The Council of State, Finland
 The Swedish National Maritime Administration
 Est-Line, Tallinn
 Est-Line, Stockholm

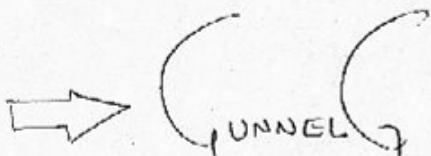
Fax and Draft of Statens Report dated 24.10.94

Enclosure 37.2.453

26/10

4665

FAX

ESTONIA
A 32Hans
Tack för fax

Ge Olla och Hans och Stein kyrkan ut
Gifvet minst tre dagliges bidrag.
Kan inte möjlig Olla bröda den här till
Keri och Andi M. R Nej till OF

Hans
Tack
Hans

Tack till OF, Hans, Stein 941026/46

Not for publication*DRAFT*

24 Oct 1994

STATUS REPORT

MV ESTONIA - Probable Sequence of Events as Cause of the Accident

The following is a summary of the hypothesis regarding the sequence of events judged most probable at the time of writing. It is intended to serve as a basis for verifying a joint understanding of the likely cause and for identifying known and missing facts.

It is, in summary, judged that the ship's speed, the sea condition and the strength of the bow visor latching mechanism may each one and independently have been the final cause for the accident or could have been able to prevent its happening. Information/lack of information may have been a fourth parameter. Further work is needed to qualify the significance of these parameters during the actual circumstances.

1. The bow visor separated from the vessel at 0115 hrs and water started to come in at the damaged forward ramp (3rd engineer's observation). MAYDAY was sent at 0124 and the vessel had lost stability around 0130. The vessel sank around 0150.

1.1 The wreck is located at position N59°23.9' E21°42.2' and the visor has been found about 1 nm west of the wreck. The movement of the vessel from losing the visor until it sank has not been determined, nor the last actions from the bridge. The rudders are in hard starboard position.

1.2 Various witnesses have reported heavy wave pounding against the ship and some sharp metallic bangs as much as one hour before the final sequence started. Deckman Silver Lindhe also heard sharp metallic sounds from the bow area at about 0030-0040.

1.3 One witness have seen the bow visor moving up and down before the accident.

2. The bottom and side latching mechanisms of the bow visor have failed.

2.1 The bottom latch has failed in the steel plate lugs and in the welds between these lugs and the guide bushings for the locking plunger. The fracture of the plate lugs seems to indicate failure by overload, generally by an upwards force. The welds seem to be pure fillet welds without chamfer of the lug edges. The available pictures do not reveal any signs of cracks or fatigue. The existence of some cracks cannot, however, be disregarded.

2.2 The side lugs have failed in the welding between the lugs and the bow visor plating. These lugs too seem to be welded by fillet welds rather than full penetration welds. The direction of the load cannot be seen from the failure surfaces but must be assumed generally to be upwards in the same way as at the bottom latch (this is the only possible movement of the visor as long as the deck hinges are intact).

3. The latching mechanisms may have failed under wave impacts at the reported early bangs and the visor thereafter been sitting in position due to its weight, occasionally making some vertical movements in heavy waves.

3.1. The normal operation of the visor is affected by two one-way hydraulic jacks, lifting the visor to open position. Lowering the visor is done by gravity and via flow restrictors in the hydraulic lines to control the velocity. The working space in the cylinders is thus in direct communication with the hydraulic oil reservoir, although via the flow rate restrictors. Severe movement of the visor may have caused excessive pressure in the cylinders leading to rupture of the hydraulic hoses. The initial dampening effect of the hydraulic jacks on the movement of the visor has then been eliminated.

4. The hinge arrangements on deck have failed. The failure is assumed to have taken place in the lugs of the deck arms of the visor. These parts have not yet been investigated as they are covered by bottom sediment at the location of the visor. It may be desirable to lift the visor for investigation of these lugs. The deck mounted part of the hinges are undamaged. The pins, having been secured to the visor lugs, are in place but have partly fallen out.

5. The visor arms have left the deck area without distorting the deck mounted hinge parts or the railing surrounding the hinge arrangements. The movement of the visor during final separation therefore seems have been in a generally forward direction.

6. The box on the visor deck, enclosing the upper part of the ramp, is judged to have hit the port side of the ramp from the rear, forcing the ramp partly open. No major damage can be seen on the upper starboard side corner of the ramp.

7. The observations under 5. and 6. would be satisfied if the visor, having lifted from its bottom positioning studs, has moved in a rotation to starboard side. This rotation could take place around the contacting point at the outer shell at starboard side and as a result of wave impacts on the port side.

8. This movement has brought the visor forward. The visor, now attached by only the hydraulic jacks, has forced the jacks to cut through the hull plating on upper deck and at the front bulkhead, also piercing at least one heavy deck beam. It still has to be verified by calculations if the visor could have got sufficient energy due to accelerations to create this damage and subsequently to break away from the hull.

9. The openings in the deck and front bulkhead seems to generally follow weld joints by a "zipper" effect. The openings created by these damages would allow water to enter service spaces in the forward part of the vessel and water could to some extent enter the car deck.

10. The openings along the sides of the forward ramp may have an effective area of 0.2 to 0.5 square meters together. This may have allowed one to two cubic metres of water per second to enter the car deck and sufficient water for loss of stability (still to be verified by calculations) could have been collected during a time span of 500 to 1000 seconds.
11. The extensive internal structure of the bow visor has also hit the front side of the ramp. Severe damage has been observed at several places. In particular in the lower parts of the ramp. The port side bottom hinge of the ramp seems to have been broken off. Simulation of the movement of the visor is needed to show the likely movement of the visor during the final phase. The visor has eventually left the vessel, most likely at starboard side.
12. The stabilizer fins were according to witness observation in extended position during the sinking, despite they seem to be in retracted position in the wreck.
13. Calculations will have to be carried out to determine the hydrodynamic load on the visor in the wave spectrum that is expected to be identified from weather analysis.
14. Calculations of the strength of the locking and positioning devices of the visor will be carried out as well as simulation of the movement of the visor under the wave loads and the pitching and rolling accelerations of the vessel.
15. The above calculations as well as stability calculations in various water filled conditions will be carried out as soon as the wind and wave analysis data has been obtained.
16. The likely track of the vessel will also be evaluated based on all available information. This evaluation will attempt to show when any turning action was initiated and other significant events during the final phase.

24 Oct 1994

Borje Stenstrom

Status Report dated 28.10.94

Swedish Board of Accident Investigation
 STATUS REPORT - WORKING PAPER
Not for publication

Enclosure 37.2.454

ESTONIA

Issue #2
 28 Oct 1994

A32

MV ESTONIA - Technical Evaluation of the Probable Sequence of Events and Cause of the Accident

The following is a summary of technical findings and a hypothesis regarding the sequence of events, judged probable at the time of writing. It is intended to serve as a basis for a joint understanding of technical facts related to the accidents and for identifying known and missing facts. Comments and corrections are invited from readers.

It is, in summary, judged that the ship's speed, the sea condition and the strength of the bow visor latching mechanism may each one and independently have been the final cause for the accident or could have been able to prevent its happening. Information/lack of information may have been a fourth parameter. Further work is needed to qualify the significance of these parameters during the actual circumstances.

1. The bow visor separated from the vessel at 0115 hrs and water started to come in at the damaged forward ramp (3rd engineer's observation). MAYDAY was sent at 0124 and the vessel had lost stability around 0130. The vessel sank around 0150.

1.1 The wreck is located at position N59°23.9' E21°42.2' and the visor has been found about 1 nm west of the wreck. The movement of the vessel from losing the visor until it sank has not been determined, nor the last actions from the bridge. The rudders are in hard starboard position. The propellers are in low pitch setting.

1.2 Various witnesses have reported heavy wave pounding against the ship and some sharp metallic bangs as much as one hour before the final sequence started. Deckman Silver Lindhe also heard sharp metallic sounds from the bow area at about 0030-0040.

1.3 One witness has seen the bow visor moving up and down before the accident.

2. The bottom and side latching mechanisms of the bow visor have failed.

2.1 The bottom latch has failed in the steel plate lugs and in the welds between these lugs and the guide bushings for the locking plunger. The fracture of the plate lugs seems to indicate failure by overload, generally by an upwards force. The welds seem to be pure fillet welds without chamfer of the lug edges. The available pictures do not reveal any signs of cracks or fatigue. The existence of some cracks cannot, however, be disregarded.

2.2 The side lug attachment seems to have failed in the bow visor plating. Part of the plating seems (at least at the port side lug) to have been torn out of the visor aft bulkhead.

SAC

3 The latching mechanisms may have failed under wave impacts at the reported early bangs and the visor thereafter been sitting in position due to its weight, occasionally making some vertical movements in heavy waves.

3.1 The normal operation of the visor is affected by two one-way hydraulic jacks, lifting the visor to open position. Lowering the visor is done by gravity and via flow restrictors in the hydraulic lines to control the velocity. The working space in the cylinders is thus in direct communication with the hydraulic oil reservoir, although via the flow rate restrictors. Severe movement of the visor may have caused excessive pressure in the cylinders leading to rupture of the hydraulic hoses. The initial dampening effect of the hydraulic jacks on the movement of the visor has then been eliminated.

4. The hinge arrangements on deck have failed. The failure is assumed to have taken place in the lugs of the deck arms of the visor. The deck mounted parts of the hinges are undamaged. The hinge arrangement on deck deviates, however, from that shown on drawings. The visor parts of the hinges have not been investigated as they are covered by bottom sediment at the location of the visor. It seems desirable to lift the visor for investigation of these lugs. The pins, having been secured to the visor lugs, are in place but have partly fallen out.

5. The visor arms have left the deck area without distorting the deck mounted hinge parts or the railing surrounding the hinge arrangements. The movement of the visor during final separation therefore seems have been in a generally forward direction.

6. The box on the visor deck, enclosing the upper part of the ramp, is judged to have hit the port side of the ramp from the rear, forcing the ramp partly open. No major damage can be seen on the upper starboard side corner of the ramp.

7. The observations under 5. and 6. would be satisfied if the visor, having lifted from its bottom positioning studs, has moved in a rotation to starboard side. This rotation could take place around the contacting point at the outer shell at starboard side and as a result of wave impacts on the port side.

8. This movement has brought the visor forward. The visor, now attached by only the hydraulic jacks, has forced the jacks to cut through the hull plating on upper deck and at the front bulkhead, also piercing at least one heavy deck beam.

9. The openings in the deck and front bulkhead seems to generally follow weld joints by a "zipper" effect. The openings created by these damages would allow water to enter service spaces in the forward part of the vessel and water could to some extent enter the car deck.

10. The openings along the sides of the forward ramp may have an effective area of 0.2 to 0.5 square meters together. This may have allowed one to two cubic metres of water per second to enter the car deck and sufficient water for loss of stability (still to be verified by calculations) could have been collected during a time span of 500 to 1000 seconds.
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12. The stabilizer fins were according to witness observation in extended position during the sinking. The port side one seems to be in retracted position in the wreck, this could possibly be explained by the fin having retracted by gravity after failure of the hydraulic system.
13. Calculations will have to be carried out to determine the hydrodynamic load on the visor in the wave spectrum that is expected to be identified from weather analysis.
14. Calculations of the strength of the locking and positioning devices of the visor will be carried out as well as simulation of the movement of the visor under the wave loads and the pitching and rolling accelerations of the vessel.
15. The above calculations as well as stability calculations in various water filled conditions will be carried out as soon as the wind and wave analysis data has been obtained.
16. The likely track of the vessel will also be evaluated based on all available information. This evaluation will attempt to show when any turning action was initiated and other significant events during the final phase.
17. Significant events since last issue:
 Discussions with building yard on 27 Oct.
 Discussions with salvage companies about lifting the bow visor
 Discussions with VTT, SSPA and KTH about a joint program for verification of stability, ship movement and visor failure modes.

Borje Stenstrom

Distribution:

~~Andi Meister~~

~~Kari Lehtola~~

Olof Forssberg

Tuomo Karppinen

Hans Rosengren

Sten Andersson

Notes by Dr. Holtappels at the first meetign with the JAIC members in Papenburg

Enclosure 37.2.455

AHLERS & VOGEL RECHTSANWALTE NOTARIE	SACHVORLÄUFER	DATUM	SEITE
		27.10.94	1
		STENSTRÖM / KARPPINEN.	
		HÖTTRAT / Watermann.	

1) Commission
Estonia/ Sweden/ Finland.
3 members from.

1) Bow visitors came loose at lower end
2) Broke away upper end of ramp
3) Water came 1m.
4) Speed 15 kn.
5) Wave heights 5-6 m significant/ max 10m
6) Wind SW from landward
7) Wind speed 25 m/s mean value.
8) most significant wave height in Baltic
7 cm January 83
9) course 282.00.
10) uneven load, despite all trimming
not 10 stb lost when leaving
not reaction from bridge more tested
on port side or release of the fresh water

AHLERS & VOGEL RECHTSANWÄLTE HAMBURG	SACHE/VERTEILUNGEN	DATUM:	SEITE: - 2. -
		BEARBEITEN	
		GEPRÜFT/STAMMEN	

11) hinges on deck (both sides) not
 torn out.
 12) Haltungen am Antikorrumen am Schiff
 due to local experience broken.
 Haltungen am Bowman: Belegung
 nach Rely takes hauptäthyls Reis
 am Bug und nach Stb (Ankergriffet
 (Rampf Port oben ausziehen))
 13) Ramp damaged hence port conns
 stern port damaged
 14) Why did vessel move forward
 15) Double consumption and design
 criteria for water and heating
 mechanism.
 16) Info confirmation not received.

Letter by Meyer Werft to Stenström/Karppinen


MEYER WERFT

PAPENBURG SEIT 1763

 JOH. L. MEYER & Söhne
 AG
 PAPENBURG / GERMANY
 SCHIFFSMÄRKE
 SHIPBUILDERS

 Joh. L. Meyer & Söhne AG
 Postfach 1000 - D-2770 Papenburg
 Postamtgebiet 0201-0277 Papenburg

VTT Manufacturing Technology
 Maritime Technology
 Att. Mr. Tuomo Karpinen
 Teknillantie 12, Espoo
 P.O. Box 1704

FIN-02044 VTT, Finland

K O P I E

Draugstahl

Dr. Zacher

Ulf M. Schäfer

Dietrich

Tug

Von Karpinen

Your Ref.

Dietrich

1994 Edition

Date

GL/Mo/Km

- 271

2nd Nov. 1994

Dear Sir,

Subject: S. 590 M/S ESTONIA**Ref:** Our meeting in Papenburg on 27/10/94

The following documents were given to you during the above meeting.

1. Dwg No. 1106✓ Bow flap interlock (BV approved)
2. Dwg No. 1103 Bow flap
3. Dwg No. 1101a✓ Sketch reinforcement of atlantic cylinder (BV approved)
4. Dwg No. 49111-304 Cylinder fastening bow flap
5. Dwg No. 49111-301✓ Hydr. diagram for drive-on ramps, hanging decks, bow flap, bow ramp, stern ramp
5. Dwg No. 49111-360 Hydr. locking arrangement bow ramp
7. Dwg No. 49111-371✓ Interlock for bow flap
6. Dwg No. 49111-361 Interlock for bow ramp
9. Complete description of the "von Tell" System

Enclosed please find the following documents.

10. Dwg No. 49111-301a Bow ramp
11. Dwg No. 49111-302✓ Details for bow ramp
12. Dwg No. 49111-303✓ Details for bow ramp
13. Dwg No. 49111-304✓ End hinge outside bow flap
14. Dwg No. 49111-310✓ Bow flap and bow ramp
15. Dwg No. 49111-372✓ Automatic and manual locking arrangement for bow flap
16. Dwg No. 26/10 Window plan 1
17. Dwg No. 26/11 Window plan 2
18. Dwg No. 26/12 Window plan 3

- 2 -

 Datum: 04.01.01-0
 Telefon: 040 818 1000
 Telefax: 040 818 1000
 Seite: 27/10 meyphd

 Joh. L. Meyer GmbH & Co.
 Abteilung Papenburg HPA 1000
 USt-Ident-Nr. DE 11696417
 Abteilung Papenburg HPA 210

 Per-Sekr. Geschäftsführer: Joseph-Franz Meyer-Göckel
 Abt. Papenburg
 Abteilung Papenburg HPA 210

 Geschäftsführer
 Dietrich Meyer



MEYER WERFT
FABRIK FÜR SCHIFFE UND MASCHINEN

- 2 -

VTT Manufacturing Technology

, 2nd Nov. 1994

- 19. Dwg No. 24/3 Side houses and ventilation A-deck in forebody
- 20. Dwg No. 1104 Forebody A-deck - C-deck fr. 138-160
- 21. Dwg No. 1102 Forebody fr. 139-148
- 22. Dwg No. 1101a Forebody fr. 149 - fwd. A-deck
- 23. Dwg No. 1015 Tankplan
- 24. Dwg No. 02/1 General arrangement plan
- 25. Dwg No. 404/10 Sill plan D-deck
- 26. Dwg No. 404/18 Sill plan G-deck
- 27. The walls are IWO B15 acoustic bulkheads covered with Perstorp FF1 1.5 mm. Core mineral wool 80 kg/cbm for H-profile mounting.
- Company: IWO-laminat AB
Hantverksgratan 7
S-54201 Möklinta
- 28. Telefax from Schiffbautechnische Versuchsanstalt Vienna
- 29. Receipt or Transfer Certificate
- 30. Specification, pages 1-1 - 1-9 and 3-1 - 3-4
- 31. Contract, pages 1-8
- 32. Our load calculations, sheets 1-4 (forwarded to von Tell)

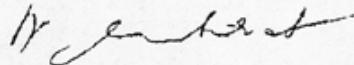
The drawings of the windows will be sent to you by separate mail.

If we can be of any further assistance or you have any questions
please feel free to contact us at any time.

Yours faithfully,

JOS. L. MEYER GmbH & Co.

Encl.



Memo by Börje Stenström dated 06.12.94

Enclosure 37.2.457

The ESTONIA Accident

Memo
6 December 1994**NOT FOR PUBLICATION**

To: Olle Forssberg, Hans Rosengren, Michael Huss, Olle Nordh, Bengt Schager, Sten Amliersson, Tuomo Karppinen, Aarne Valgma

From: Boerge Stenström

Observations in the bow area and on the navigation bridge during diver investigation 3 December 1994.

The summary below describes the findings during the diver examination of the wreck, subject to further examination of the video films. The divers examination took place from 3 December 1900 hrs to 4 December 0400 hrs. A supplementary examination of the bulbous bow by ROV took place on 4 December.

A. Damages**1. Ramp hinges.**

Number 1, port side. Outer eye on ramp lower beam bent, inner one broken. Hull mounted part intact, hinge separated.

Number 2. Both lugs on ramp lower beam broken, hinge separated.

Number 3. No damage, some play at pin.

Number 4, starboard side. No damage, same play at pin.

2. Ramp front side.

Heavy damage at lower end, most at starboard side.

Ramp beams damaged at lower ends and in centre line at mid length (possible contact with fore peak deck locating horn).

3. Ramp inner side.

Some damage at top

4. Ramp actuating cylinders.

Port side one found extended, rod end failed.

5. Ramp locking plungers.

Starboard side ones, both in extended position, mating boxes deformed.

Port side ones, upper one in fully extended position, mating box deformed, lower one partly extended, no visible damage to mating box.

6. Visor bottom lock.

Failed lugs on fore peak deck removed and recovered for examination of welds.

Plunger of bottom lock recovered and examined, measured general diameter 78.2 mm, 77.8 over contacting surface with visor lug.

7. Visor side lugs.

Remain in front bulkhead. Estimated play, both sides, max 10 mm. Failures in bulkhead plating around weld bead (part of bulkhead plating attached to lug bottom side but not over the entire area).

8. Visor hinges.

Deck lugs intact, no visible twisting. Design deviates, however, from that shown on drawings. Starboard side one has been beaten by visor arm more than the port side one. One hinge bushing recovered for examination.

9. Front bulkhead.

Not much damage except around port side locating horn and ruptures caused by visor hydraulic rams.

10. Fore peak deck.

No damage except some around centreline and in way of rubber seal.

11. Bulbous bow.

Heavy scratch marks on ice breaker horn, clear evidence on front and bottom of bulb from contact with visor.

12. Navigation bridge.

One Shipmate GPS navigator recovered for possible retrieval of data.

The navigation PC could not be found.

The engine control levers on port side bridge wing and on centre console were in full astern position.

The controls for the watertight doors were found to be push button switches and no information about ordered positions of the doors could therefore be found. The watertight door checked by the divers was in closed position.

13. EPIRB beacon.

One casing for an EPIRB beacon was found on top of the bridge, the other position was unaccessible for the diver. The casing was open and empty. The casing was recovered for further investigation.

D. Likely sequence of events.

The vessel has been hit by heavy waves on bow quarter.

1. Bottom lock of visor failed in lugs and in welds. Visor side lugs did not participate much in carrying the load due to flexing of the visor aft bulkhead.

2. Side locks failed subsequently by rupture of plating around weld.
3. Port side hinge failed more or less simultaneously due to overload.
4. Visor lifted from bottom locks, side locks and locating horns and twisted somewhat to starboard, causing starboard side hinge to fail. Port side locating horn was beating the visor aft bulkhead during this movement. The visor now remained attached to the hydraulic rams only and had a limited fore and aft movement.
5. The visor rotated forward under gravity and pitching forces, pulling the ramp partly open due to the mechanical interference. The interior structure of the visor made some heavy impacts on the ramp at this stage.
6. The visor continued to rotate forward under wave loads on the visor deck and pulled the hydraulic jacks out of the hull.
7. The visor was lifted by waves and pitching and moved forward, guided longitudinally by continued contact with the ramp. The visor landed on top of the bulbous bow and bounced several times on the ice breaking horn of the bulb, causing extensive damage to the bottom of the visor. The lateral loads on the ramp during this phase caused the ramp port side hinges to fail.
8. The visor continued to tumble forward due to wave loads on its deck and separated from the ramp. It tumbled forward and was hit by the bulb during this rotation.
9. This sequence left the ramp fully open, probably resting on the locating horn on the fore peak deck and initially allowing large amounts of water to enter the car deck.
10. Water on the car deck collected aft due to initial trim. This lifted the bow out of the water and reduced the water inflow. This explains the initial rapid increase of starboard list, followed by a slower development of the sequence. (As water was collecting aft, the free surface was less than would have been the case at even keel and more water could have been accumulated onboard before loss of stability.)
11. The vessel lost stability and started to sink, stern first.
12. Loss of the visor took place at 0115, stability was lost and the vessel down to 90° starboard list at 0130. The bridge was partly submerged at 0135 (the ship's clock in the chart room stopped at 1135 UTC). The vessel had sunk at around 0150.
13. Doors at boat deck and aft deck have been found missing and many windows broken, explaining a rapid flooding of the accommodation decks.

6 Dec 1997 RS


Notes by Dr. Holtappels made at the second meeting with the JAIC members at Papaneburg

Enclosure 37.2.458

AHRS & VOGEL RECHTSANWALTE NOTARIE	REG-FAKtenZICHTEN	DATUM 6.11.99	SEITE 1
BESPRACHSHABER:			
Stenstrom / Hirsch / Moltke / Dethny.			
Notar Humpf / Herff / Lang / Wirthsander.			
<u>Situations:</u>			
1) Bottom rock started due to over load factors no signs.			
2) ordinators have not taken measures due to lack of education.			
3) Wind 20 m/s significant 4 - 4.5 angles 7 - 8 m 14 - 15 km			
4) Pont deck hinge broke.			
5) Ship jolted off end of ramp whilst still hanging on side hinge and hit hydrant & station			
6) Bombs on deck.			
<u>Unsichtbaren due to hull deformation.</u>			
<u>Situation: Sankt Petersburg</u>			
Ramp: first movement forward. but totally torn open			

AHLERS & VOGEL RECHTSANWÄLTE NOTARIE	EINHEITSPRÄZISIEN	DATUM:	SEITE: <u>(2)</u>
		BEARBEITER:	
		GESPRÄCHSNOTIZEN:	

Hundezylinder (Dier) haben Dier
Dier und Dier bitten gegen.
Gier off only

Status Report by Börje Stenström dated 06.12.94

Enclosure 37.2.459

Swedish Board of Accident Investigation

STATUS REPORT - WORKING PAPER

Presented to the third meeting of the Joint Accident Investigation Commission on 15th December 1994.

Not for publication

MV ESTONIA - Summary of Technical Findings and Technical Evaluation of the Probable Sequence of Events and Cause of the Accident

The investigation of technical facts related to the accident has continued with high priority. The findings and conclusions reported and agreed on during the meeting on 17th October in Tallinn are essentially still valid but various additional findings have been made and the related probable development of the accident has been further clarified and modified.

The additional technical information is the result of recovery and examination of the bow visor and the performance of a diving examination of the wreck. The bow visor was brought ashore on 19th of November and diving examination on the wreck took place on 2nd to 5th of December.

Supplementary discussions have been held with the shipyard and the classification society on 7th and 8th of December respectively. A study of hydrodynamic loads on the bow visor in a wave spectrum that may have existed at the time of the accident has been commissioned at SSPA. Information about similar work carried out within the Finnish commission has also been reviewed. An extensive analysis of the weather conditions has been received from SMHI.

The summary below describes the technical findings and also the effect these may have had on the development of the accident.

1. All evidences found so far confirm the hypothesis that the mechanical failure started with failure of the lower locks of the visor. Most probably the bottom lock failed first. The mounting lugs for this lock have been recovered from the wreck. They indicate that the failure in the lugs has been caused by overload and also that the actual welding of the locking plunger housing to the lugs has been less extensive than presumed in the engineering calculations. The total load carrying capacity of the mounting of the bottom lock has therefore been less than intended. The internal work routines of the shipyard relevant for this condition are being discussed with the yard.
2. The side locks failed at the same moment or immediately after the bottom lock. Inadequate rigidity in the mounting of the lugs of the side locks have reduced the ability of these lugs to pick up load at the same rate as the bottom lock, indirectly contributing to overload of the bottom lock.

3. The hinges at the visor pivoting points on upper deck have also failed due to overload. The port side hinge has probably failed first, at the same instant as the lower locks, under a forward directed force generated by the side load on port side of the bow. The starboard side hinge has failed subsequently as a result of bending and twisting of the visor, now attached only by the actuating hydraulic cylinders. One hinge bushing has been recovered from the wreck for further detailed investigation of the welding joint to the visor arms.

4. The visor was now free to move forward under the pivoting force of its own weight and acceleration forces due to pitching of the vessel. This has caused the visor to rest against the top of the ramp and to force the ramp partly open. Contact has primarily been on the port side due to the sea load on port quarter of the bow. The contact marks in the deck box of the visor and those on the upper side of the ramp have been confirmed and calculations of the force required to cause the damage in the deck box and the force required to break the ramp locking mechanisms is presently being carried out. The locking plungers of the ramp have been confirmed fully extended and the mating boxes twisted open except for the port side lower plunger that was only half way extended. Water is assumed to have started to enter the car deck at this stage as observed and reported by personnel in the engine control room.

5. The visor has continued to tumble forward under acceleration forces and possibly by sea load on the deck, now tilted forward. The lower part of the visor has during this movement hit the front side of the ramp. The hydraulic cylinders have been forced forward, rupturing the plating of the deck and the front bulkhead and finally being pulled out of the hull. The forces involved in this movement are being verified by calculations.

6. The visor has now separated from the hull but the ramp has still been extending into the interior of the visor, supporting it in a straight fore and aft movement. The visor has rested sideways on the ramp (due to the port side sea loads), causing verified damage to the port side interior of the visor and on the port side upper area of the ramp. The port side hinges of the ramp have also failed under the load of this sideways contact. The visor has during this phase moved further forward and has been bouncing on the bulbous bow, verified by damages to the bottom area of the visor and on top of the bulb.

7. The visor has finally tumbled forward over the bulb and has been hit by the bulb as it was sinking in front of the ship.

8. When the visor left the ship it left behind it the ramp in fully open position, initially allowing large amount of water to enter the car deck within a short period of time. This is believed to explain the reported rapid initial generation of starboard list. The subsequent development is believed to have resulted in the ship turning away from the wave direction, reducing the rate of inflow of water. The main engines have stopped during this phase and the ship drifted in the seaway during its flooding and sinking.

9. Information that has been recovered from the navigation bridge includes one GPS navigator, being sent to the manufacturer for retrieval of any stored data. The navigation computer could not be found as it seems to have slid down to starboard bridge wing that has been crushed against the bottom. Both engine control levers were found to be in full astern position. The details of the movement of the ship during the final phase of the accident are still not clear.

10. In total it is considered to be verified that inadequate structural strength in the visor locking mechanisms has been the underlying condition for development of the accident. The sea loads on the visor generated by an irregular wave condition with occasional high waves in combination with the speed of the vessel is considered to have been the ultimate factor, triggering the structural failure in the particular instant.

TOTALT HNT. SID 84

Press Release by the JAIC on 15.12.94

MV ESTONIA

1994-12-15

PRESS RELEASE

1. The Joint Accident Investigation Commission on the ESTONIA accident met in Stockholm on 15th December 1994 to review the progress in the investigation into the cause of the accident and to discuss the further work program.
2. The Commission considered verbal and written information from all parties regarding the status of the ongoing work. The Commission agreed that most of the work was still in process and needs further detailed substantiation before conclusions should be drawn and made public.
3. The Commission confirmed however its opinion that the strength of the locking devices for the bow visor in combination with the sea load on the visor in the prevailing wave condition and headway of the ship is the main cause of the accident.
4. The Commission noted that the effect of the ship's speed on the loads on the visor is still being investigated. It was noted that studies made by research organisations (SSPA and VTT) showed no indication that the ship's movement and acceleration had exceeded values normally encountered during heavy weather voyages.
5. The diving investigation carried out on the wreck has revealed that the ramp was locked in closed position prior to the accident. After loss of the visor the ramp has been significantly more open than the present position on the wreck, at least during some phase of the development of the accident.
6. The detailed timing of the sequence of events has still not been clarified but substantial amount of water was flooding into the car deck between 0115 and 0130 (Estonian time). The ship sank due to the accommodation being flooded and disappeared from radar screens at 0148. The clock at the radio station on the navigation bridge has stopped at 2335 UTC (0135 Estonian time).
7. The EPIRB beacons have been found on the Estonian shore and it has been confirmed that weak signals from one of the beacons were received by one of the rescue helicopters.
8. The Commission agreed that the next meeting should be held in Helsinki during the last week of January 1995.

Letter by Börje Stenström to Meyer Werft dated 19.12.94

Enclosure 37.2.461



Mr P. Motikat, Director
Jos. L. Meyer GmbH & Co
P O Box 1555
D 26855 PAPENBURG
Germany

19 December 1994

Ory: *me*
f BM
f Wa/Mö
f Dr. Ho
f 2c/1 Skrfl

Dear Mr Motikat,

Enclosed please find, as promised, one copy of the video recording from the divers investigation of the bow area of the Estonia. The length of the film is about 65 minutes and it contains all the substantial observations made during the 10 hrs of diving for the accident investigation (the remaining time being divers search for the areas to be investigated etc.).

Enclosed is also a copy of the press release that was produced during the meeting of the joint accident investigation commission meeting on 15th december.

We have initiated an examination of the lugs for the bottom locking device with regard to any signs of old cracks in the fracture surfaces or defects in the welds. We expect the preliminary investigation in this respect will be completed during this week. We will inform you about the findings from this examination.

As I have mentioned before, the Commission was not ready to publish any details about the technical findings at this meeting and a new meeting is set for the last week of January. This date was selected, also taking into account your desire to have time up to and including the second week of January to investigate the matter from your end.

I will look forward to our further correspondance with great interest and, in the meantime, I am taking this opportunity to express my best wishes for a Merry Christmas and for the New Year.

Yours faithfully,
Swedish Board of Accident Investigation

Börje Stenström

Fax Börje Stenström to SSPA dated 30.11.94

SHK TELEFAX

From: Statens Haverikommission

B. Stenström

TO: SSPA, VTT

Att: Peter Ottosson, Tuomo Karppinen

Date: 30th Nov 1994

"ESTONIA" - Condition of the cargo

I have received the following calculated information about the liquids at the time of accident.

tank 10, 108 m³

tank 11, 108 m³

daytank 36, 25 m³

settling tank 38, 20 m³, total 261 m³ IFO 180 bunker

tank 41, 10 m³

tank 18, 32 m³, total 42 m³ MDO

tank 20, 10 m³, total 10 m³ gas-oil

tank 1, 175 m³

tank 13 + 14, 183 m³, total ballast 358 m³

In this is not included the freshwater and other service tanks. I assume that it could be reasonable to calculate that they were half filled.

According to the cargo lists last manifest there were 34 trucks and trailers with combined length of 607 m and a total weight of 970 tons. The total length of lanes on the cardeck is 940 m divided into 7 lanes (3 starboard, 4 port side).

The trucks were in the stern and the rest of the lanes were according to the information approx. filled with cars. This should be accurate enough for calculations. I will be back to you with the information and the data about the turning manoeuvres.

signed Börje Stenström

From: B Stenstrom, chief maritime accident investigator,
 fax No. +46 8 737 58 42
 To: SSPA, VTT
 Attention: Peter Ottosson, Tuomo Karppinen
 Fax number: 031 63 96 24, 009358 0 455 0619
 Date: 30 nov 1994
 Number of pages (incl this one): 1

ESTONIA, lastkondition

Har fått följande beräknade uppgifter om vätskor vid olyckstillfället:

tank 10, 108 m³
 tank 11, 108 m³
 daytank 36, 25 m³
 settl.tank 38, 20 m³, totalt 261 m³ IFO 180 bunker

tank 41, 10 m³
 tank 18, 32 m³, totalt 42 m³ MDO

tank 20, 10 m³, totalt 10 m³ gas oil

tank 1, 175 m³
 tank 13 + 14, 183 m³, totalt baliast 358 m³

Häri ingår inte färskvatten och andra servicetankar, förmodar det kan vara rimligt att räkna dessa halvfulla.

Lastmanifestet upptar 34 lastbilar/trailers med en sammanlagd längd av 607 meter och en totalvikt av 970 ton. Den sammanlagda tillängden på bildäck är 940 meter, fördelat på 7 filer (3 om styrhöjd, 4 om babord). Lastbilarna stod akteröver och resten av filerna var enl uppgift i stort sett fyllida med personbilar.

Detta bör räcka med tillräcklig noggrannhet för beräkningarna

Aterkommer om girdata.

Börje Stenström

Postal address	Visiting address	Phone	Fax
Box 12538 S-102 28 STOCKHOLM SWEDEN	Västerbrogatan 3 Stockholm	Nat 08-737 58 40 Int +46 8 737 58 40 GG 737 58 42	Nat 08-737 58 52 Int +46 8 737 58 52

Letter Sjöfartsverket

From: Johan Franson

TO: Börje Stenström

Havarikommissionen

Date: 16th Nov 1994

Börje, As you presumably know Sjöfartsverket is at the moment negotiating about the survey of "Estonia". Olie has got the specification whom we have been sending possible companies that give us offers.

In the specification has been given two options, i.e. partially to cut pieces from the bow and partially to investigate and possibly take away some equipment from the bridge. There has been the wish to try to get a computer from the bridge. As you can see from the specification I have asked that the contractors should accommodate 5 people according to the wishes of Sjöfartsverket.

(That means that there is specification now that he is sending probably attached to this letter where he says that they need to accommodate 5 additional people which this Johan Franson is asking for.)

I will calculate that we shall be able to negotiate the contract on the 24th November and that the divings can start a few days after that. Can you in good time before the 24th define what you want to have done with the ship and can you tell me if the Commission wants to have somebody onboard to monitor the divings.

Regards, Johan Franson

Request for Investigation and Comments

to the Finnish Criminal Police

(translator: The funny thing is that there are two requests here about the same thing, but they are clearly two different documents and on the top of everything else there are two translations, but the date for both the translations and for the original documents are same. I don't know if this is important, but they are identical in contents, but they are different documents.)

Notes by prosecutor B. Cronier made 28.09.94

Lottas 88m C-mail

ÅKLAGARVÄS

DAGBOKSBLAD

Datum

Enclosure 38.5.463

940.

ÅKLAGARMYNDIGHETEN
STOCKHOLM
1994-09-28

Dnr.

9-1-10894

Misstänkt (fullständig namn, sifferkombination markeras)			
Försvarare	Telnummer	Förhandlade	Telnummer
Brott			
<i>M/S Estonia havariet 940928. vad hänt i Sjöfartspolitiken vid tillståndet för att anmäla M/S Estonia havariet.</i>			
Anhållan den	Häktades den	Resses bud den	Anmälningsskyldigheten där
<input type="checkbox"/> Ej ätal	Beslag den	Året sedan den	Datum Sign:
Utdrags ur kriminalregister		Uppgått från polisarbete	

Övriga anteckningar
*940928 del 1040 Uno Hagberg bel: berlut
 att märkta för und. angående
 M/S Estonia havariet.*

*Utanför Stockholm Häveritbolag Olaf
 Forsberg bel 08/7375857 - uppt.*

*Meddelat påtälj bevarin om berlutet
 RPS Jönköping Bladblad akt 9101 - 7/94*

*Samtal med Olaf Forsberg - havari
 han har ej egen förmak han har för
 för att tillsammans med Timo o Estland
 rätte sig en havariet. O F under-
 rättad om Hagbergs berlut / BZ
 - kontakt konstchef Klas Hellström i Finland
 Jk bel 1603940. Teknisk undersökare Kari
 Ichola sitter på plats i VTB. Broktsutredning
 över kriminalkommissarie Kurt Allopaeus ÅBO
 bel 921/655550 - kompolisören Hibko Paatero
 Åbo 21/660111. Handräkning.*

*941004 kontakta UD Pia Rudolfsson
 röpräkning berlut i Estland och pröf
 lämnat i sitt problem / Bz*

941005 del. 103° Hallungs bkt

ÅKLAGARVÄSENDET		DAGBOKSBLAD	
Datum		Datum	
Missändikt (kvinnslödigt) namn. Hållnamnet markeras)		Personnummer	
Väravärdare	Telefonnr.	Förvarade löne	Telefonnr.
Kraft			
Anhållen den	Hållt den	Resettäbuden	Anmälningsskyldigheten
<input type="checkbox"/> Ej åtal	Beslag den	Anslagssort den	Datum Sign
Utdrag ur kriminalregistret		Uppgift från polisområdet	
Övriga anmärkningar			
<p>941102 Samtal KT disk. Polisen i Finland sätta en helikopter från + utvärmen Norden.</p> <p>3 platser härsig med havarietem.</p> <p>dca: Förbered redovisning 2570-94 Veritas veritatis gummibåten är till utvärmen fortfar i England</p> <p>941108 Handikong från Finland gewoon 018822,</p> <p>941208 Hearing</p>			
<small>RÄ 20 1984 25000 68 115150</small>			

Letter by Börje Stenström dated 22.12.95

TELEFAX MESSAGE**SHK**, Swedish Board of Accident Investigation

Fax Number +46 8 737 5852
 Telephone Number +46 8 737 5857
 P O Box 12538, S-102 29 Stockholm, Sweden

To Ahlers & Vogel, Hamburg
 Fax number 00919 40 371092

21 Dec. 1995
 2 pages

Attn Capt Werner Hummel

Dear Werner,

Looking through, again, the memo which you left here during our latest meeting (16 pages plus enclosures, no date), I have a couple of comments and questions I would like to pass on.

1. On top of pages 4 and 6 you say that von Tell submitted and BV approved load calculations for the locking devices. The only document we know about is the short telex from von Tell to BV informing that they had used LR rules for defining the strength of the locking devices and were somewhat high on shear stress (must presumably refer to the locking bolt). Have you seen any calculations?
2. On page 6 you further say that von Tell produced drawings sent to the yard for production. The von Tell drawings showed the von Tell deliveries and the complete assembly but not installation arrangements. Agree that the parts indicated by von Tell as "Westf Lifting" are not clearly identified as information or as manufacturing guidance and we say in our text that this may have been misleading.
3. On bottom of page 6 you say that the yard compared the von Tell design requirements with own results. Again, where are von Tell design requirements given?
4. Page 7, item a), refers to welding tables instead of drawing information. The steel drawing for the visor does indeed contain very detailed welding information for welds which may be regarded as standard, such as butt joints between plates of different thickness. It is lacking, however, details of the non-standard welds, such as welding 60 mm thick plate. This seems to be contrary to your explanation.
5. Page 8, item (b). The lugs of the bottom lock show clearly that the holes for the bushings were made by machine flame cutting. The lugs for the hinges show at several places a machine flame cutting pattern. (The coarse flame cutting pattern still being a questionmark.)
6. Page 9, first para. We have not seen any von Tell drawings giving welding information to the yard.

TELEFAX MESSAGE

SHK, Swedish Board of Accident Investigation
Fax Number +46 8 737 5852
Telephone Number +46 8 737 5857
P O Box 12538, S-102 29 Stockholm, Sweden

7. Page 11, last para. We understand that Viking Sally was on the contrary a few hundred tons lighter than originally estimated.

8. Page 12, 4th para. We have no documentation showing that the bottom lock was installed to meet a design load of 132 tons. If available, please provide. Bottom of the same page, the safety factor is not so easily defined in a design where base material and welds carry the load simultaneously because the welds have somewhat lower ductility once the yielding strength is exceeded.

9. Page 13, bottom. Was the extract from the von Tell drawing with the length of the side lug 370 released by the yard for production? If so, based on which calculations? As far as we can calculate, the strength of the side lug installation was somewhere around 100 tons when subjected to the combined pulling and bending force. This matches the actual tests carried out in Helsinki.

10. Page 15, mid. The "Copenhagen Convention" you are referring to certainly does not put any obligations on classification societies but contains an agreement between the Nordic countries that classification societies may be authorised to perform certain functions under the jurisdiction of one country and agreement that such authorisation will then be accepted also by the other administrations.

11. Further observations. I have looked back on ROV videos and have seen views of the bottom lock sensor mounting plate where the smaller holes for the magnetic sensors are clearly visible. Still no signs of the sensors themselves.

Have also seen plenty of rubber packing on the lower oak deck in various state of separation from the flat bars.

Understand the visor was flooded already during the sea trials. Do you have any information about how this was corrected?

Work continues but now we will take a little holiday break. Wishing you and Peter all the best for a Merry Christmas and for the New Year!

Best regards


Boerge Skanström



NORDSTRÖM & THULIN

STATENS HAVFARTSKOMMISSION	
Ink	1997 -10- 31
Dnr	ESTONIA
Aktbil.nr.	B178

VTT MANUFACTURING TECHNOLOGY
Att. Tuomo Karppinen
Maritime Technology
P.O. Box 1705
FIN-02044 VTT, ESPOO
Finland

1997-10-24
UN/UE

Ang. underhållsrapporter M/S ESTONIA

Bifogar underhållsrapporter för M/S ESTONIA enligt vårt fax idag.

Med vänlig hälsning

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Telex 13170 Taxisw Dept.
17907 Shipowner Dept.
18172 Sale & Purchase

Fax Klaus Rahka dated 18.06.96

43884557002

VTT/KALMISUS/ERN

F-389 1-173 P-1001

18.00.20 15.11.

Enclosure 39.2.466.1

Fax to 99049 40 362 198

Werner Hummel

MCP/Hamburg

Total 2 pages

Thanks for your fax

My suggestion is that the total cross section of the weldments should be around 1000 mm². This would mean that a 3mm weldment should cover at most 30 % of the total length available (assumed to be (157x6+120=942mm), 30 % of which is 282 mm) or that the weldments should be no wider than 0.9 mm if the full length is used.

This, of course, is a rough estimate only.

The main target would be to have a test where the visor lug would stretch about or slightly less than 5 mm, which according to my estimate would occur at about 1.75 tons.

In espoo 18.6.1996

Yours

Klaus

Letter Olof Forssberg to MUST dated 13.09.96



Enclosure 39.3.467

B.57

STOCKHOLM
1996-09-13

Estonia

Överste Håkan Pettersson
MUST
Högkvarteret
107 85 STOCKHOLM**Utvärdering av videofilm**

Med hävning till telefonsamtal i går får jag härmed meddela att videofilmen kommer att skickas till Dig av universitetslektor Mikael Huss som är expert åt den Internationella kommissionen för undersökning av Estoniaolyckan. Jag hoppas att Huss förklarar vad uppdraget går ut på. Som jag har förstått det önskar man en datorbearbetning med konturförstärkning av vissa sekvenser.

Jag föreslår att de kontakter som behövs tas med Huss.

Faktura på arbetet emottes till Statens haverkommission under adress som framgår nedan. Om Du önskar kontakt med mig är mitt ditteknr 441 38 22.

Med vänliga hälsningar

Olof Forssberg
Olof Forssberg

TELEFAT	TILL/TO: <i>Herr Huss</i>
	Från/From: <i>Vissa + för kommissionen</i>
Datum/Date:	<i>13/9</i>
Ant. sid./No. of pages: <i>1</i>	
Pkt. artnr. 404.124	

Besöksadress/Postal address Box 12538 SE-102 29 Stockholm Sweden	Besöksadress/Visitors Wernerbergsgatan 10 Stockholm	Telefon/Phone Nat +46 8 441 38 20 Int +46 8 441 38 20	Telefax Nat +46 8 441 38 21 Int +46 8 441 38 21	E-mail info@havkom.se
--	---	---	---	--------------------------

MUST Comments on the passenger video dated 13.09.96

Enclosure 39.3.468

AEN ENSSK
1996-09-20
ESTONIA
B 158

Estonia, stillbild från video av bogvisir**Förutsättningar**

Vi har inte kunnat arbeta med originalvideotapen utan här endast kunnar utnyttja en kopia. Visiret filmades en mulen dag. Ljuset är diffust, men de skuggor som finns i videosekvensen visar att solljuset kommer från en riktning ca 10 grader vänster om uppåt i bilden. Det finns även reflekterat ljus som kommer från bildens nedre del (reflektion mot båtens överbyggnad). Vi har inte gjort någon grundligare studie hur ljuset faller i området runt gångjärnet, men det är uppenbart att det förekommer skuggor i olika riktningar i detta område.

Kommentar till bildsekvensen

Mikael Huss nämner en "vit linje" vid botten av visirarmen och gångjärnets högra del. Då sekvensen studeras bild för bild ser man att denna linje ibland är sammanhängande och ibland ser avbruten ut.

Vi har tagit med två exempel på delbilder som visar denna variation. Denna effekt kan man få i bilder om avståndet mellan två objekt endast är ett par bildelement. Ibland smälter objekten samman och ibland syns mellanrummet mellan dem. Detta beror på hur de digitala sensorerna i videokameran råkat hamna i varje enskild bild.

Bildförbättring

Ett antal delbilder har genererats från videosekvensen. Dessa har sedan sammanlagrats till en resultatl Bilden.

Resultatl Bilden innehåller därmed information från ett stort antal enskilda bilder. Dessa har inte valts ut subjektivt, utan alla bilder i en kort sekvens har använts.

Vi har inte använt filter för att påverka skärpan eller kanteffekter i bilden. Vi bedömer att filter skulle påverka tolkbarheten negativt.

Tillgång till originalvideotapen skulle troligen ge ett an bättre resultat.

Levererade bilder

1. Originalversion av den mittsta bilden i den sekvens vi valt att bildförbättra
2. Förbättrad bild
3. Samma bild som ovan, men förstorad
4. Bildexempel där "vita linjen" är sammanhängande
5. Bildexempel där "vita linjen" ser bruten ut

Svenska Dagbladet article dated 28.09.96

NRIKE**HD stoppar
forskränning**

Högsta domstolen har avgjort i saken mellan markägaren Per Norderfors och flotturen Karsten Yde. Karsten Yde förtynats att fortsätta anordna förskränning i Per Norderfors del av Norrströmnen i Åtran em. inte Per Norderfors ger sitt medgivande där till. Millet har fått stor uppdragssumma eftersom det berör den svenska allmännsrätten.

Per Norderfors tyckte att dansken Karsten Yde gick långt i omnyttjanget av den rätten. Alli Öerlunda ledde dock bort intresset från förskränningen, vilket ledde till att slägat vattenströget och naturen runt omkring. Per Norderfors ansåg att det var urimligt att hans mark skulle stå till förlagan för ett massigt kommersiellt omnyttjande. Karsten Yde å sin sida hanvisade till allmännsrätten. Han saade sig dock vara villig att kompensera markägaren.

Karin E. Persson

**"Bogvislets gång
jäm var friska"**

De bilder som påstås visa att gångjärnen till bogvislet på "Estonia" var miss behandlade visar i stället att gångjärnen var "fullkomligt friska".

Det säger Olof Forsberg, ordförande i den svenska delen av den internationella "Estonia"-kommissionen. Kommissionen har under två dagar träffats i Stockholm under den nya ordföranden Uno Laur.

Ledamöterna tittade bland annat på en bild från en amatörfilm. Enligt det svenska varv som byggde fartyget visar filmen att gångjärnen till bogvislets styrhöjd sida är totalt miss behandlade. Varvet anser att redet har tillåtit felaktiga reparationer och missköts underhåll.

**Svårt få jobb för
iranska tandläkare**

Världens tredje tandläkarsmed, invandrarkräkten som blev klar med utbildningen 1993 till 1994 är utan jobb. Det visar en enkät Tandläkarförbundet lätt sätter.

Under åren utexaminerades 850 tandläkare. Av dem svarade 453 av de tillfrågade på ankletten. Drygt en tredjedel varit nyutbildade kvinnor. De som varit barna hade in-

Enclosure 39.3.469

Dagens Nyheter, Saturday, 28.9.96

"The hinges of the visor were sound."
 The pictures which allegedly show that the visor hinges were maltreated show instead that that the hinges were completely sound.
 This said O. Forsberg, chairman of the Swedish part of the International Estonia commission.
 The commission had just met for 2 days under the new chairman Uno Laur.
 The participants looked at stand pictures, among other things, from an amateur video. According to the German yard which built the vessel the film shows that the visor hinges at stb. side are completely maltreated. The yard believes that owners have carried out faulty repairs and neglected the maintenance.

Article Dagens Nyheter dated 21.10.96

Videofilm vållar strid

"Estonia." Experter oeniga om skador på gångjärn i bogvisiret.

Av Anders Hallberg
08-738 10 44

Det har uppstått strid om den videofilm som, enligt de anhöriga till offren i "Estonia"-katastrofen, visar att olycksförfärgen hade allvarliga skador på bogvisiret redan flera veckor före katastrofen.

En fotoukundsexpert i London hävdar nu, liksom de anhöriga och Meyervarvet i Tyskland som byggde "Estonia", att videobilderna klart visar att det fanns skador på st. bords gångjärn som höll upp bogvisiret.

Den internationella havariikommisionen har lättat svenska försvaret göra egna uppförstörningar och utvärderingar av den videofilmen som en turist tog ombord på "Estonia" några veckor före katastrofen.

- Vi anser inte att bilderna tillför något nytt, det framgår inte av dem att det fanns sådana skador som de anhöriga hävdar, säger Olof Forssberg, ordförande i den svenska delen av havariikommisionen.

Börje Stenström, teknisk expert i kommissionen, påpekar att påfrestningarna under olycksnatten bör ha kommit från baborde och inte styrbords gångjärn, som varvet också hävdar.

Inte heller Sten-Crister Forsberg, teknisk chef på Nordström & Thulin, deltagare i Estonia, tar särskilt allvarligt på den engelska expertens rapport:

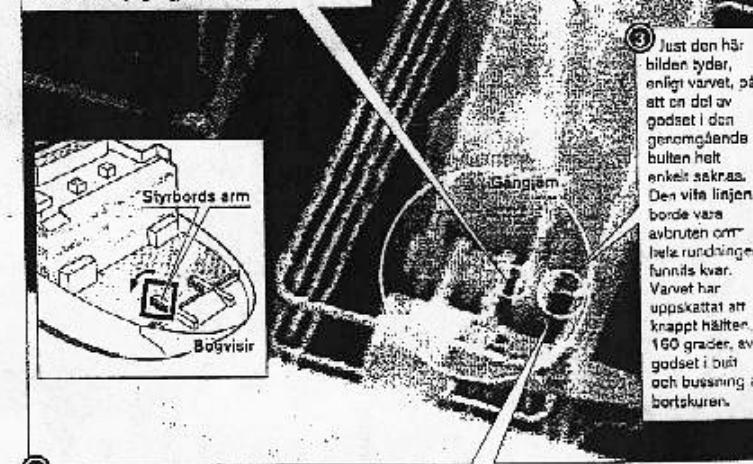
- Vad jag förstår rycker utmanad från svenska försvaret och havariikommisionen undan grunden för det tyska varvets teori.

Den engelske experten på fortolkning, B E W Roberts, konstaterar i sammanfattningsen av sin rapport att "videobilderna visar på skador (disruption) på "Estonia", särskilt på beslägen i styrbords gångjärn och på gångjärnets axel".

Skadorna på "Estonias" gångjärn

① Styrbords arm, som håller bogvisiret, ser ut att vara sned och vridon. Det skulle tyda på att balansen i varvet har varit fel till följd av att vatten kommit in i vissret och att attiviteten varit delvis sunderrostad strax under visirer.

② Skuggan på högeridan av gångjärnet är för bred och borde vara avburen av ett ljusare parti. Detta tyder på att delar av bussingen som ska smida gångjärnet är borta.



③ Här pekar svenska försvarare experter på att den vita linjen kan se olika ut på olika bilder i videosekvensen. För en liten riktig bedömning, säger förevararets experter, måste man göra en sammanvägning av flera bilder.

Roberts rapport är mycket detaljerad och konstaterar att det finns skador och antydningar till materialutmattning på flera ställen på styrbords gångjärn, samt att bulten i gångjärnet varit sned.

Den militära underrittelsete och sakerhetsjänsten, MuSt, på försvarets högkvarter hävdar att det inte går att bara titta på en förstörd bild från en videoekran, utan att man måste göra en datorsammanvägning av alla bilderna.

- När försvaret har gjort en sådan sammanvägning finns

inte de skador som varvet hävdar, säger Börje Stenström.

Varvets linje lända sedan katastrofen för över två år sedan har varit artvisentliga delar i bogvisirets gångjärn har bytts ut under årens lopp, och när underhållet var så dåligt sedan fartyget blev estniskt att det inte var i sjövärdigt skick när det sjönk. Skulden här, enligt de anhöriga inom DIS - Den internationella stödgruppen - redovisar och det transna klassningsförsäkret Bureau Veritas.

Enligt varvet berodde de kraftiga slagarna inte på s bogvisirets lossnat och fall av, utan på att vatten trängt genom det otäta visireret och inte helt stängda rampen.

Dette gjorde att "osurrilast" och vatten på bildvägande ner bilrampen, veket i sin tur ökade slagarna och knäckte gångjärnen i bogvisiret uppå däck.

- Men detta är inte en s som vi ansluter osäkert till att havariet har haft andras orsaker, att läsen i visu först har knäckts, säger Boi Stenström.

Letter GGoE to JAIC dated 22.07.96

The German Group of Experts investigating the sinking of M/V "ESTONIA"
c/o AHLERS & VOGEL, Schaartor 1 D-20459 Hamburg, Telephone 49-40-371075

The Joint Accident Investigation Commission
/o Statens Havarie Kommission
Attn. Börje Stenström
Box 12538 S-102 29 Stockholm

Ihr Zeichen/Your Ref. Unser Zeichen/Our Ref. Hamburg/Date WH/PH/hz July 22nd, 1996 "ESTONIA"

Dear Börje,

Several months have passed since our last contact in writing and although we have recently spoken a few times on the phone, we would like to put down on paper a number of items which we consider to be of relevance before your respective investigations are finalised and the Final Report is completed.

I. Our letter dated 22.01.96 in reply to your letter of 21.12.95 has not been commented on by you at all. Consequently, we do assume that all the items raised in your letter have been answered respectively commented by us to your satisfaction, as has been confirmed by you recently during one of our telephone conversations. Nevertheless, we shall revert to some of the items further down as new information/evidence has been obtained in the meantime.

II. We have read the interview which Olof Forsberg gave the magazine "Stern" some weeks ago with interest, in particular his remarks concerning the quality of our work found our attention. In order to clarify our position with regard to the so-called FELIX Report please accept the following explanations:

1. We had received a translation of 5 pages (out of 85) of the FELIX Report from Spiegel TV with the request to find out whether the results of our investigation would confirm or disprove the allegation of the FELIX Report "that crew members had attempted to open the visor at sea". Before doing so we have cross-checked certain other allegations made in this Report in Tallinn and found them to be basically confirmed.
2. When reviewing our information/documentation it became obvious to us that certain observations of survivors - all of which were told to the criminal police during the interrogations on the first days after the casualty - but also particular circumstances which, so far, remained unexplained, could make sense if indeed crew members had tried to open the visor some time before the casualty sequence.
3. We conveyed our findings to Spiegel TV and "Der Spiegel" where they were published in distorted form.
4. In anticipation of the reaction of the media following the publication of Spiegel TV/Spiegel Magazine on 14th/15th April, we had prepared a press release (enclosure no. 1) which, we believe, makes our position quite clear, i.e. we have never said or written that we believe the allegations of the FELIX Report in connection with "Estonia" to be true, but that assuming that they should be true the stated observations of survivors and particular circumstances - as lined out in our press release - could make sense. So much for the FELIX Report.

III. Evidence from the Wreck

We were most surprised to learn from the Swedish media that your Commission has stated it needed no more evidence from the wreck. During our last meeting in Stockholm you had told us that you would make sure that the interesting items would be brought up respectively taken on video film before the covering commences. How is this discrepancy to be understood? Why are you no longer interested in bringing light into certain matters which do need clarification, if for no other reason than to avoid the creation of legends? We have been requested from various sides during the last weeks to state what we consider necessary to be brought up respectively to be examined/filmed on site and have summarised this in a letter, which is attached as enclosure no. 2. The letter was initially written upon request of Henning Witte, the lawyer representing the DIS-Group of Relatives (Bendreus) in their efforts to persuade the Swedish Government to postpone the covering until at least your final report has been published. The letter was subsequently also sent to Swedish TV stations, Svenska Dagbladet and Dagens Nyheter (Anders Hellberg). It has recently been amended by the necessity to have the condition of the watertight doors examined, which certainly had influenced the sinking speed! We have read your interview in Dagens Nyheter in this respect and might remark that the control light arrangement for the WT doors on the bridge must have been changed after the vessel was renamed "Estonia", because as long as she was sailing under Finnish flag the lights were "green" when the doors were "open" (which was the normal situation) and "red" when the doors were "closed". To sum it up, in our opinion, it is mandatory to have the accessible objects brought up and to examine the other items on site respectively tape them on video.

IV. The book "Katastrofen Kurs" by Anders Jörle and Anders Hellberg

We have read this book with great interest. We gather therefrom that it is now public and undisputed knowledge in Sweden that the ramp was untight and that the technical managers and part owners of the vessel knew this positively. After they had allowed the visor to become untight they also allowed the vessel to sail with the only forward closure of the cardeck being untight as well. As will be shown later this is the root of the catastrophe.

V. Finally, we would like to bring to your attention further investigation results in addition to those reported to you already in our previous letters. These are:

A. Visor 1.

- Deformation / Misalignment / Non-Watertightness / No Firm Connection Vessel-Visor 1.1. Hinge plates*
- 1.2. Stempost
 - 1.3. Missing rubber packings
 - 1.4. Old damages

2. Locking devices

- 2.1. Atlantic lock
- 2.2. Hydraulic sidelocks
- 2.3. Manual sidelocks

3. Hinges

4. Visor lugs of Hydraulic Lifting Cylinders (Actuators)
5. Inner Bulkheads
6. Conclusion 1-5

B. Bow Ramp**7. Deformation/Misalignment/Non-Watertightness**

- 7.1. Port outer hinge / bearing
- 7.2. Locking bolts
- 7.1. Leakages/Gaps
- 7.4. Conclusions

C. Cardeck / 1st Deck

- 8. Penetration of Water
 - 8.1. Scuppers
 - 8.2. Lifts / Doors / Sills

D. Summary of Observations made by Passengers and Crew on different Decks**E. Sequence of Events****In detail:****A. Visor****1. Deformation / Misalignment / Non-Watertightness / No Firm Connection Visor/Vessel**

1.1. Hinge plates Examination of the remains of the visor hinge plates at KTH, Stockholm revealed a/o that - the starboard hinge plates have deep burning marks from which numerous cracks (fatigue) had started and penetrated the material to varying extent. - the port hinge plates have a smooth surface with slight indications of burning marks in some restricted areas only. - measurements of the closest distances between the vertical plates to which the hinge plates are welded and the hinge plates revealed that this distance is 10-12 mm smaller at Starboard side compared to port side. This leads to the conclusion that the burning action has destroyed 10-12 mm of the hinge plate material of the Starboard hinges which, however, remained at the port side hinge plates. Consequently the visor was misaligned by the distance of 10-12 mm. Evidence: Report of Prof. Hoffmeister, Photos.

1.2. Stempost The stempost was originally the strongest part of the visor - 200 mm wide and 60 mm thick - and formed the forward lower support, taking the major part of the design load of 55 ts, thereby resting on the upper extension of the ice-stem being the forward part of A-Deck, thus there was steel to steel contact. According to the initial design the stempost was supposed to carry at least 80% of the weight, whilst the 2 compression bars fitted on A-Deck and the (intact) rubber packings took the remaining weight. Due to this distribution the bottom of the visor was pressed into the rubber packings some 8-10 mm - as long as they were in place - thereby assuring watertightness. Between the top of pyramid on A-Deck and the pocket into which it fitted there was a design play of 50 mm, to the side just of 3 mm. As long as the visor had its original shape and geometry there was no steel to steel contact between the inside of pocket/pyramid nor between bottom of visor/A-Deck. Upon investigation in Hangö it was noted that the stempost was broken practically in 4 parts the lowest of which had disappeared well before the casualty, leaving a gap in the bottom of the visor. Due to the missing part of the stempost as well as the cracks sustained therein the stempost could no longer carry the main weight of the visor which was now taken up by the pyramid/pocket and the forepart of the visor bottom, which in turn led to cracks in the welding seams already some time before the casualty. Furthermore, the changed weight distribution caused additional stress on hinges and locking devices and added to the misalignment of the visor as a whole.

Evidence: Report Prof. Hoffmeister, Photos.

1.3. Missing rubber packings It is evident from the underwater videos and demonstrated by several photos that the rubber packings on A-Deck were either missing or damaged with very few exceptions, whilst the flat bar and holding bolts, between which the rubber packings were fitted, are obviously undamaged and in place. The same refers to the holding bolts fitted by the crew when the vessel was still "Viking Sally". Consequently, there was nothing to prevent seawater from entering the visor inside once the outboard level was rising above A-Deck. The rubber packings were not just gone on the A-Deck but also in the most crucial areas in front of the 2 bulkheads at both sides of the ramp opening, i.e. of the vessel, where they are missing about 2 m upwards of the bulkheads. This is exactly the area where they are most required, i.e. on A-Deck in front and about 1 m up the bulkheads, because intact rubber packings, in particular in the above-mentioned locations, not only seal the visor inside against water ingress but are also a relevant part of the visor's closing system, because only the counter pressure of intact rubber packings against the closed locking devices assures a firm connection between visor/vessel and prevents vibration of the visor at sea. The lack of rubber packings in most relevant areas did not permit this firm connection between visor and vessel and the visor therefore vibrated within the existing play, which created the 'banging noises' heard by many passengers not only on the casualty voyage but also before. Needless to say that these movements of the visor created undue further stress on the locking and holding devices.

1.4. Old Damages There are 2 severe damages having existed before the casualty, viz. - in front of the visor between bottom and up the 2nd stringer level, and - in way of the 3rd stringer port side, which is bent upwards with bent and buckled frames/brackets. These damages have doubtlessly affected the geometry of the visor and led - in addition to all the other explained circumstances - to additional misalignment. Details have been explained in previous letters.

Evidence: Report Prof. Hoffmeister, Photos.

2. Locking Devices

2.1. Atlantic Lock Examination of the remains of the 3 lugs fixed to A-Deck, now at KTH, Stockholm, revealed that up to 90% of the welds between lugs/bushings were *fatigue* cracked and the load carrying capacity reduced respectively. The starboard lug with the support bracket is not original, the welds between lug/bushing, bracket/bushing are repair welds made when the starboard lug/bracket was fitted to A-Deck.

Evidence: Report Prof. Hoffmeister, Statements of Yard welders, Photos.

To test the load carrying capacity of the Atlantic Lock a mock-up was built by Meyer Werft with original dimensions, except for the welding seams between lugs/bushings which were dimensioned just 3 mm - as found at the lugs recovered from the vessel (original 7-8 mm) - upon request of Klaus Rahka/VTT. The breaking test performed by the Institut für Schiffbau of the University, Hamburg - Professor Petershagen - in the presence of Tuomo Karppinen and Klaus Rahka/VTT-Helsinki revealed that the visor lug broke at a load of 210 ts. Subsequent examination by Prof. Hoffmeister revealed that the bolt (ST 52 steel) was slightly bent, that Starboard and centre lugs were slightly bent apart but the welding seams - although just 3 mm - showed no cracks at all.

Evidence: Report, Video film, Photos from Institut für Schiffbau, Hamburg, Report Prof. Hoffmeister

2.2. Hydraulic Sidelocks

We have nothing new to report, but would like to have the parts available at KTH to be examined by Prof. Hoffmeister for fatigue cracks.

2.3. Manual Sidelocks

These additional securings - called "heavy weather securings" by Bureau Veritas - were not - as we all know - engaged. We are aware of the statement of Ulf Hobro at our first joint meeting on 16.2.95, namely that these locks were only engaged when other parts, e.g. the hydraulic cylinders, would be repaired in port. Therefore it might be helpful to draw your attention to the statement of the 2nd engineer Peeter Tüür taken on 3.10.94 by the Tallinn police, in which he testifies that he was the responsible engineer for watertight doors and the hydraulic arrangements of the visor. He further stated that the visor has 5 fixing points and that there were 2 manual bolts which the boatswain has to engage. Evidently Peeter Tüür knew that these bolts had to be engaged, thus it follows logic to assume that at least the nautical officers and the boatswain - if not the technical inspector - knew it.

Evidence: Statement of Peeter Tüür taken on 3.10.94 by Tallinn Police, Report about Joint Meeting International Commission/ German Group of Experts - 15/16.02.95

3. Hinges at Stockholm

(a) Examination of the recovered steel bushing with part of the visor hinge plate still attached to it revealed a/o that - the gap between bushing and hinge plate is some cm wide; - the material accumulated at one side and extending into the gap is apparently welding material; - in the remains of the welding seams between bushing/visor hinge plate small burning marks can be seen. This leads to the conclusion that the gap must have existed prior to the casualty as otherwise the material could not have gotten into it.

(b) A video film made a couple of days before the casualty by a passenger shows the Starboard hinge in detail. It is obvious that - there is a wide gap between the outer hinge plates of vessel/visor in a location where normally the inner part of the steel bushing and the distance ring should be; - the outer securing plate is missing, although 3 bolts can be seen sticking out of the bushing; - the outer part of the bushing appears to be disproportionately large; - the lower part of the bushing at the outer side appears to be missing completely. **Note:** The relevant part of the video film will be analysed by a professional analyst and the result will be submitted to you in due course.

(d) Examination of the remains of the 4 visor hinge plates at KTH, Stockholm revealed a/o that - the 2 Starboard and the inner port hinge plates are straight; - the lower part of the port outer hinge plate is bent to port. According to Prof. Hoffmeister this leads to the conclusion that the port outer hinge broke last when the visor was in a position to the port side of the centre line of the vessel.

Evidence: Report of Prof. Hoffmeister Report of Brian Roberts Photos / Computer drawing

4. Visor lugs of Hydraulic Lifting Cylinders (Actuators)

After the failure of the hinges the visor moved forward and the lugs underneath the visor arms were cutting through the 8 mm deck plating, but only for 120 mm, then they hit the rather strong transverse deck-beam. According to the estimate of metallurgists it took any time up to 10 minutes for the lugs to cut through this strong beam. The condition can best be demonstrated by the photo below showing the void space on B-Deck Starboard side with closed visor.



B-Deck starboard side pre-casualty condition When the lugs were working their way through deck and deck beam whilst the visor was moving forward/aft naturally deep scorings were sustained by the lugs. Assuming that the vessel was still in an upright condition - which is part of your scenario - these scoring marks would be more or less of similar intensity at the outer as well as at the inner lug plates. This, however, is not the case as can be clearly seen by the photos below.



The above photo shows the *outside of the port lug* with evidently no or only minor scratches.



The ***port inner side***, however, which is shown on the above picture, evidently sustained very deep and sharp scorings indicating severe pressure from port to starboard and straight as drawn by a ruler. The following picture shows the ***inner side of the starboard lug*** - practically the counter-part to the port outer side - with some deep scorings at the upper part indicating more of a circular movement.



The picture below finally shows the outer side of the starboard lug - practically the counterpart of the severely scored inner side of the port lug - indicating also severe pressure from port to starboard side, though apparently not as heavy as at the port lug inner side. The cut area through the green painted forecastle deck is clearly visible and straight as if drawn with a ruler.



The above pictures lead to the following conclusions:

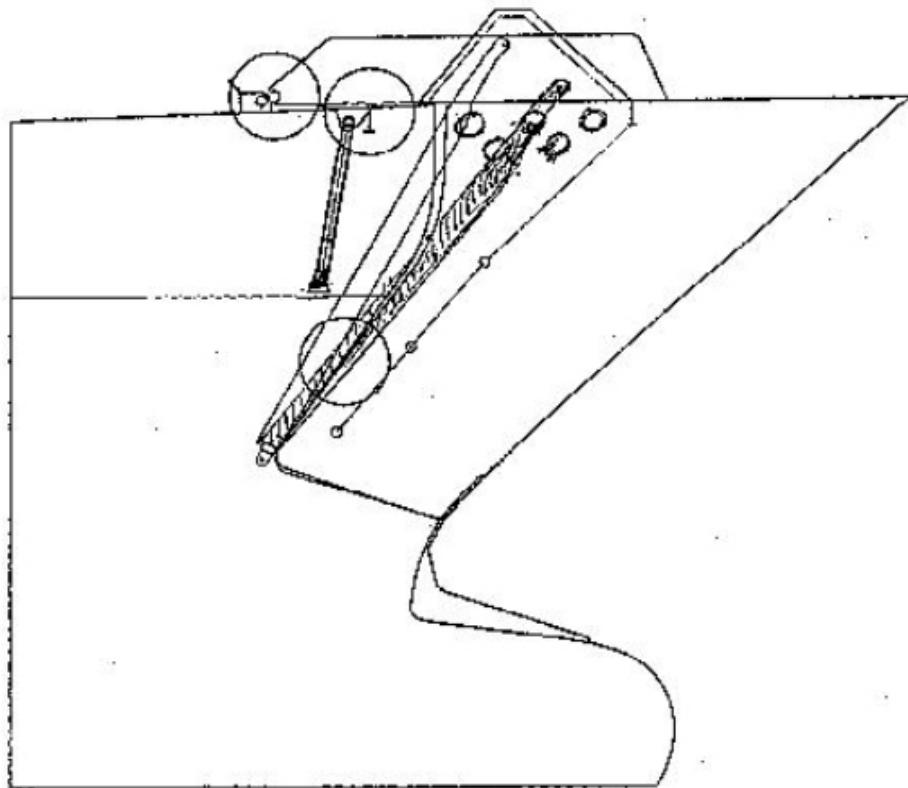
- The scorings at the lugs can only have been caused when the lugs were cutting through deck/deck beams.
- Contact between lugs and deck/deck beams is only possible after the hinges have failed.
- The much deeper scorings at the port inner side respectively starboard outer side compared to the port outer side and the starboard inner side indicate severe pressure from port to starboard.
- This leads to the conclusion that the vessel listed already to starboard when the hinges broke and the lugs commenced their cutting work.
- Since it took some 10 mintues for the lugs to cut through the deck beam and thereafter another 360 mm of deck plating had to be cut before the aft side of the ramp-house could have come into contact with the ramp, however, there are only very minor scratches at the outer side of the port lug plate, it has to be concluded that the vessel must have already had a considerable starboard list while this cutting work was in progress.
- Furthermore, bearing in mind that there had obviously only been sufficient contact between these frames (at port side of the inner ramp house in way of the first 4 frames) and the port side of the ramp to overcome the ca. 40 ts holding power of the port ramp hook, the question arises what force opened the starboard ramp hook (if it had ever been closed), because the minor indentation and mainly only light scorings decreasing from port to starboard at the inside of the ramp house do demonstrate
 - a.) that there was only very minor contact between the larger part of the upper ramp and the ramp-house between the 5th frame counting from port side and then decreasing to the starboard side, and
 - b.) that the visor at the time of contact, i.e. when the port frames were bent and the starboard ones only scored, must have been in a condition shifted to port as it had already been when the last hinge plate, i.e. the port outer hinge plate, broke.
- In other words, it can be concluded that when the ramp-house finally came into contact with the upper part of the ramp the vessel had had a very substantial starboard list for some time already and the visor had been in a condition shifted to port of vessel's centre line.

5. Inner Bulkheads

The same as can be observed from the lugs underneath the visor arms is confirmed by the damage/scorings to the port inner bulkhead, whilst the opposite starboard side is completely untouched with absolutely no contact marks. The 2 pictures below show the inner side of the visor bulkhead with deep scorings/indentation and the holes partly torn.

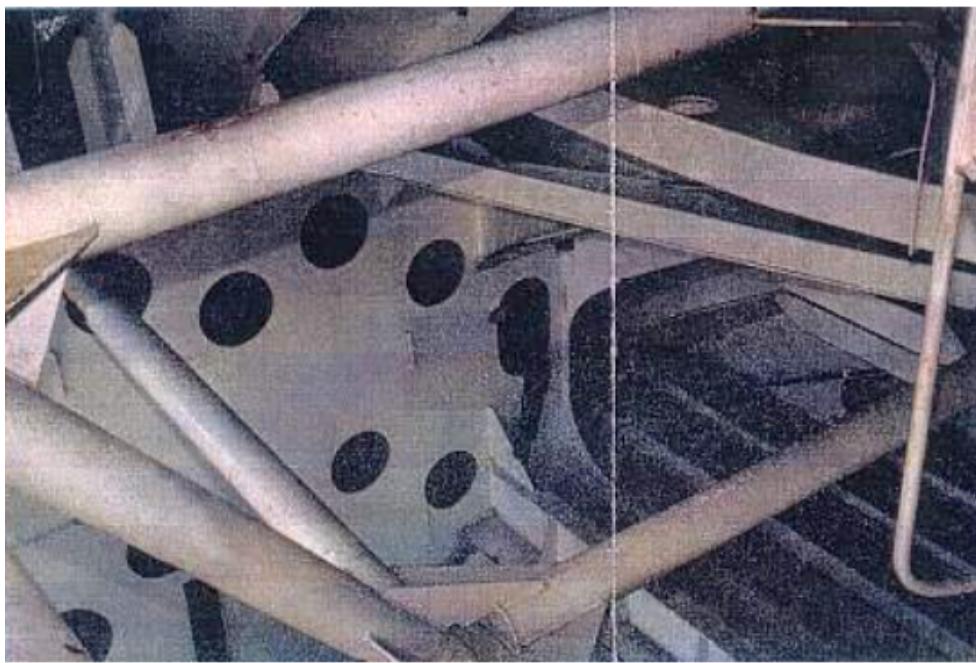


The ramp is at that stage already partly pushed open whilst the visor is resting in way of the obvious contact area on the ramp. The partly open ramp is thus preventing the visor from falling off to starboard. The sketch below shows the approximate situation at this particular moment. The foundation of the port actuator is still inside of the vessel's front bulkhead, although already broken loose from B-Deck.



Of course, the side view cannot demonstrate the severe list which the vessel must have already had at that time.

The following 2 pictures show the starboard inner bulkhead totally without damage or even scorings/scratches.



6. Conclusion

1-5 In summary of item A.1-5 the following further conclusions can be drawn:

- The visor was also misaligned due to improper burning at the starboard hinge plates.
- The stempost was severely damaged and had lost its main weight carrying function nearly totally. This led to additional misalignment of the visor in combination with additional stress on hinges/locking devices. The gap in the stempost area in connection with cracked welding seams has led to flooding of the visor inside up to outboard level.
- The missing rubber packings had, in addition to the a/m gap in the stempost and cracked open welding seams, also resulted in a rapid flooding of the visor inside due to the so-called pumping effect.

- The firm connection between visor/hull of vessel normally established by the combination rubber packings/visor weight/tension of locking devices was lost due to the missing rubber packings in relevant locations which led to movements of the visor at sea within the existing play and additional stress on hinges/locking devices. The movements of the visor created the low banging noises heard by passengers on previous voyages as well as on the casualty voyage.
- At least the 2 most severe old damages in the visor had led to additional deformation and misalignment.
- The Atlantic Lock arrangement at vessel's side was weakened due to improper repair and fatigue cracks in the welds between lugs/ bushings of up to 90% of its initial load carrying capacity.
- The 1st breaking test performed by the "Institut für Schiffbau", Hamburg revealed that the visor lug broke at 210 ts load whilst deformations of the bolt and the starboard and centre lugs were minor. The welds, however, showed no cracks at all, although just 3 mm strong. This leads to the following conclusions:

- (a) The arrangement failed at 210 ts which is more than double the design load of 100 ts.
- (b) The arrangement at vessel's side with even weaker welds than having existed at the initially installed Atlantic Lock - withstood 210 ts, i.e. is able to carry more than 210 ts.
- (c) According to the damage picture found on "Estonia" the lugs at vessel's side broke, whilst the visor lug withstood, although stretched and bent. This leads to the conclusion that the Atlantic Lock arrangement at vessel's side must have been substantially weakened - as found by Prof. Hoffmeister - and thus failed at some load below 210 ts.
- (d) The Atlantic Lock arrangement which was installed on "Estonia" at the time of its failure can in no way be compared with what had been installed by Meyer Werft on the newbuilding "Viking Sally". Its load carrying capacity was substantially reduced.

Note: Three further breaking tests were performed by the "Institut für Schiffbau", viz.

- (a) bushings/lugs at vessel's side without any welding connection at all = **result : 100 ts;**
- (b) bushings/lugs at vessel's side connected with spot welds only (in order to simulate as closely as possible the condition existing at time of casualty) = **result : 142 ts;**
- (c) bushing/lugs at vessel's side with 3 mm welds connected as found at the lugs having been installed at the time of casualty/visor lug over-dimensioned to make sure that the lugs at vessel's side break, bolt ST90 (as has been at the previous tests already) = **result : 220 ts.**

As the breaking occurred with no **welds at all at 100 ts** and with **3 mm welds at 220 ts** it can be concluded that **1 mm welding seams corresponds to a load carrying capacity of 40 ts**, i.e. the initially installed lugs/bushing with 7-8 mm welds had an LCC of $7 \times 40 \text{ ts} = 280 \text{ ts} + 100 \text{ ts} = 380 \text{ ts}$. Based on the test results of VTT, Helsinki the break-load of the starboard side lock was found to be **178 ts**, whilst the port one was found to be only **131 ts**. In addition, the **2 manual sidelocks** would have produced about **50 ts each**, i.e. 100 ts. In summary it has to be concluded that at the time the vessel was delivered to her owners there was an LCC of in total **789 ts~800 ts** available which fulfilled all requirements having then been in force.

- The manual side locks were not engaged, although they should have been according to 2nd Engineer Peeter Tüür and Bureau Veritas.
- The starboard visor hinges were substantially predamaged. This is not only demonstrated by the remaining parts available at KTH, Stockholm, but also by the video film made by a Swedish passenger a couple of days before the catastrophe.
- The different damage pictures of the lug plates underneath the visor arms, i.e. the scratches/scorings at the inner and outer sides can only have been developed when those lug plates were cutting through deck-plating/deck-beams. Such cutting was only possible when the hinges were broken and the visor moved forward. The port outerside plate just shows some minor scratches whilst the port innerside plate is very deeply scored, indicating load from port to starboard. A similar picture is shown on the starboard lug plates where the outerside is much more deeply scored than the inner side. This is clear evidence that the visor's weight was lasting from port to starboard and this cannot be explained with the waves coming from port, because when the hinges broke wind/sea were already coming from straight ahead (statement V.Kikuts), whilst the vessel was turning further to port (statements Hillerström and Jonsson). The deep indentations/scorings at the port inner longitudinal bulkhead of the visor which were created when the visor was resting on the ramp, support this assumption as at the opposite side - the starboard inner longitudinal bulkhead - there is not even a scratch. There are more marks/indentations/ scorings and scratches pointing in the same direction, but the a/m should be enough for now. From the above it has to be concluded that the hinges broke when the vessel already had a considerable starboard list which triggered off the catastrophe sequence-of-events and must have been caused by something other than the bow ramp being pulled open by the visor. As will be explained in the following water entered the cardeck not only from the full visor through the damaged bow ramp, but also through the ventilation openings and subsequently through the scuppers with non-functioning non-return valves.
- At the time of the hinges breaking and contact between ramp/ramp-house the visor was in a condition shifted to port of vessel's centre line.

B. Bow Ramp

We would like to begin this section with some statements made by crew members to journalists on the day of their survival, the 28th September, 1994, after they had just been brought to safety:

- (a) On 28.9.94 at 12h33 the following was published: "The 2nd engineer of the ship has been rescued and in an interview he said that the front "car gate" was defective and had let in water."
- (b) On 28.9.94 at 15h57 the following was published: "According to an Estonian machine operator, Henrik Sillaste, who

managed to escape from the ship through a funnel, the gate of the cardeck was for some reason slightly open and water came to the deck through it. The body of water, weighing many tons, that got inside the ferry made it very unstable, and the wind and the size of the waves (according to the reports as high as 10 metres) were enough to push the ship to its side."

(c) On 29.9.94 Reuter published the following: "The cause of the accident has not been determined. Henrik Sillaste, a surviving member of the crew, said he saw water pouring in through the bow gate shortly before the vessel capsized off the Finnish coast Wednesday morning. When the water was knee-high on the cardeck the engines stopped. The boat listed to its side and sank. Sillaste said he thought it was rain and wave water entering the ship because one of the two bow gates was not properly locked."

As the above statements were made only a few hours after the crew members had survived the catastrophe and were still under the impression of what they had gone through during that night, and as they were made totally without the later influence from shore people, these statements have to be considered true, no matter what the respective person might have stated subsequently. As a matter of fact, there is more evidence in respect of "the front gate was defective and had let in water" and "the gate of the cardeck was for some reason left slightly open and water came to the deck through it", because 2nd engineer Peeter Tüür stated on 3rd October 1994 to the Tallinn Police among other things, "... behind the visor there is the ramp. It shall also be hermetically tight! You find just a few spots where the ramp is not hermetically tight." Meant is certainly the gap or gaps created by the twisted port outer hinge with broken bearing which had been put by the crew repeatedly (your words) on repair lists, however, repairs of which were obviously deferred by the management possibly until the next scheduled time in shipyard. In the book "Katastrofen Kurs" Anders Hellberg and Anders Jörle mention in this respect on page 76, top a/o: ".. But let us first turn to the damage to the ramp which according to N&T was taken up in the list of repairs to be carried out. Already here a fact is found which no normal classification society should accept: There was practically a damage to which in practice was the collision bulkhead of the vessel, but which was just put on the list for repairs to be carried out." As stated above this is obviously undisputed public knowledge in Sweden!

7. Deformation / Misalignment / Non-Watertightness

7.1. Port outer hinge/bearing It has to be assumed that this hinge became twisted when the vessel had a list to starboard in excess of 2°, which was not adjusted before the loading or discharging of trucks commenced and the damage occurred when one or more heavy trucks drove over the ramp. This seems to be a risk well known to ferry operators. The hinge became twisted and the bearing broke, which was most probably only noted by the crew when the ramp could not be closed before departure because the port side had sunk down somewhat. To rectify this some piece of steel was hammered underneath the bearing to keep the ramp closest possible to its upper normal position. Obviously it was thereafter possible to open/close the ramp, however, some gaps remained, i.e. the bow ramp = upper extension of collision bulkhead above freeboard deck = was not watertight anymore, or to use the words of 2nd Engineer Peeter Tüür: "no more hermetically tight", because it was deformed and misaligned.

The temporary repairs can best be seen from the photo below made from one of the underwater video films. The steel piece underneath the bearing can be clearly seen. The ramp was kept in approximately normal position as far as up/down is concerned, however the forward deformation could not be corrected by that.



7.2. Locking bolt

In addition to the 2 hooks at the upper part of the ramp, there are at each side 2 hydraulically operated and conically shaped locking bolts which moved from vessel's side into pockets at the ramp side, thereby increasing the pressure of the ramp on

the rubber packings. The 2 starboard bolts and the upper port bolts apparently still had been able to move into their mating pockets, because these pockets were found to be torn open after the casualty. The port lower bolt, however, could not move into its pocket due to the deformation of the ramp in forward direction.

7.3. Leaks / Gaps

As a result of the above there were substantial leakages around the ramp to the large cardeck.

- at the port lower corner about 1,5 m upwards and about 1,5 m athwartships;
- at some locations at the opposite starboard side of the ramp. As at sea there was always water inside the visor up to the outboard level - the picture below shows the normal height - something had to be done to avoid major water ingress on the cardeck.

As the owners/technical managers were obviously not prepared to take the vessel out of service for the required time to permanently repair this damage and on the other hand major water ingress to the cardeck had to be avoided by all means, the crew sealed the existing leakages both from visor side - see picture below - but also from cardeck side. This was frequently observed by truck drivers and other passengers.

Note: According to a previous crew member it was known to those responsible since March 1994 that there were substantial leakages in the bow ramp and that there was always some water on the cardeck.

Needless to say that such method to secure watertightness of the upper extension of the collision bulkhead of a passenger vessel is unacceptable and totally useless against a water column of about 6 m in the visor

7.4. Conclusion

In summary of this Section B it has to be concluded that

- the bow ramp - being part of the upper extension of the collision bulkhead - was damaged to such an extent that there were substantial gaps/leakages between the inside of the visor and the cardeck;
- the port lower securing bolt could not engage its mating pocket at the rampside incl. the sensor for the indicator lights (in consequence neither on the bridge nor on the cardeck panel could be "green" indicating ramp closed and secured).
- the cardeck was open to the water quantities inside the visor which would have been disastrous for the stability of the vessel already long before the catastrophe. To avoid this the crew plugged the leakages from visor as well as from cardeck side, which might have been partly successful during normal trading, but was ineffective against the pressure built up in the visor on the night of 27/28.9.94.

C. Cardeck / 1st Deck

8. Penetration of Water

8.1. Scuppers

We assume that there had always been some water on the cardeck since March 1994, the quantities of which certainly depended on the height of the water level inside the visor, which, in turn, depended on the sea condition. In other words, the worse the weather and seastate were, the higher the water level was inside the visor (and the more violent was the water movement inside the visor) and the heavier was the water pressure on the "seals" in the leakages, the more water penetrated these "seals" onto the cardeck. All this was well known to a number of crew members and the technical managers. In order to cope with the water on cardeck which, due to the more or less permanent stern trim, quickly ran to the aft part, some or all scuppers were constantly open. We assume that the remark made by Äke Sjöblom to a journalist when he was interviewed on the 28th September, 1994 about his findings onboard the "Estonia" on the 27th September, 1994 has to be understood in this respect. He said: "We went down to the cardeck and experienced a lack of respect for loadline matters, and when we say this and we discussed it with the Chief mate, we said we don't understand how come that this hatch cover is open here? It has always to be closed and it has not been closed for the last 1 or 2 years, and so on. I think it was in 2 or 3 places." In the subsequently drawn up "Report of Inspection in Accordance with the Memorandum of Understanding on Port State Control" signed by him in Tallinn on 27th September, 1994 Äke Sjöblom has a/o noted:

"1250 Covers on bulkhead deck to be closed."

Convention reference: LL66, C II-1

Action taken: 17 = to be rectified before departure"

You know certainly much more from him as you have no doubt spoken to him in detail. In any event he certainly does not know in what condition the scuppers and other openings on bulkhead deck = cardeck were, when the vessel departed from Tallinn.

8.2. Lifts / Doors / Sills

There are 4 lifts inside the centre casing with openings to the cardeck

- in the forward part a person-lift which goes via 1st Deck down to 0-Deck (swimming pool/sauna);
- in the middle part a person-lift which ends on 1st Deck. Both lifts have only 100 mm sills on cardeck level (the cardeck doors have 230 mm sills). In addition there are 2 big store lifts further aft down to the provision/ store area on the 1st Deck which have no sills at all (suitable for forklift). It is thus possible for water to run from the cardeck through the lift casings into 0-Deck (most forward lift) and straight into the 1st Deck (deck below cardeck) into the accommodation area as well as in the provision area. Whilst we have no evidence that there was water in way of the provision area (although we assume that there was), there is a lot of evidence that there was water in the accommodation area of the deck below cardeck and on the cardeck at a time when the bow ramp was still only slightly open, i.e. before the major starboard list commenced. The

quotations below are part of the statements of passengers having been in cabins below the cardeck. These statements were taken by the criminal police soon after the rescue.

Antti Arak: cabin 1056 - 21 years "At first I heard screaming and **then I saw water running in the alleyway.**"

Ain-Alar Juhanson: cabin 1056 - 18 years (at Turku 29.9.94). "Whilst I slept I heard a heavier bang which I had heard before already, but not so heavy. After that bang the vessel suddenly listed to starboard. All 4 of us woke up, grabbed our clothes and **jumped into the alleyway, where we noted water.**"

Martin Nilsson - cabin 1027 - 22 years. - he left the cabin and jumped up one flight of stairs to the next deck (cardeck), **there was some water on the bottom - some cms.**

Bengt Nilsson - cabin 1026 - 35 years. - He opened his door and saw Martin Nilsson jumping past him.

- When he reached the deck above (cardeck) **he saw water coming from wall and streaming over the bottom and walls. It was rising.**

- He stated also that he saw something **along the walls which looked like some powder.**

Carl Övberg - cabin 1049 - 42 years.

- he knew his way up and when he **passed the cardeck, he saw water penetrating.**

Note: This was at a time when the first - slight - starboard list had just occurred, i.e. before the sudden port list at 01h02.

Carl-Erik Reintamm - cabin 1094. - ca. 23h00/23h30 in bed;

- suddenly he heard **2 heavy, strange scraping noises** which apparently came from below;
- he felt also that the **cabin was tilting**, but just a little bit;
- he opened the door and **saw a small stream of water behind one alleyway wall on the floor;**
- vessel had only a small list at that time;
- he rushed up and reported to 2 crew members that he had seen water in the alleyway downstairs, whereafter both rushed down;
- the vessel listed more and more.

Taavi Raba - cabin 1070 - 21 years.

- when he left his cabin (after the first list) he **had to jump through a water curtain (wall)** to reach the stairs;
- when he passed the **cardeck doors he saw water penetrating.**

Jaan Stern - cabin 1122 - 53 years (Estonian)

- most forward cabin directly adjacent to the water ballast tanks;
- was in cabin which he had to leave, **because water was already entering the cabin.**

Holger Wachtmeister - cabin 1047 - 41 years. -

- he was awakened by **a scraping noise and a hard bang - the scraping noise continued;**
- he got up and dressed and left the cabin when the list started;
- **he noted water when he passed cardeck possibly already below in front of his cabin.**

Jasmina Weidinger - cabin 1027 - 19 years

- . - she was also hearing the noise of the stabilisers which held the vessel steady when she suddenly heard **a murmuring noise.** The noise, which she had not heard before, was low in its intensity. It appeared to her that the **murmuring sound came from above and it appeared to her as if water was running very slow**
- she looked at her watch; - this was at 24h00 (Swedish time);
- a little later she heard a heavy sound above the cabin ceiling;
- she got the impression that something large and heavy was moving from one point to the other;
- after these heavy scraping noises the vessel took the first list;
- Daniel jumped out of the cabin and shouted **that there was water in the alleyway;**
- **she also saw that water trickled out on the floor before her cabin.**

All cabins are located on the 1st Deck at starboard side, i.e. the deck below cardeck, with the exception of cabin 1056 - which is located at port side but directly at the midship alleyway next to the 3rd stairway (from forward) leading down from the cardeck - all other cabins are located at the starboard side. In the same connection has to be seen the conversation between Security Officer Ervin Rhoden and an unknown man in Estonian language held in Södersjukhuset Hospital on 28.9.94, which was overheard by Paula Liikamaa (casino employee). Paula testified to the police: "The watchman whose 1st name is Ervin and surname is Rhoden said that he had switched on his walkie-talkie when he was in his cabin, when he heard another watchman - Silver Linde - say over his walkie-talkie that he was on the cardeck and that there was a lot of water on the cardeck and that they must leave the vessel." As Ervin Rhoden with absolute certainty did not listen to any walkie-talkie communication after 01h02 when the abrupt and severe port listing occurred it must have been before that time, i.e. this is another indication that Silver Linde was on cardeck before 01h00 when there was already a lot of water.

In summary of the above quoted extracts from statements taken by the criminal police of Finland, Sweden or Estonia shortly after the casualty it can be concluded with sufficient certainty that at the time when the vessel took the first major starboard list, there had already been so much water on the cardeck that

(a) it was able to flow over the 100 mm sills of the person-lift, run down the casing to the 1st Deck, fill the deepening below the lift and fill part of the alleyways between the cabins at starboard side, partly already penetrating into the cabins;

(b) it was able to flow over the 230 mm high sills of the cardeck doors and was rising inside the centre casing on cardeck level, simultaneously flowing down the stairs to the deck below (water curtain).

D. Summary of Observations made by Passengers and Crew on different Decks

In order to get as close as possible to the most probable sequence of events we have carefully analysed the statements of passengers and crew members made to the police shortly after their rescue. The various statements of Silver Linde have not been taken into account.

Deck 8 : In the fore part were the accommodations of Master and Chief engineer as well as the owners cabin, which was occupied by one of the Stockholm pilots with his family. The Master and Chief engineer and the Stockholm pilot with his family are missing. In the aft part are some crew cabins and the day-rooms of officers and crew. After the first heavy list to starboard one crew member looked out of one of the windows at starboard side of the dayroom and saw "another ship in the sky".

Note: This must have been "Silja Europa" then already abeam.

Deck 7 : This is the main accommodation deck for the crew with 4 cabins in front of the superstructure which were used as follows: (from starboard to port)

1st cabin starboard side: Economy superintendent Jan Bergendahl (did not survive)

2nd cabin starboard side: Technical superintendent Tomas Rasmusson (not onboard)

3rd cabin starboard side: Chief mate Juhan Herma (did not survive)

4th cabin starboard side: 1st Engineer Arvo Tulvik (did not survive).

The windows of these cabins were overlooking the foreship and it has to be assumed with certainty that the Chief mate and the 1st Engineer did look out of their windows probably already after the first severe bangs at 00h45/50 and at that time apparently saw nothing, therefore it has to be assumed that the visor hinges and locking devices were not yet broken at that time and that the visor was still in place, because otherwise they would have alarmed the bridge already at that time and would have commenced action much earlier. Consequently the bangs heard at 00h45/50 must be connected to something different breaking, e.g. the bow ramp. About 10-15 minutes later, i.e. shortly before 01h00 or at 01h00, also the visor hinges and side locks broke and the visor moved forward/aft and somewhat up and down within the 120 mm space between the fore part of the actuator-lugs underneath the visor arms and the strong athwartships deck beam at frame 159. Each time the visor had moved forward a gap of 100-120 mm opened athwartships and water from the inside of the more or less full visor splashed out in cascades and subsequently surged in depending on the movements of the vessel. This was observed by Valter Kikuts, the deck passenger sitting with his friend behind the windows at port side in the stairway on 7th Deck, i.e. directly next to the cabin of 1st Eng. Arvo Tulvik and before the cabin of 2nd Eng. Peeter Tüür. Kikuts has stated to have seen this gap opening/closing already at 00h36 which appears to be impossible, 00h56 is the more likely time. In any event it was obviously seen by 1st Eng. Arvo Tulvik already before or immediately after the 1st heavy listing to starboard, i.e. at about 01h02. He had apparently left his cabin and walked aft when 2nd Eng. Peeter Tüür opened his cabin door and Arvo Tulvik said to Peeter Tüür: "Apparently the visor broke up, would be good if the vessel would be beached." This was also heard by the Reefer engineer Andres Verro, who left his cabin at the same time. Based on the apparent fact (see statement Mikael Öun and many others) that the 1st severe starboard list occurred at 01h02, Arvo Tulvik must have made his observation before that time, i.e. probably at some minutes before or at 01h00, as it is most unlikely that the 1st Engineer would have stayed in his cabin much longer than a couple of minutes (to phone the bridge knowing that they can see only the tip of the visor and his boss, the Chief engineer one deck above him, who as well as the master can see from their cabin windows nothing at all of the visor, finally to get dressed and leave the cabin). That's when he met Peeter Tüür and Andres Verro.

Consequently it has to be considered an established fact that the visor hinges and side locks broke at 01h00 or some minutes before.

Next relevant observations made / noises heard by crew-members and passengers shall be summarised as stated below:

2nd Eng. Peeter Tüür:

- woke up by things moving around in his cabin
- had heard before metallic bangs apparently caused by objects hitting against each other
- thought the noises came from badly secured lifeboat or **that the visor had gone loose;**
- **felt that the speed was reduced** and that there was a starboard list of about 30°;
- opened the cabin door and met the 1st Engineer Arvo Tulvik who said: "**Apparently the visor broke up, would be good if the vessel would be beached.**"

Note: The cabin of 1st Engineer Arvo Tulvik is on 7th Deck, port side, in front of the accommodation. From the window he can overlook the foreship with visor. The above remark from Arvo Tulvik was also heard by the Reefer Engineer Andres Verro (see his statement).

- Next he heard "Mr. Skylight 1 and 2", which means according to Peeter Tüür's understanding: "Fire Alarm", the 2 fire-fighting teams had to go to their stations
- he was No. 1 of team No. 1 and his station was on the 8th Deck - port side;
- he went back to his cabin, picked up walkie-talkie and flashlight, left via window (due to the list) and went to Deck 8;
- at that time he was confident that there was the risk that the vessel might sink;
- heard on his walkie-talkie that the Information Desk tried to reach the bridge, but got no answer;
- he tried it himself but also got no answer;

- light went out but came back (auxiliary shut off and start of emergency generator);
 - after 4-5 minutes also this generator stopped - vessel on the side - and thereafter only emergency lights fed by batteries.
- Note:** This was 01h31.

Andres Verro - Reefer Engineer - cabin 710 - 35 years.

- was in cabin;
- at ca. 01h00 was in bed reading a book when the vessel suddenly listed to starboard;
- heard by radio "Mr. Skylight 1 and 2" which means actually "Fire Alarm" spoken by a male voice;
- believes that he heard **before the list** some strange metallic sounds;
- when he left his cabin he met the 1st and 2nd Engineers, one of them said: "Visor went away" (or something like that);
- he got the impression that possibly the fastening clips of the bow ramp had failed and through them water came in.

Aarne Koppel at Turku - 29.9.94 - cabin 7011:

- 5°-10° starboard list, felt it was an unnormal situation and woke up
- heard a low breaking sound;
- at 01h00 - when we got dressed - the vessel suddenly listed to ca. 30°;
- when I was still in the cabin putting on warm clothes the light went out/on several times, that was when the main engines stopped;
- it took ca. 5 minutes from the moment I woke up from the 5° list to my leaving the cabin through the window, which was at the high port side.

Elmer Siegel - motorman - cabin 7007 - 43 years. Statement taken 29.9.94 at Mariehamn:

- was in cabin on 7th Deck aft;
- 3-5 minutes before list started heard noise **like somebody beating against vessel's hull with a large hammer which came from cardeck direction.**

Andres Vihmar - cabin 713 - 7th Deck (cabin is located 20 m aft from front bulkhead)

- 5-7 minutes after 1st listing the list was already 45°;
- when he came to the boat area on 7th Deck port side **Aulis Lee and Aarne Koppel were already there;**
- people were streaming up to the 7th Deck through the open doors for another ca. 5 minutes, thereafter it was no longer possible due to the list and no one escaped anymore from the inside of the vessel.

Note: This means that already after ca. 01h15 it was no longer possible to get out of the inside of the accommodation.

Summary of observations made / noises heard on Deck 7 and 8

a) **Before the starboard list:** 1st Engineer saw visor moving / loose / broken up and various crew members heard metallic noises and as if somebody was beating with a large hammer against vessel's hull which came from cardeck.

b) **After the starboard list:**

- there was a vessel about abeam at starboard side
- probably "Silja Europa";
- speed was reduced and subsequently the engines stopped after the list was 30° or more;
- the Information Desk as well as 2nd Eng. Tüür tried to reach the bridge by walkie-talkie - ca. 01h10/01h12 - both got no reply;
- already after ca. 01h15 it was no longer possible for anybody to get out of the vessel due to the excessive list.



Fax GGoE to Karppinen dated 18.04.96

**The German Group of Experts
Investigating the sinking of M/V "ESTONIA"**
do AHLERS & VOGEL · Schaarler 1 D-20459 Hamburg · Telephone 49-40-371075

FAX TRANSMISSION

TO: Tuomo Karppinen

From: Werner Hummel

Ihr Zeichen/Your Ref.	Unser Zeichen/Our Ref.	Seiten/Pages	Hamburg/Date
	WHMz	6	18th April 1998

Dear Sirs,

re: M.V. "Estonia" - Covering of the Wreck by Concrete

As you know it is the intention of the Swedish Government to have the wreck of the "Estonia" covered by stones and concrete as soon as possible, an attitude which is difficult to understand bearing in mind that

- (a) the final report of the Joint Accident Investigation Commission has now been postponed until September;
- (b) it has to be assumed that the investigation by the above-mentioned commission disregards relevant evidence which is - sofar - still available in the wreck, but would be destroyed forever after the wreck has been covered;
- (c) the cardeck has never been inspected as far as possible in order to prove or disprove that there are 2 trucks with Cobalt as alleged by the FELIX Report and radioactivity, according to Sjöfartsverket (Fransson), has never been measured;
- (d) Bureau Veritas and Meyer Werft are still threatened to being sued in France and/or Germany by the DIS Group of Relatives (Bendreus) if and when additional evidence from the wreck could be demanded by judges/counterparts.

In detail, this Group of Experts is of the considered opinion that the below stated objects should be brought up by divers for examination ashore:

- Both bolts of the visor hinges (in particular the port bolt is of importance, because it is still attached to the steel and brass bushings, and to the steel bushing there is still part of the visor arm with fracture surfaces and welding seams attached), the bolts are very easily accessible.
- Port and starboard side locks; i.e. bolts, lugs and hydraulic cylinders.
- Atlantic Lock: hydraulic cylinder with pipes and piston rods; and parts of the electrical cables to which the sensors were initially attached, the sensor plate.
- About 1 m from the remaining rubber packing from forepeak deck.
- Both locking hooks of the bow ramp (if impossible, to be closely inspected and filmed).
- One or both lifting cylinders of the bow ramp together with their broken connecting parts.

Furthermore, the following objects should be closely examined and filmed on video by divers:

- Bow ramp: port lower securing bolt with mating pocket at ramp side (explanation to be found why this bolt did not engage its mating pocket);
port outer ramp hinge (explanation to be found why this hinge is so severely twisted - contrary to the other 3 hinges - what the steel piece below that hinge could mean and what all the rags and clothings around the hinge area mean, which had apparently been squeezed into some gap or the like).
- Control box: at cardeck port side behind bow ramp, position of levers, buttons, etc. to be established, doors open/closed, as many parts as possible to be dismantled and brought up.
- Hydraulic station in port sidehouse (B-Deck), manufacturer, type, etc. of hydraulic pumps to be established, pressure valve to be brought up.
- Port Sidehouse (B-Deck) open/closed position of hatch leading to bow thruster room to be established, further whether the dogging are workable.

- Port Cardeck: It should be established from outside and inside whether the scuppers are closed.
- Forecastle deck / Front bulkhead: Both cuts created by the lugs of the visor actuators should be filmed in detail including as much as possible from the insides.
- Visor hinge parts at forecastle deck: to be carefully filmed for forward/aft, port and starboard, top and underside.

Detailed examination and evaluation of the above would reveal the condition of relevant parts having influenced the casualty sequence and contributed to and/or caused the catastrophe.

In addition, inspection of the cardeck including measurement of radioactivity could at least give some indications whether there is some truth in the FELIX report, e.g. whether there are actually large quantities of cobalt, etc.

So much for the time being.
As promised we are also attaching our 'Press Release' following the Spiegel / Spiegel TV publications.

Good luck !

Sincerely yours,
For the Germany Group of Experts

Werner Hummel

Best regards,
Werner Hummel

Fax Stenström to Karppinen dated 15.04.96

SHK Statens haverikommision
Board of Accident Investigation

FAX
1996-04-15

From No. **08-737 58 52**
Name: **Gunnel Göransson**

To No. **009358-0-455 0619**
VTT Manufacturing Technology, Maritime Techn.
Attn: **Tuomo Karppinen**
Pages: **1**
(incl this)

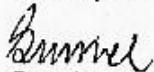
Hej Tuomo!

BILDER FRÅN ESTONIA

Här är vad Börjebett mig meddela dig ang fotografering:

"Har funderat och ser fortfarande att vi skulle ha behov av bättre bilder från skadorna på däcket och frontskottet, inklusiva bilder in genom hålen i fartyget. Dessutom närbilder av de elektriska ledningarna vid lägeskänna vid bottenlåset, speciellt ledningarnas fria ände och framsidan av plåten där lägeskänna sutit monterade.
Skulle jag komma på något ytterligare hoppas jag att det går att improvisera.

Halsningar Börje "


Gunnel

Postadress	Visiting address	Phone	Fax
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Fax Rahka to GGoE dated 05.06.96



MANUFACTURING TECHNOLOGY

Enclosure 39.5.475
TELEFAX

Attention:	Werner Hummel
Company:	MCP
Number:	99049 40 36 21 98

From:	Klaus Rahka	Phone:+358 0 456 6869 fax 7002
Date:	1996-06-05	
Number of page (incl. this page):	1	

Message: Dear Werner

Thanks for Your fax and chat across the phone. I also talked with Prof. Hoffmeister. We seem to share somewhat ideas about the technology and technical motives of testing models of the Atlantic lock. With respect to doing a test including weaker than actual weldments we seem to share an interest toward a test, because that would be the only practical way to find the magnitude of an extreme minimum strength of a lock of this general configuration. As it is now - estimates of minimum strength have only been made analytically, and we see a strong chance that these estimates inevitably produce low values for the strength estimates. The forepeak structure is high quality FE 37-type steel, which thanks to its high ductility could work to even out loads between the three hulls, thus raising the result above that obtainable by calculation only. Technically it would thus be valuable to determine the behaviour of such a structure, because the assumptions underlying the analytical calculations most likely underestimate load sharing between the three hulls. An experiment would be the only reliable way to find out how much this technical minimum is larger than the analytical estimate.

Klaus

VTT MANUFACTURING TECHNOLOGY Operational Reliability	P O Box 1701 FIN-02041 VTT Finland Street address: Kekkolaantie 1, Espoo	Tel. +358 0 4561 Telefax +358 0 456 7002, +358 0 456 7010
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Article in Svenska Dabladet from 08.06.96

Inrikeschef Mats-Eric Nilsson, tel 08-13 51 55, e-post: inrikes@svd.se
 Redaktionssekreterare Katarina Ekspong, tel 08-13 56 25, Henrik Ennart, tel 08-13 57 20, Niklas Kierregaard, tel 08-13 51 54

Rapport om Estonia kan försenas

På tvårdagen i september preskriberas rederiets ansvar för olyckan

• Det finns inga garantier för att havrikommisionens rapport om Estoniakatastrofen blir klar till tvårdagen av förtidningen.

Det säger Olof Forsberg, ordförande för den svenska delen av kommissionen, i en Svd-intervju.

Förfasningen är rapporten blir en beroende för många anhöriga. På tvårdagen preskriberas rederiets ansvar för olyckan, och anhöriga har hädlat att de behöver havrikommisionens rapport för att stämma redet.

Kan inte vänta

– Om det finns en preskriptionstid på två år så kan de anhöriga inte sitta och vänta på vår rapport. Då måste de på grundval av eget material finna in stämningsansöknan, säger Olof Forsberg.

Vår för dröjer rapporten? Från början var det sagt att den skulle komma ett år efter katastrofen. Nu är det osäkert om den blir klar till tvårdagen.

– Man shall komma ihåg att vi i Sverige inte kan påverka allt i kommissionen. Detta är faktiskt en internationell kommission med en enskild ordförande.

– Det är alltid besvärligare



Olof Forsberg

Bakgrund: Skilda slutsatser i tidigare rapporter
 Bogvisiriet låg var underdimensionerat och rampen hängde. Så länge domen över Estonias konstruktion, enligt den internationella havrikommisionens preliminära rapport våren 1995. Låsen brast, växel öppnades och rampen drogs ned. Rampen, tänkt att fungera som ett vattenfall skott, stack närmast upp i väret. Så kunde vattnet flöda in på båtdeck. När det öppna däcket vattenfyllt kunde färjan mycket snabbt. I kommissionens rapport heter det tungt ansvar på det varv som byggde Estonia.

Tyska Meyervervet har dock sin egen havrikommision. Enligt denne hade visserligen gångjärn och lås utsetts för undermåliga reparations. Detta försvagade den ursprungliga strukturen. Dåliga tänningar gjorde att vattnet kunde tränga in genom väret, varpå de försvagade låsen öppnades av olyckas inför. Varvet ansar att redet och kaptenen är ansvariga för olyckan. Redet undanhöll inte båten ordentligt och kaptenen körde henne för hårt.

Estonia förliste 28 september 1994. 852 mäniskor dog, 137 räddades. <svd>

så här man är en kommission med ledamöter från tre länder, så när man är en nationell kommission. Barn en sådan sak som språket ger fördröjningar och komplikationer.

Diskussioner om oredsel

– Texten skall läsas och alla skall vara överens, och det tar tid. Det blir diskussioner om oredsel, särskilt när man skall bedöma mäniskor och mäniskors handlingar – då gäller det att vara aktsam med orden.

Det har sagt att förtidningen skulle beröra på oenighet inom kommissionen.

– Det vill jag kraftfullt demontera.

Kommer kommissionen, med ledamöter från Estland, Sverige och Finland, att bli överens?

– Blir vi inte överens så får vi skriva våra skilljaktiga meningar. Om man inte delar en majoritetsuppfattning får man ju reservera sig.

För ett drygt år sedan presenterade havrikommisionen en

deirrapport som berörde de tekniska aspekterna på fartyget. Besiktningens agerande behandlas först i slutrapporten.

Olof Forsberg vill i dag varken bekräfta eller demontera uppgifter om bristande initiativkraft hos den estniska besiktningen.

Vad säger du om den bild av kaptenen som ges i journalisterne Anders Hellberg och Anders Ståles bok om fartygsolyckan? Kaptenen pläderade för siktat tillstånd och inkompetens.

– Om man pratar med lougar ger de en annan bild. Det finns väldigt olika uppgifter om kaptenen.

Men när Estonia fick slagsida gav de också kaptenen en beboende granskning som förstärkte slagsidan?

– Riktigt teoretiskt hade kaptenen hamnat i en bättre situation om han gjort åt andra hålet. Men det går inte att föra ett så enkelt resonemang att man kan säga att kaptenen gjorde åt fel håll. Oftaft när man får slagsida är det normalt att man gör upp mot sjö, precis som kaptenen gjorde.

Dåliga reparations

Varvet som byggde Estonia hävdar att Nordström & Thulin misskött fartyget och snattade honom för undermåliga reparations. Kan du avlämna dessa påståenden?

– Vi kommer att redovisa våra synpunkter på detta när slutrapporten är färdig, säger Olof Forsberg och tillägger att det tycka varvet har "ett antal teorier under den här tiden".

Han påpekar att varvet exempelvis intresserat sig för en rysk rapport som hävdar att Estoniaolyckan var en följd av att fartyget användes som smugglingbåt.

Menar du att varvet griper efter varje halmeträ för att hitta förklaringar som främmer varvet?

– Man får trycket att de försöker göra det.

Hur har du varit att utreda den värsta civila olyckan i Europa i modern tid?

– Många gånger har ministrar och upptäcktingar att man så många har omicidium måste det ha varit väldigt komplicerade orsaker till olyckan. Men det kan ju vara en skäligen banal olycka, även om konsekvenserna blir fruktansvärda.

– Det är här att tänka att en massa mäniskor miste ha gjort en massa fel. Men föland är ju tillvaron helt entiskt sådan att det sker olycksändelser.

Kommer teorierna och spekulationerna om förlustenliga orsaker att ta slut när ni väl presenterar er rapport?

– Nej, eftersom vi inte har tilltagit till vraket kommer rykten att leva vidare. Det är som med Knut Wallenberg försvarsdele, Dag Hammarskjöld flygolycka och mordet på Olof Palme – teorier kommer att dyka upp med jätta mestanrum.

ELISABETH ANDERSSON

Enclosure 39.5.476

Attendance List of the JAIC meeting 19-21.11.96

Enclosure 39.5.477

The Joint Accident
Investigation Commission

ATTENDANCE LIST
MEETING

Aktbilaga
A 205
ESTONIA

Date: Tuesday 19 - Thursday 21 November, 1996

Place: Långholmen Konferens, Stockholm

+ Å 205a

Name	Organization/Country
Seppo Rajamäki	AIB / Finland
Heimo Iivonen	- r -
Pirjo Vuorasaari	- r -
Kari Lehtola	- r -
Tuomo Karpainen	- n -
Klaus Rahka	VT - r
Kari Larjo	AIB / - n -
Hans Pihlén	KRS / Finland
Malle Pedak	ENMB / Estonia
Heino Jaakula	ENMB / Estonia
Lindo Laur	CHM LSD Estonia
Enn Neidre	ESCO Estonia
Jaan Metsjäeber	TTU TALLINN
Sint Kauko	Ministry of Transport and Communications of Finland
Olli Varti	- r -
Priit Märt	Bronit
August Dangervik	ESI MARIT ACAB
Bengt Schager	Sweden
Sten Anderson	- n -
Olof Grankvist	- n -
Gunnar Stenström	" -
I. Karl Hult	- n -
Börje Stenström (det)	" -
Hans Rosengren	"

Fax Börje Stenström to Dr Holtappels dated 03.12.96

FAX
To Dr. P Holzapfel, 00949 - 40 362198
from B Stenström SHK

Dear Peter,

You will no doubt learn through your press monitoring about what has been going on in Stockholm during the past days. A radio channel reporter had talked to an outside expert, getting the impression that there were additional parts about the locking mechanisms beyond what is mentioned in the Part Report. This led to activities in several other media, including two TV channels by which I have been interviewed.

I stated repeatedly in the interviews that we do not point out who installed the lock attachments at their current dimensions. Unfortunately this was not picked up in any one of the broadcasts but rather an impression that it was now more clear than before that the yard had installed undersized lockings.

Lawyer Witte was also interviewed and claimed quickly that chances to sue the yard will now increase. I will call Witte Tuesday morning to explain to him that his conclusions are not based on facts of our report, on the contrary we will remain silent on the issue of who may have installed the weak parts.

It is regrettable indeed that it is so dangerous to answer any questions by reporters, indeed this was another example of that. Hope the issue will soon calm down again.

Best regards
B Stenström

101013

00949 40 362198

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Copies of the 'Black Book' in Swedish

/NTRYCK

AV

DEN TYSKA EXPERTGRUPPENS

UTSTÄLLNING

SPÄRVAGNSHALLARNA

STOCKHOLM 12-19/6 1997

Stockholm 97-06-13

Med all respekt för de omkomna.

Vartför har inte de här presenterade
fakta utnyttjats av havsrikommisarien.

För oss som har följt det hela via
TV och press är denna utställning av
stort värde. Nu förstår vi vad som
har hänt.

Hoppas att folk med riktig yrke in-
ställning och uppfattning kan reda ut
det hela. Samt att vi slippas se vidare
dåliga uppträdanden i frågan från svenska
politiker.

Clas Svart
Stockholm

Enlightening the mysteries
of the sea is important for
everyone, so one can go on
with respect for all victims
in this tragic accident.

Annelie Hasper

Stockholm 15/6 - 97.

En intressant och mycket informativ presentation av händelseföloppet.

Mitt intresse är dock att det är underlättningen att varit färdigget av senaste ägaren bygga om förskjutts ramp med en ny placering som var den direkta oanledningen till katastrofen. Enligt utfridet disponens tilläts endast sjöfart i övre vatten, max 20 nm från land, med den ursprungliga konstruktionen.

Nilsrik Rosendal.

(Saltholmabaden)

Stockholm 970613

Tack för att någon söker närmare sig
sanningen på ett informativt sätt
Om sanningen kommer fram
någon gång är det många som
utgör märkliga faktorer:

1. Gångjärnen och läs är väldigt
utan någon säkerhet. De förde
rävit 399 r starkare (500-600 ton)

2. Fartyget var fällat i
Tallin. Tidtens ens med full, bry-
gards trimmingsluck var lartey
utas och gjorda (10 storbrd)

3. Lastbilarna (~ 50-60 ton/st)
var inte fast kajade i läcket
utan kunde hänga i längdled
och i rörelse.

4. Rampen var bräsig i gång-
järnen och kunde inte vällas
fri.

5. Fartyget var endast grötäkt
från Ålandsleden! osv. osv.
När så många agerade gör givna
missar med Estonia måste det bli
en katastrof.

Kolla igenom alla färjor!

Rolf Norrell Strand
us

Sten Waldus Källberg
Detta är ett intressant projekt.

We were passengers on the Estonia a couple of months before she sank. We were somewhat alarmed at the poor passenger safety — no lifeboat drill, heavy, almost immovable passenger doors, and an exit to shirtsleeve totally out of consideration that the passengers had a long queue to get onto the only after landing gangway. We find your investigation extremely enlightening and encourage its evident contributions to future ship safety and maintenance.

Deafes Nitch
San Francisco, CA, USA

Jämför Estonia med ett lyckekärl med lock
 som hålls på plats medelst en flans med
 genomgående bultar. Normalt har man
 16 eller 32 bultar, som drages fast härt
 så att inte vättske (eller salt) tränger igenom.
 Flansen ber varv 5-10 gånger en stark
 sär ejälva kärleff, så att eventuell deformation
 ej sker i ejälva flansen och överbyggnar
 lättetefter. Ingen skulle väl drömma om att
 redan nu antalet bultar till 5. (I så fall
 skulle flansen behöva dras till s.s., 50 gånger
 så stark som ejälva kärleff).
 Men på Estonia har man endast 5
 fästpunkter för visiret. Dessa kan är
 flansen och ejälva visiret mycket klara
 av löshygget skrov. Det är inte ett
 dagg förvirrande att det gick som det gjorde
 klor grundkonstruktionen i kombination med
 döligt underhåll är en trovig förklaring
 till katastrofen. — (av Loggeman)

Det är av största vikt att de olycksövarkerna klarläggs på ett oordnägt sätt, och att de skyldiga ställs till ansvar!

Hans Flisck, Industriidesign, Stockholm

Sanningen har ett egenvärde och kan aldrig bli för util för förhandling mellan inblandade regeringar om möjligheter. ^{i just hand}
Go for the truth! Vår hand

Skaldfrågan kommer i andra hand.

Torb Paeg, filmare

14/6-97. Jag o min familj har inte med handelns att göra. Men som aktivat kristen har Gud lagt en kollectiv kyrklig till denna handelse. Till alla överlevande, efterlevande o till att allt skall arbeta sig till allas bästa. Jag hörer för er alla varje dag, som den mors ocksi en festdag / rucka för det här..

Röra hälsningar med
Kristen kyrk. ^{Bibi} Birthe
Mariann Simon ^{Bibi}
Marianne Simon i muntl Stockholms

Bristor i underlättet av boggiens
och myndig bilaras utombanade
kontroll är uppenbarligen orsaken
till att vatten kom in på bilen
därav vilket ledde till havariet.

Vatten kan snällast komma
in på bilen av andra orsaker,
t.ex. collisioner, explosion etc.

Alla fartyg med öppen bilväg
utan mellanvagnar är i grunden
felkonstruerade. 50 fartyg förlorade
runt hår havariet av denna orsak
varav tre de senaste åren i Nordeuropa.

Den slakta som miste driften är
att fartyg utan mellanvagnar i
bilväg inte får byggas i framtid.
De fartyg som finns måste byggas om
annars kommer katastrofer att
upprepas före eller senare.

Borg Johammar Sjöingen
Timmer

P.S. Skulle ett flygplan med ett all-
varligt konstruktionsfel förlägga
över landstinget? Efter första havariet
skulle den flygplanstypen tas bort
med flygförbud.

En pedagogiskt bra utvecklad redovisning
Det borde gå att fattaliga orsaken varit teknik
till 98% sannolikhet. Ofattbart att ink detta
kan redovisas öppet av haverikommisionen
Även om det finns olika uppfattningar - visst den!

Götz

Intressanta upplysningar.

Bekräftar mina egna frunderingar

H. Åberg, Flygkapten Fjällräven

Ulla & Per Ro. Kalleellsten

Kommunikation: Enkelt & förståeligt
- upphäggar utredning - material
frågans omödiga.

Jan 19
Post Box nr
15/1-1997

Förminne om olyckans svalliga urak är väl-
bekränt och de har lyckat si underhållande
utställning. Särståndigheten känner, att ambulansen
lägger in sammansätt för att informera allmänheten.

E. Götz
15/1-1997

15/6 97

Hans undersöknings av faktor
som kan resultera i Torben Glaumann
att utstå tillvaron.

Kem A Res.

Torben Glaumann är en AR

Hans Glaumann:
intressant, orsakerna till döden
tycks klarlagda.

15/6 - 97

Jag anser att världen talar
om att det är ett stort nöje för
människan. Det finns inte berättat om
att någon med professionell person
eller skadom som uppmärksat under
denna tids period att
kort men hårt mäktigt i s
det här sätet

Roy Björk



English Translation of the entries in the 'Black Book'

Office translation
of the

**Remarks written by Visitors after
having seen the Exhibition**

1. With all due respect for those who lost their lives. Why have the facts presented here not been submitted by the Commission? For us having followed the whole via TV and press this exhibition is of great value. Now we understand what has happened. I do hope that people with a proper professional comprehension are able to clear up the whole mess. Otherwise we shall continue as before with slippery and bad appearances of Swedish politicians in connection with such questions.

Claus Ekwall
Stockholm

2. Enlightening the mysteries of the sea is important for everyone, so one can go on with respect for all victims in this tragic accident.

Annelie Hasper

3. An interesting and very informative presentation of the chain of events. My impression is that it is the failure of building of the new ramp at the correct location during the last change of ownership which was the direct cause of the casualty. According to the certificate of traffic in inner waters max. 20 nm from land was allowed with the original construction.

Henrik
(Saltsjöbaden)

4. Thank you for trying to approach the truth in an informative way. If the truth should come out at some stage many people will be found to have contributed:

- (1) The hinges and locks were calculated without any safety factor.
They should have been 3 times stronger.
- (2) The ship was wrongly loaded in Tallinn. Not even with full port heeling tank could the ship maintain an upright position.
- (3) The trucks, 50-60 ts each, were not secured to the deck, but were free to move both lengthwise and sideways.
- (4) The hinges of the ramp were broken and the ramp could not be kept watertight.
- (5) The ship was only accepted for traffic on the Åland line.
When so many people make so many grave mistakes as with the "Estonia", a catastrophe was inevitable.

Check all ferries!
Rolf Nordell

5. This is an interesting project.
Sten Waldus Källberg.
6. We were passengers on the "Estonia" a couple of months before she sank. We were somewhat alarmed at the poor passenger safety - no lifeboat drill, heavy, almost immovable passage doors, and an exit to shore so totally out of commission that the passengers had a long queue to get out the only open landing gangway. We find your investigation extremely enlightening and encourage its evident contributions to future ship safety and maintenance.
Douglas Nolde
San Francisco, CA/USA
7. Compare "Estonia" with a pressure vessel with a lid which is kept in place by a through-bolted flange. Normally you have 16 or 32 bolts which are secured to prevent a liquid or gas to escape. The flange must be 5-10 times as strong as the vessel itself so that a possible deformation does not occur in the flange itself and risk the integrity. Nobody would dream of reducing the number of bolts to 5. In that case the flange needs to be 50 times stronger than the vessel itself. But on the "Estonia" there are only 5 securing points for the visor. In addition, the flange and the visor itself is much weaker than the ships hull. It is not surprising at all that the accident happened. A probable explanation for the accident is a basically weak construction combined with bad maintenance.
Carl Lagercrantz, Civil Eng. KTH
8. It is of the utmost importance that the actual causes of the accident are clarified in a indisputable way and the people responsible for the accident are brought to justice.
Hans Ehrich - Industrial designer
Stockholm
9. Truth has a value in itself and can never be subject to negotiations between the involved government and authorities. Go for the truth primarily and let the question of responsibility be clarified later.
Tord Borg, Movie maker
10. I and my family have nothing to do with the incident. But as an active Christian I feel that God has provided a collective love for this incident, also to all survivors, relatives and that everything shall be resolved in the best possible way. I pray for you all every day and also keep one day every week without food because of this.
Marianne Simon + family
11. A well designed pedagogic display. It should be possible to determine the cause purely technically with a 98% probability. It is incredible that this cannot be openly publicised by the Commission. Even if there are differing opinions, show them.
Emil

12. Interesting information, supports my own thoughts.
H. Ahlgren, Aviation captain
13. The truth simple and credible = additional investigation into the material question is now unnecessary.
Illegible signature
14. The truth about the real cause of the accident is well documented, but this exhibition, however, has been open in a fairly out-of-the-way place. Decency requires that the mass media inform the public
Illegible signature



15. Deficiencies in the maintenance of the bow visor and lack of control by the Authorities are obviously the reasons why water entered the car deck, which lead to the capsize. However, water can also enter the car deck due to other reasons, for example a collision or an explosion etc. All vessels with open car decks without a bulkhead are basically constructed wrongly. 50 vessels have foundered world wide due to, whereof three in Northern Europe during the last years. The conclusion that has to be made is that vessels without bulkheads on the car deck are not to be built in the future. Existing vessels have to be re-built, lest the catastrophe should repeat itself sooner or later.

Börje Jälhammar Maritime Engineer

PS

Would an airplane with a serious constructional error be allowed to lift at all? After the first wreck that airplane-type would be imposed with air ban

16. Demand a (new) survey of vessel soonest and get Mrs. Blusman to the exhibition.

Bo Johansson IMO AB

17. Interesting, the reasons for the accident now seem to be solved.

Hans Gisumann

18. I think Nordström & Thulin ought to take greater responsibility for the accident. They have not surveyed nor used professional people in the repairing the damage generated over the years, for instance damage from sailing at too high speed in ice and heavy seas.

Roy Björk

19. Thanks for a clear exhibition were everyone can draw his own conclusions. Unfortunately there are parallels with the Palme murder, such as delaying and covering up.

20. A splendid exhibition. What is needed now is that the Government does not participate in further cover ups, but appoints an impartial inquiry after the vessel has been salvaged, alternatively following further dives.

Thorsten Höglund

21. Thank you for a splendid exhibition

Erik Tofft

22. Thank you, now I understand much more of the catastrophe, thanks to the models and the lectures.



Article in Svenska Dagbladet of 22.09.97

REDAKTÖR: HANS STRANDERG, TEL. 08-55 31 33. TELEFAX 08-656 60 42. E-POST: nyheter@vdu.se
BRAKETTJÄRSKOGS-KAUZ: KATAHEMMA ERBUDD 08-53 56 15. TELEX 113 574 40

"Estoniarapport skyddar besättningen"

Estoniarapporten är ofullständig. Kommissionens estniska ordförande ville undvika kritik av besättningens och detta styrde kommissionens arbete, hävdar en expert som hoppas i utredningen.

— Jag har inte fått några på kommissionens sida, säger Bengt Schager, politisk expert i stämkommissionen, som upptäckt urkrediter i protokollet.

Ma riktar Estoniarapporten, som snart är på väg till tryckeriet, att finna mycket av sin invändighet.

Bengt Schager menar att estniskakommisionen inte ordentligt utvärderat berättelsen om brister på fartyget. Det han har varit allt för kritisk.

— Det har funnits en förmåga att tolka sakerna och ting som varit oförståeliga för besättningen till dess fördel.

"Dålig konstatering"

Estniskakommisionen är en trenationskommision med experter och ledamöter från Finland, Norge och Sverige. Bengt Schager tycker att det är allt för uppehållt styrt av en örtisan och komma överens. Svenska och finländska har röstat vid att lägga ifrån.

— Det har varit så viktigt att

hålla ihop kommissionen att man integrerat med folkcivilsamhället, säger han.

Jag peker inte att det är bra kvalitet på rapporten. Det finns mer förlönar att dra av den här objekten där vad som kommer fram i rapporten — det har ju faktiskt varit en massa brister sannhert, säger Bengt Schager som hoppas av efter nämnda tre års arbete.

Dålig dokumentation

Bengt Schager betonar att det inte riktigt ingår meningar inom kommissionen om förlösningens huvudanledningar. Det var tekniska brister som ledde till att Estonia hamnade i djupet. Detta skrivs här inte varit det omistliga kontroversiell.

Men frågan om den estniska besättningens sätt att han-

tera situationen har varit derö, men kontroversiell. Bengt Schager menar att dessa frågor tocken återsätts.

— Det finns saker och ting som burde ha rapporterats i rapporten, men som inte finns med, säger han.

Bengt Schager är kritisk till rapportens sätt att behandla besättningens ageringer. "Säkerhetsskulden var ja faktiskt inte upp till den standard som man kunnat förvänta sig".

Muchum menar att också han är kritisk till brister.

Turbulent utredning

— Vi ska analysera rapporten och se var det misslyckat, säger han och påpekar att det faktiskt handlar om att undra om enskilda företyckta i modern tid.

Stressad kommission

Bengt Schager ser redan stort till att utredningen enligt honom blivit bristfällig; vissa frågor har varit klassliga, sannolikt som kommissionen ständigt kunnat sig stressad.

Utdrarna har inte kunnat stå emot mediernas kritik på att snabbt bli färdig och presentera den för en finalrapport.

Bengt Schager menar att Estniskakommisionen skulle ha tillåtit sig att utreda saker och ting ordentligt.

HANNAEÅ Astri Åberg

BNS Message from 17.11.97

~~first session before Dec. 15 at the latest, and is to be called by the former head of the local government.~~

~~The present council puts down its powers as soon as the new council is formed.~~

~~The government should before January 1, 1998, to draw rules regulating financing of education establishments, orphelinages, old people's homes and social welfare institutions in a respective local government.~~

ESTONIAN OBSERVER CLAIMS DID NOT SEE WHOLE ESTONIA FERRY DIVERS MISSION 1997

TALLINN, Nov 13, BNS - An independent Estonian observer said he did not see the full course of the diving mission on board the Estonia ferry's sunken wreck in December 1994, because his monitor on board the support vessel was switched off part of the time.

In December 1994 international observers were invited to watch the course of the divers' mission on board the wreck of the Estonia ferry which had sunk about two months earlier. The Estonian observer was Arne Valgma, head of the Maritime Department ship control service.

The divers' mission, which lasted for 64 hours, was filmed and the video picture was continuously forwarded to the support vessel. The Swedish Maritime Administration, which had commissioned the mission, supervised it from aboard the same ship, and also the Swedish criminal police observed the course of the mission there.

Valgma said that during the 64-hour mission there were moments when there was no video picture in his monitor.

"All I can presume is that the diving work was not filmed during those breaks," Valgma told BNS on Thursday.

Maritime Department general director Kalle Pedak said it was not very likely there were breaks in the video recording during the divers' mission.

"Valgma has admitted that at intervals he saw no video picture in his monitor room, and had no access to the ship's main monitor," Pedak told BNS. "I believe there was video picture in the main monitor all the time, because the divers were constantly watched."

Pedak and Valgma didn't want to comment on why the video picture was interrupted in the Estonian observer's monitor.

Valgma shared his monitor room with a foreigner whose name he said he no longer remembered. He said the man

- 4 -

97 11/17 15:10 FAX

17-NOV-97 MAN 11:51 SND FAKTAERGOETEN

+46 8 125168

FAX 08 125168

S-02

introduced himself as a Finn.

"Valgma thinks the man was a Swede, because according to Finnish officials there were no Finns on board the support vessel," Pedak said. "We have been unsuccessfully trying to establish the identity of the man who shared the monitor with Valgma on board the support vessel."

Some people closely connected with the Estonia ferry disaster investigation committee have expressed the opinion that the Swedish Maritime Department and criminal police tried to hide some video sequences from the Estonian observer. The video recording later sent to Estonia was an edited version, and no one of the Estonian members of the committee or observers have seen the original of the tape.

"The corpses had been cut out from the video sent to Estonia," Valgma said. "I cannot say whether also anything else had been cut out."

Former chairman of the disaster investigation committee Andi Melster has criticized organization of the diving mission in the Estonia's wreck and accused the Swedish Maritime Administration of superficiality.

A study of the video films and diving work log books of the Rockwater company reveals that, for some reason, the divers did not investigate the cabins of the ship's top officers and other key persons in the bow part of the upper decks. Melster said that employees of the Swedish Maritime Department who supervised the mission failed to order the divers to enter the cabins of the ship's captain, the chief mechanic and the shipowner's representative, although the windows of those cabins were easily accessible. The divers didn't even look into the windows of those cabins, to check whether they were open or closed.

Neither did the divers show any interest in the front cabins on Deck 7, which belonged to the ship's top officials.

Also, the divers were not interested in the wireless room at the back of bridge.

The divers were not told to investigate the ship's medical room and find out how many persons could have come there to ask for help and to find out how that help was given. No one attempted to break into the ship's lockup room to check whether there was anyone inside. On the bridge, the divers made no attempt to identify three bodies.

Melster said that it was amazing that the divers took so long to film the nameplates on crew member Suanne Pundi's cabin door and on passenger Alexander Voronin's attache case in his cabin.

"The diving mission was one of the reasons why I

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'First Remarks to the Report of the international Commissin'

First Remarks on the Report of the International Commission

Within the short available time the members of the German Group of Experts have browsed through the report and found the following obvious contradiction, omissions and mistakes, which diminish the value of the report substantially.

1. The Condition of the Visor and the Ramp

The report states in Chapter 3.3.6 that

the Mc Gregor Group was entrusted with annual maintenance of the operating and control system of the bow visor and the ramp whilst the ship was under Finnish flag. New rubber seals for the visor and the ramp during this period had been supplied almost yearly. After transfer to Estonian flag the ship's crew was entrusted with the maintenance. After 20 months of service new rubber seals had been "ordered" and it was known that "the play in the ramp hinges was approaching the point where corrective action would be needed".

This cloudy language conceals the following facts, which are known to the Commission:

The Rubber Seals

The rubber seals of the visor were never renewed after the ship had come under the Estonian flag, nor did the Technical Managers of the ship ever intend to do so. The visor was thus not watertight any more. Consequently the Commission states in Chapter 15.9

the sealing on the forepeak deck had clearly not always been in a condition to keep the lower part of the visor watertight. The Commission has learned from individuals involved in other ferry operations that this quite common in many ferries....

Despite these findings the Commission comes to the following conclusion (see Chapter 15.9)

the Commission has concluded that the general maintenance standard of the visor was satisfactory.

The Commission is aware that on delivery of the vessel to her first Owners the Class Surveyor only issued the Class Certificate after having convinced himself that the visor was watertight and that the Class Surveyor who surveyed the vessel during her stay under Finnish flag always made it a point that the visor must be watertight under all circumstances. Furthermore: If the visor is not watertight, then the inflowing water does not restrict itself to the "lower part of the visor", but fills up to the outside water level, as can be learned from the principle of communicating pipes. On the night of the casualty the water

level outside the visor, because of pitching and waves, was varying between 0 and about 14 metres when the vessel shipped green water over the forecastle deck.

The Ramp Hinges

Corrective action on the ramp hinges was already demanded by the last Finnish crew 2 years before the casualty. In the meantime it indeed became urgently necessary, because the port ramp hinge was broken as a consequence of which the ramp was twisted, leaving a gap of several centimetres in the lower port corner between the ramp and the ramp coaming, through which water regularly flooded onto the car deck from the water filled visor. There are numerous witnesses, who have stated that they experienced water on the car deck at sea during previous voyages.

It transpires that the two consecutive barriers to prevent an influx of water on the car deck were not intact and thereby a deadly situation for the vessel was created. **The watertight visor and the watertight ramp both did not function anymore and hence the vessel was unseaworthy and should never have set sail from Tallinn.**

The Rags

Crew members and other witnesses have reported that mattresses, blankets and rags were constantly used to plug the gap between the ramp and the ramp coaming and that the flaps between the ramp and the car deck had been removed in order to facilitate easier filling of the gap with such material. The Commission in Chapter 13.2.3 states

this may indicate that a sealing problem in the ramp, mentioned by the 2nd Engineer in his testimony, had been temporarily cured by packing rags into the gap. However, the Commission considers it more likely that the rags were washed into the area from nearby storage spaces during the final flooding of the car deck, as this area of the wreck is full of debris.

In the opinion of the Commission it is therefore thinkable, that rags, blankets and mattresses float upwards and against the current of the inrushing water in their attempt to settle down in the gap between the ramp and the car deck under the flaps. The German Group of Experts does not wish to comment on such assumptions.

The Port Locking Bolt of the Ramp

In Chapter 13.2.3 of the report the Commission notes that one of the locking bolts for the forward ramp was

most probably not in its properly extended position at the time of the accident.

The Commission then concludes that the locking bolt possibly

had been in its proper position and had backed out prior to the accident due to the movement of the ramp and ramp coaming in combination with hydraulic leakage.

- 3 -

The Commission states

such movement of locking bolts at sea has been noted on other Ro-Ro ferries.

The Commission unfortunately overlooks the fact that such peculiar movement of the locking bolt was not possible on the "Estonia" because

a spring loaded mechanical plunger was installed

see Chapter 3.3.2, which fitted into a groove in the bolt in order to secure its position and make sure that what may have happened on other ferries could not happen on the "Estonia".

The Sensor Plate

In Chapter 13.2.3 the Commission describes the position of the sensors controlling the functions of the Atlantic Lock. It states

the empty ends of the sensor cables were near the mounting bracket of the sensors. The mounting bracket appeared to be undamaged... This indicates that the sensors were not in their place during the accident voyage. According to crew members and the technical Superintendent the bottom lock position indicator had been in working order.

The Commission then concludes

the most likely absence of the sensors would not have had any effect on the accident, since there was no indicator light on the bridge showing the position of the locking bolt.

What the Commission does not say is the following:

Underwater pictures clearly show and prove beyond any doubt that the cables have been cut.

The mounting bracket, as well as the cables were removed by the divers, but their whereabouts are unknown, they probably were thrown back into the sea, as was the bolt of the Atlantic Lock (which fact is also not mentioned by the Commission in their report).

The dismantling of the sensors was equivalent to tampering with a Class related item. As this was done without the consent of the Classification Society it follows that the vessel's Class was suspended with immediate effect.

Had the control system functioned properly then there would have been no light on the bridge control panel, with the result that the Officer in charge would have noticed that the visor had not been locked properly.

2. Strength Calculations

When discussing strength calculations a clear distinction must be made between

- design load
- break load
- acting moments / forces

The Design Load

The design load of the attachment points of the visor were calculated in accordance with relevant regulations at that time by von Tell, Gothenburgh, who designed the visor. The builders of the ship, the Meyer yard, ran a control calculation on the design load. The control calculation showed a design load of 100 mts / attachment point.

The Breaking Load

The breaking load is the load, at which the tested attachment point fails. Tests executed by the Shipbuilding Institute of the University of Hamburg showed that the Atlantic Lock as found on the wreck broke at a pulling force of 208 mts. The side locks were tested by VTT in Finland. They broke at 120 / 160 mts respectively.

The Acting Moments / Forces

The Commission has run tests with a model of the "Estonia" at the VTT and has found that during these test runs a maximum acting opening moment of 4 - 20 MNm. (400 - 2000 tonmetres) were recorded. (See Chapter 13.5)

The maximum opening moment to which the visor was exposed after the vessel had turned at the last waypoint is estimated to have been between 4 and 20 MNm and the max resultant force between 1 and 9 MN. Such high loads and opening moments occurred randomly. The resultant load and the opening moment may have exceeded the lower limit of the range a number of times within half an hour under the prevailing conditions. Levels above the upper limit of the range have a low probability of occurring, but cannot be excluded. The vast majority of wave impacts created no opening moments at all.

This assumption is entirely based on theoretical model tests, whether indeed the "Estonia" has met waves with such opening moments is unknown. It is noteworthy that the Commission (comparing the opening moment with the design calculations of the shipyard) comes to the following conclusion (see Chapter 15.2).

The Commission has noted that the estimated maximum sea loads at the time of the accident in terms of vertical and longitudinal forces on the visor were of magnitudes about equal to those used by the shipyard as design loads.



English Translation of the entries in the 'Black Book' made during the 2nd exhibition

Enclosure 40.4.484

The Black Book(s)

01.12.97

Having perused the exhibition it is totally clear for someone who has acted as Master for 25 years in the Baltic, on the Atlantic and the Pacific on vessels similarly constructed as the Estonia that the Estonia was driven at excessive speed under the prevailing conditions. - *Birger Handelin*

I am of the same opinion as above. To erase all question marks the vessel must be salvaged. - *Bengt Stahl*

The catastrophe was caused by excessive speed, ignorant crew and bad maintenance. - *Bertil Lindahl*

Thanks for a well researched exhibition. - *Sven Andersson*

The reasons for the accident: 1) Bad or no maintenance at all. 2) Bad seamanship - excessive speed. In addition extremely badly handled by the Authorities - as usual. They don't seem to know anything at all about shipping. It would have been better if Inez Usman had founded. Good exhibition! - *Erik Sandqvist & Eric Johansson, Solna*

I am surprised at how subjective some conclusions are in parts of the exhibition. - *Nils Nilsson*

Nordström & Thulin is a bloody shit association (jävla skit förening!) with about 800 lives on their conscience. - *No name*

I cannot understand that the Estonia was allowed to sail when they did not maintain the ship. I think it is shameful of Nordström & Thulin to put economy before human lives. It is tragic. - *Johan Gunderswärli*

Sucky Boat! - *No name*

Nordström & Thulin = idiots. - *No name*

02.12.97

Good exhibition! The ship is / was doomed due to short port calls & an internal policy never to be late. It is surprising for someone, who has witnessed the loading / discharging routines on Ro-Ro's and ferries, that this did not happen earlier. - *Kyöös Peter Alsparr, teacher, School for Seamen, Stockholm*

Accidents don't happen, they are caused. And actions by the Authorities are just as straight-backed as one has reason to expect. The exhibition is good and revealing. - *Pedro Sjögren*

Thanks for an exhibition, which brings some information in this difficult accident! - *Margareta & Holger Furudig*

Very Good! - *Jan Hane*

It is horrible that Nordström & Thulin's greed caused the catastrophe. It is unacceptable that the Government and International Commission do not clarify the issue. - *Lars Simmers, Borlänge*

I should want a protest list, which would force them to bring up all the dead from the Estonia. Demand that they start with this. - *Micke*

Very thought provoking for someone, who previously in the main has accepted the official truth. Thanks for sounding the alarm! - *J.B.*

Having worked on the Finland ferries for 10 years as an Engineer and also in foreign shipping lines with the same type of hull construction as the Estonia had I am convinced that the accident was caused by excessiv speed, bad maintenance and negligence on the part of the crew. It makes me still more convinced when I see that the visor locks have been badly repaired on several occasions. - *Kristian Hedelin, Marine Engineer*

I fully agree. - *Oscar Lundberg*

Having worked at sea my whole life, i.e. as a Master on the North Atlantic and as a Pilot in Sweden I am unfortunately forced to agree fully with Kristian Hedelin here above. - *Gerd Borgström, Master Mariner*

The International Commission Report is a compromise, the Shipyard Report is a serious analysis.
Unintelligible signature, Civil Engineer

When I heard about the accident over the radio at 0530 on the night of the sinking my first thought was: Where was the Captain who carried the ultimate responsibility onboard? Why has this self-evident question still not been answered? - *Bertil Wrangé*

Very interesting to see this evidence! How are we supposed to believe in "objective investigations" after the International Commission Report? - *Axel Hyberg, Gräddö*

*Gullible passengers have trusted the Authorities, shipping line and crew and as a consequence lost their lives. The Authorities have been negligent in their control duties. The shipping line has not maintained its ship. The crew was incompetent. There is such a thing as "civil courage" that everyone needs to possess, civil servant or employee. At the end of the day it is up to each person to carry his individual responsibility. - *Ulf Trygger, Stockholm*

*Salvage the bodies NOW! - *No name*

*This exhibition should be visited by all Swedish people! Very informative and rewarding. I have a great deal of sympathy for the relatives. Respect them! - *Sven Ullenhed, Stockholm*

*Salvage the bodies! - *Kerstin Carlsson, relative*

*The Estonia sinking is a combination of bad seamanship and a too tight schedule from Nordström & Thulin. Estonia was forced to be pressed at full speed to keep her time table. The Master was too weak to oppose the shipping line. The loading was badly performed, which was a contributory fact. Shipping line & Officers have a large portion of blame in the accident. - *P-O Sundgren, teacher in Navigation*

*If you do not know what happens when maintenance is neglected and a time table becomes a priority you should not talk too loudly. Excessive speed combined with bad weather is the cause of the accident. Only those who have sailed in command know that negligent maintenance aggravates the situation. Rgds Peter Alsparr, Teacher Stockholm Nautical School

03.12.97

2 Signatures only

An informative and exhaustive exhibition. - *Hans Löfström, Jarfalla*

*Salvage the bodies and preferably the whole ship. Uusman should resign. - *Eva Britt Martinsson, Stockholm*

*Why has no one questioned the actions by the big ferry, which was the first vessel on the scene and refused to float their boats to save those in peril. Does not that run contrary to all seamanship tradition? A complete survey of the wreck and a retrieval of as many drowned as possible is an absolute requirement. Our confidence in the Government and Social bodies cannot stand a cover up. - *Sten Halle, Västerås*

*A race? Was the excessive speed the result of a race with the other ferries? First to the Furholmen sound? Just like the Ericson sailing ships used to race in the Baltic and like the Vaxholm vessels do in the Stockholm archipelago. - *Lars Krantz, Stockholm*

*The ship is built and tested to take heavy seas - there must be another reason than a constructional fault. - *Johan Källberg, Ekerö*

*An international investigation is necessary to determine the chain of events and the possible guilt of involved parties - including the present Commission members. - *Ola Källberg, Hägersten*

04.12.97

I hope truth prevails. - *G. Lammes*

Bad maintenance and nonprofessional repairs and changes to the visor are no doubt the reasons for the catastrophe. Insufficient training of crew and officers. The shipyard is entirely without fault. - *Eva Britt Martinsson, Stockholm*

In good socialist tradition the truth is suppressed if it is uncomfortable for the Authorities. Go on digging, the truth must become known. - *Unintelligible signature*

Inex. Uusman should revert to selling stamps. (Caricature drawing) - *Olle Höglund*

Very good and informative initiative to uncover the real, logical truth. - *Leif Vogel*

Well done. The truth at last. - *Justin Frieslund*

Has Inez Usman seen this very thorough compilation of facts? How can anyone, who has participated in the International Commission and bypassed the facts, that are presented here, sleep well at night? A submission by an involved Party, said Inez U, shameful! - *Anders Ekelund & Kaj Bäckström*

God luck in your endeavours to cause a necessary recovery of the wreck. - *Marianne Höög, Taby*

Both at the previous exhibition and now (4.12.97) I make the same consideration; The Estonia was not seaworthy when the catastrophe occurred and should not have left port! I have travelled many times on this ferry under the name Viking Sally, with an experienced crew and regular service and maintenance under the Viking Line auspices and been safe and well cared for. - *K. E. Lennart Jonsson*

A Master must know his vessel and act accordingly. - *L. Grädén*

Thus incredible accident has upset and involved many people and left deep wounds. Despite all this there is the old saying "nothing bad that does not bring anything good as well". We, who are involved, may in one way or another, have acquired new views on life. Nothing is as self-evident anymore as it used to be. My visions for the future when catastrophes are concerned are to "see a light in the dark". When all the turmoil from reports and exhibitions has died down I hope my visions materialize. My greetings to all involved parties from a hopeful person. - *Britta Bergstedt* who views the future positively, despite everything

Good initiative by the shipyard. - *P. Asnell*

Thanks for an informative and comprehensive exhibition. - *Marianna Samuelsson, spokesperson Green Party & Thomas Julin, Member of Parliament, Green Party*

Lift the vessel to get full information. The truth must become known. Continue with your info campaign. - *Jarl-Olof Ohlsson, Märsta*

The Shipping Line is responsible. 1) Bad or nonexistent maintenance. 2) Inhuman time tables and stress on the crew. - *Ari Viin, Stockholm*

Thanks for an informative exhibition on the chain of events and the causes to the catastrophe. - *Sven-Erik Berggren 019 202727*

I absolutely believe the Estonia sank because of excessive speed combined with bad maintenance of the locking devices. My father is a Master on one of the Viking ferries and he says the Estonians still keep high speeds despite heavy weather. The Estonians probably don't wish to hear that they are bad seamen, but it is a fact that late last winter they (Viking & Silja) were again overtaken when proceeding at a speed reduced to 8 - 10 knots, while the Estonians kept considerably more speed. Damn I say. - *Björn Skogberg, Marihamn*

Very informative. Thanks for having been provided this opportunity. - *Peter Öström*

Extraordinary exposition of facts & findings. Don't give up! - *Erik Andersson*

