Investigation report

C6/2006M

Passenger Vessel MS NORDLANDIA, Collision with Quay in Tallinn on 28.10.2006

Translation of the original Finnish report

SUMMARY

PASSENGER VESSEL M/S NORDLANDIA, COLLISION WITH QUAY IN THE PORT OF TALLINN ON 28 OCTOBER 2006

The Finnish car-passenger ferry M/S NORDLANDIA had departed from Helsinki to Tallinn on 28.10.2008 at 08.00. The weather was fine at the time of the departure. The meteorological institutes in both Estonia and Finland had forecasted storm in the Gulf of Finland with westerly-northwesterly winds 20-25 m/s. The wind increased during the voyage. The option of waiting for the weather to improve was never discussed.

When the NORDLANDIA was approaching Tallinn, the master, the officer of the watch and the helmsman were on the bridge. The vessel’s wind-meter showed that the wind was from northwest and that the wind speed was over 20 m/s. The chief officer also arrived on the bridge, and the master told him that he had ordered tug assistance.

The master was steering the vessel to the basin at a greater speed than usual from the port wing steering place. He tried to get the tug to assist. In the berthing the bow of the vessel hit the quay constructions.

The port side of the NORDLANDIA’s bow was damaged when it hit the quay fender. As to the port constructions, the fender and the covered passenger gangway were damaged. The collision with the quay did not cause personal injuries and the damages did not endanger the safety of the vessel while it was in port.

The NORDLANDIA was approaching the port and hit the quay construction in wind conditions which exceeded the performance of the vessel. No information about the vessel's operational limitations had been produced to the master.

The speed at which NORDLANDIA entered the port, the track and the lack of advance discussion suggest a traditional and established procedure in good weather conditions. The fact that the circumstantial factors were taken into consideration can be seen mainly in the high speed of the vessel, which was used in order to try to control the effects of the wind.

The shipping company has no standard procedures for mooring. Each master has to develop his/her own routines. This means that the advance discussion on the distribution of work and on communication, which is essential for bridge co-operation, becomes more difficult or non-existent. In the same way there should be a common, pre-agreed plan of action for the co-operation with tugs. According to the prevailing practice, the routines can vary within one shipping company and as the masters change, even on one vessel.

The responsibility for port manoeuvring has been allocated to the master alone, but he/she has been left without support in the decision-making. The environmental limitations for port manoeuvring have not been set, and there are no minimum requirements as to the steering devices.

The SOLAS Convention rule on the operational limitations for a passenger vessel has not been applied to the wind limits of port manoeuvring. The Finnish Maritime Administration has not required this from the shipping companies. The operational limitations can be used as the basis for defining the port-specific wind limits for vessels. In their training, ship officers can be provided with port manoeuvring skills only within a vessel's operational limitations. The general character of the training requirements set in the STCW Convention are the reason for the fact that the present ship officer training does not include adequate requirements to control port manoeuvring. The operational limitations can give the STCW objectives on ship officers' skill levels in port manoeuvring a realizable and realistic framework.

The Investigation Commission has issued two safety recommendations to the Finnish Maritime Administration and one to the shipping companies. All recommendations are connected with the SOLAS Convention requirement on the vessels’ operational limitations and defining them for the purpose of port manoeuvring.

THE ABBREVIATIONS USED

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
COG	Course Over Ground
FRB	Fast Rescue Boat
FU	Follow Up
DGPS	Differential GPS
DSC	Digital Selective Calling
DOC	Document of Compliance
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
IMO	International Maritime Organization
ISM	International Safety Management Code
NFU	Non Follow Up
RPM	Revolutions per minute
SMC	Safety Management Certificate
SMS	Safety Management System
SOG	Speed Over Ground
SSB	Single Side Band
UTC	Coordinated Universal Time
VHF	Very High Frequency Band
VTS	Vessel Traffic Service
VDR	Voyage Data Recorder

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MS NORDLANDIA *(Copyright Eckerö Line)*

FOREWORD

The Finnish car-passenger ferry MS NORDLANDIA had collided with quay constructions in the port of Tallinn on 28 October 2006 at 10.26. On 17 November 2006 the Accident Investigation Board, based on a preliminary examination of the case, decided to appoint an Investigation Commission to investigate the accident. Captain Sakari **Häyrinen** was appointed as the Chairman of the Commission. Airline pilot and Psychologist Matti **Sorsa** was appointed as its member. Captain Kari **Larjo** and Chief Marine Accident Investigator Martti **Heikkilä** have acted as experts. Master of Science (Technology) Mikko **Kallas** has assisted the Commission.

No maritime declaration was issued on the accident nor was a marine casualty report submitted to the Finnish Maritime Administration. The time used in the Investigation Report is the Finnish time (UTC+2) which was also the time used on the vessel. The Investigation Report has been translated into Swedish and English by Minna **Bäckman**. The sources used in the investigation are stored at the Accident Investigation Board.

Statements concerning the Investigation. Under the Act (79/1996) section 24 concerning accident investigation, the final draft of the report was sent for statement and possible comments to the Finnish Maritime Administration, the vessel's master and the shipping company. The Finnish Maritime Administration and the shipping company gave statements on the report. The statements are available at the end of this investigation report and they have been used to revise the report.

1 EVENTS AND INVESTIGATION

1.1 The vessel

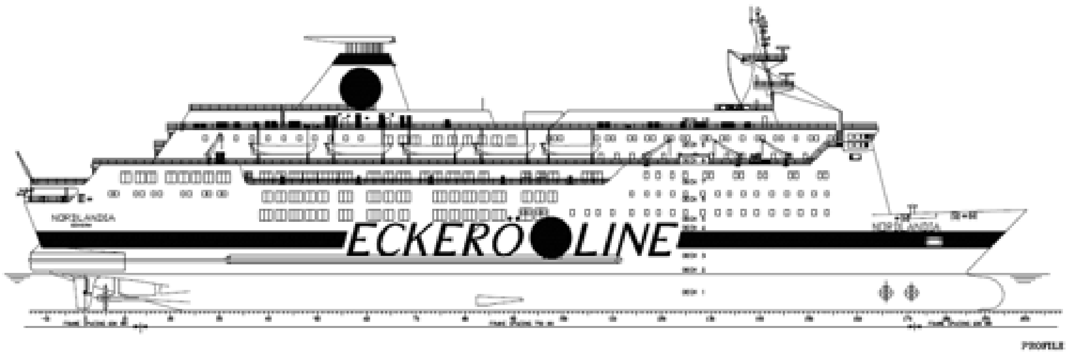


Figure 1. M/S NORDLANDIA *(Copyright Eckerö Line)*

1.1.1 General information

Table 1. The vessel's register information and the most important measurements.

The name of the vessel	NORDLANDIA
Call sign	OJGN
MMSI No.	230907000
IMO No.	7928811
Register No.	55134
The construction shipyard	AG Weser Seebeck Werft Bremerhaven
Year of construction	1981
Classification society and class	Bureau Veritas 1-3/3-E-Passenger/Car Ferry Deep Sea ICE 1 A
Gross tonnage	21,473
Net tonnage	8,695
Length o.a.	153.40 m
Length pp.	136.62 m
Breadth, max.	24.70 m
Breadth, mld	24.20 m
Draught	5.8 m
Deadweight	2,880 t
Displacement with a draught of 5.82 m	12,380 t
Engine power	15,300 kW
Speed	20 knots

Machinery:

Main engines: 4×Semt Pielstick 8PC2-5L, 529 RPM	each 3825Kw / 5200HP
Auxiliary engines: 1×MaK 6M332AK 1×MaK 6M20 2×MaK 8M332AK	852kW/1160hp 940kW/1288hp 1200kW/1630hp
Ppopellers 2×Esher Wys	Ǿ 3600, 220 RPM
Bow thrusters: 2×Jastram BU 100F	Ǿ 1940, 725 kW / 1000 hp
Stabilizers Denny-Brown-AEG	

Lifesaving equipment:

Device	Type	Device	Type
1 rescue boat	60 persons	20 life-rafts	VIKING DKF, each for 25 persons
1 FRB	6 persons	25 life-rafts	DSL 25-V-R, each for 25 persons
4 motor lifeboats	80 persons in each	Lifejackets	2,216 for adults 200 for children
4 motor lifeboats	102 persons in each	Survival suits	20
Fire alarm and Hi-Fog sprinkler system	SALWICO CS 3000 Consilium		

Table 2. The vessel's capacity and construction information.

Car deck	400 private cars
Number of passengers	2,000 persons
The aft sponson has been added to the stern above the water line.	
Doors to prevent leakage have been installed on the car deck.	

1.1.2 The shipping company

Rederi AB ECKERÖ is a private shipping company. It was founded in 1961 to meet the demands of the car-passenger ferry traffic between Finland and Sweden. The headquarters are located in Mariehamn on the Åland Islands.

MS ECKERÖ, MS ROSLAGEN, MS NORDLANDIA and ro-ro vessel TRANSLANDIA are car-passenger vessels owned by Eckerö Line.

1.1.3 Manning

The master of the vessel (born in 1954) had studied at Åbo navigationsinstitut (Turku Maritime Institute) and received his officer's certificate in 1984 and master's certificate in 1990. He had worked as a master from year 2003, first on the TRANSLANDIA and from year 2005 on the NORDLANDIA. He had had a pilotage exemption to the Port of Tallinn since February 2006.

The chief officer (born in 1974) had received his officer's certificate in 1999 and chief officer's certificate in 2002. He had worked as an officer 1999-2001 and on the NORDLANDIA since 2004. He had worked as the chief officer on the NORDLANDIA since October 2005.

No maritime declaration was issued on the dangerous situation nor was a marine casualty report submitted to the Finnish Maritime Administration.

1.1.4 The bridge and its equipment

Table 3. Navigational instruments.

Device	Type	Device	Type
Magnetic compass Heads-up display	Cassens + Plath	Gyro-compass	Anschütz std 20
A radar, the antenna of which is in the aft and the displays on the bridge wings	Krupp Atlas 4101, AZ 3011	Gyro-compass	Anschütz std 22 + off course alarm,
Radar	Raytheon MK11, ARPA 3430 / 12SU	Autopilot	Anschütz Nauto Pilot 2025
Two radars	Raytheon M34, ARPA + 2 displays on the bridge wings	Echo sounder	Furuno FE-700
DGPS	ADVETO DNAV-3101	Log	SPERRY SRD H21 two axis Doppler
DGPS	Leica MX 420/2 + MX525	Signal horn	Typhon 2 X, Zöller-Signal-Automat
Propeller control device	Stork kwant / Sneck Holland	Machinery control	Esher Wyss Wabco Westinghouse
Draught, trim and inclination gauge	SAJ instruments		
Wind meter	Thies Clima	ECDIS	Aecdis 2000 mod 800
VDR	M2 Consilium	Automatic speed control	ETAPILOT, Lund, Stanismac MK1

Table 4. The radio station.

Device	Type	Device	Type
VHF	Sailor Compact RT 2047	HF	Sailor Compact SSB RF 2100
2 VHFs	Sailor Compact RT 2048	HF	Sailor Compact SSB RM 2150
VHF DSC	Sailor Compact RM 2042	GMDSS alarm	Sailor Alarmunit 2149C
Lifeboat radios	3 Scanti VHFs 9110	Aviation radio	Jotron TRON AIR
EPIRB	Kannad 406 WH	Navtex	JRC NCR 300 A
Satellite telephone	Fulmar Globalstar Voice		

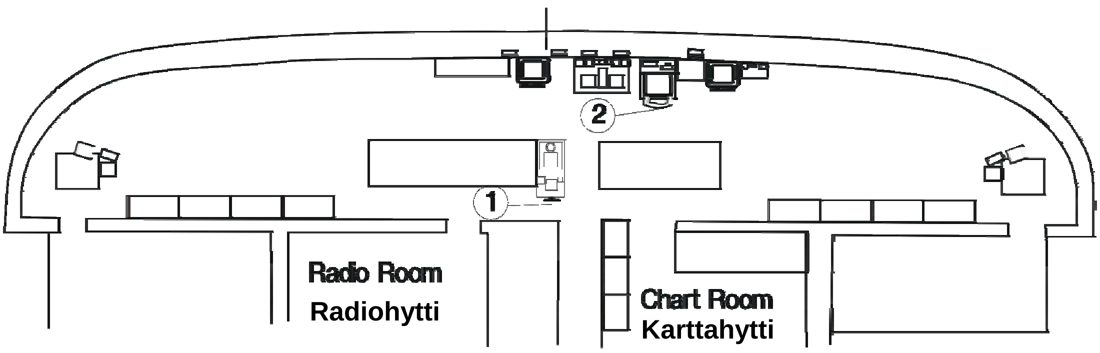


Figure 2. The bridge. The helmsman's place of work is located at point 1 and the officer of the watch's at point 2.

Figure 3. Overall view of the bridge.

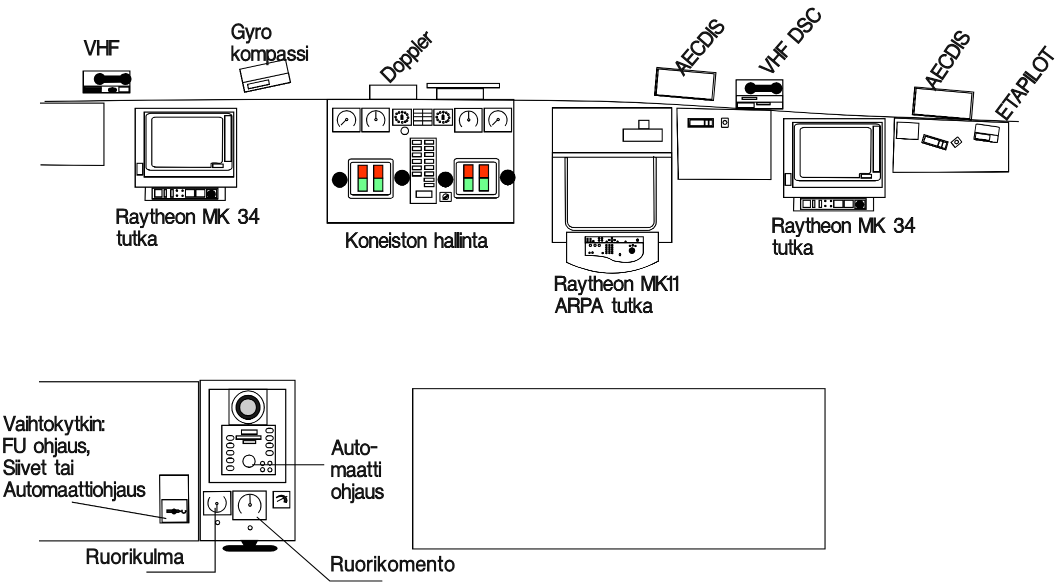


Figure 4. The middle part of the bridge and the most important control and navigational instruments.

Finnish text in figure 4.	**Translation into English**
tutka	radar
kompassi	compass
koneiston hallinta	machinery control
vaihtokytkin: FU-ohjaus, siivet tai automaattiohjaus	Switch between: FU steering, wings or autopilot
Ruorikulma	rudder angle
ruorikomento	rudder command

Control devices

The main propellers, bow thrusters and rudders each had their separate control devices. They had not been integrated.

The pitches and revolutions of the main engine propellers were chosen from the middle of the bridge or from the bridge wings. There is no mechanical coupling between them. All control devices were active simultaneously. The levers functioned with the FU-principle. All levers followed the levers which were used. It was possible to move from one manoeuvring place to another and continue manoeuvring without reactivating the levers. This has prevented human errors as to propeller control.

The control devices of the bow thrusters were placed only on the bridge wings. There is also no mechanical coupling between the manoeuvring places of the bow thrusters. Both manoeuvring places are active at the same time. The orders were given with the help of push buttons. There were two bow thrusters. Their coupled powers were divided between push buttons I, II and III. The controlling principle of all thrusters was safe.

There were two rudders on the vessel, which were coupled mechanically. The manoeuvring place is chosen by a mechanical switch to four different manoeuvring places. The switch is located at the helmsman's manoeuvring place. The only FU-manoeuvring lever of the bridge is located at the helmsman's manoeuvring place. When the helmsman leaves, he/she switches the manoeuvring to NFU-steering on the bridge wings or to the autopilot.

The autopilot can be used either from the helmsman's or the officer of the watch's place of work. The autopilot remote control panel is located at the officer's place of work. It can be used to change temporarily to NFU-manual steering. When the NFU-lever is pressed to the right or to the left, the autopilot switches to NFU-steering. When steering with the help of the NFU-lever, the officer cannot properly keep an eye on the radar, the compass or the view from the window. As the only indicator of the rudder angle, which needs permanent observation, is located in the ceiling on the left side of the officer. NFU-steering is released by pressing the NFU-lever forwards. This has been marked by the OFF-position, which means NFU OFF. At that point the autopilot starts to keep the course which the vessel had when the OFF-button was pressed.

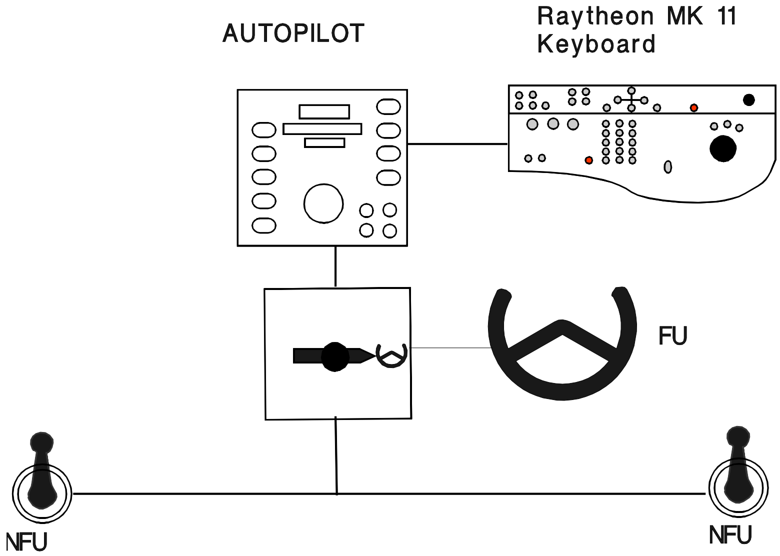


Figure 5. The rudder control device is chosen with the help of a mechanical coupling. The NFU-steerings located on the bridge wings are active simultaneously.

Indicators used in manoeuvring

There was no rate-of-turn meter on the vessel. The indicators of the rudder angle were located on the helmsman's console, on the bridge wings and in the ceiling in the middle of the bridge.

Logs

There was a two-axis SPERRY DOPPLER on the vessel. The screen of the Doppler display was dark. According to the master, the log readings were unreliable. The Doppler is not used and it is not coupled with the radars.

Radars

The Raytheon radar does not show drift. According to the master, the radars have been coupled with GPS-speed. In the display of the radars there was, however, the information LOG (W). This refers to the speed over water according to the Doppler's longitudinal speed. The radar is always used with the NORTH UP-display mode, because it incorporates all the advanced functions.

The electronic chart ADVETO

An electronic charting programme ADVETO with several displays (Figure 6) had been acquired to the vessel. The compass, GPS and wind meter had been coupled to it. The wind meter was reliable because it did not have any moving parts. Four sensors measured the relative wind direction and speed with the help of differences in pressure. The rate-of-turn was calculated from the gyrocompass. The wind vector can be seen on the symbol of the vessel. The displays of the chart programme were located on both bridge wings (Figures 7 and 8) and in the middle console (Figure 4).

According to the master, there is a separate GPS connected to ADVETO; this GPS determines the position six times more often than a normal GPS.

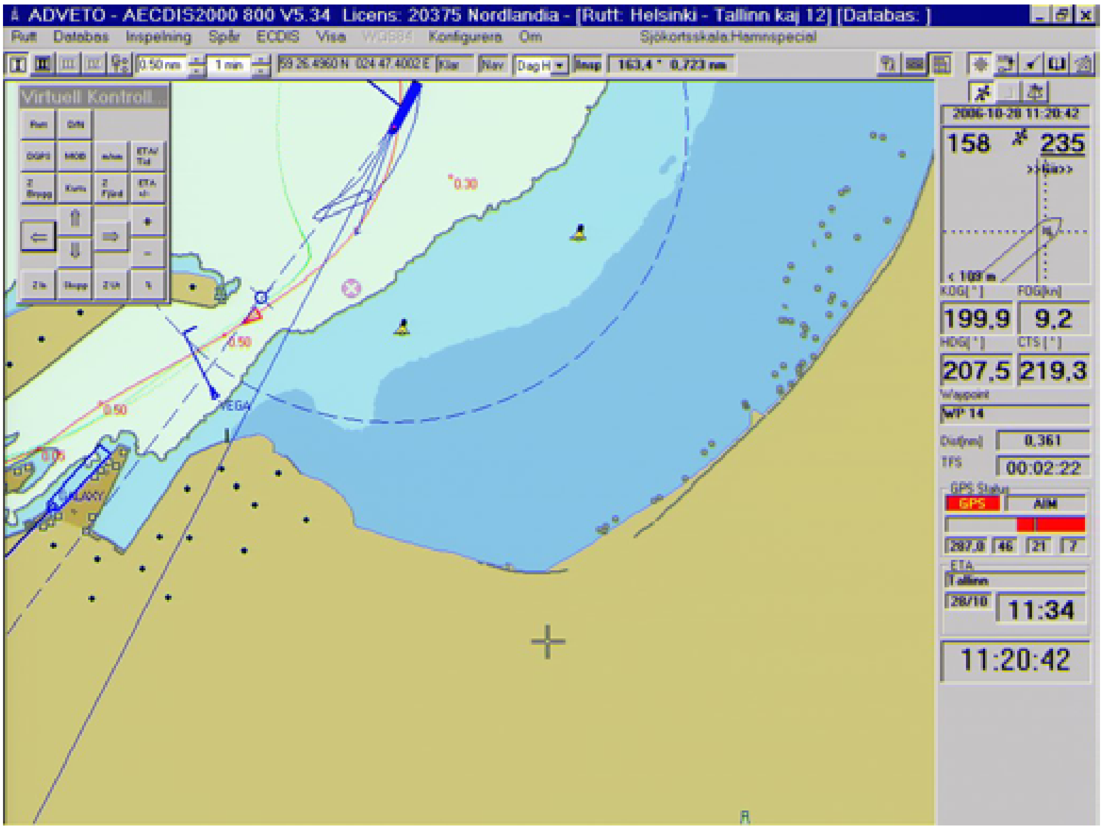


Figure 6. The display of the electronic chart ADVETO. The symbol of the vessel and the predicted position one minute ahead in time (predictor).

ADVETO was essential to be used together with the radar, because it showed the information lacking from the radar.

- motion in relation to ground (COG and SOG),
- drift angle,
- route plan and
- predictor.

A high-quality predictor display is based on a frequent GPS position determination. The master stated that he always uses the predictor when in a harbour area. He said it is the most useful information obtained from ADVETO.

The predictor which can be seen on the electronic chart presents prediction of the yawing movement of the vessel. The predictor presents the vessel's new position after a time period chosen by the user and calculated on the basis of the measured present motion. The predictor shows the information received from the satellite positioning device, compass, log and angular velocity gauge as one graphic figure. The predictor can be seen in the VDR-registration figures in the approach around the breakwater and in the basin (Figures 6, 9 and 16).

The bridge wing

Figure 7. The vessel was manoeuvred from the port side bridge wing when it entered the harbour.

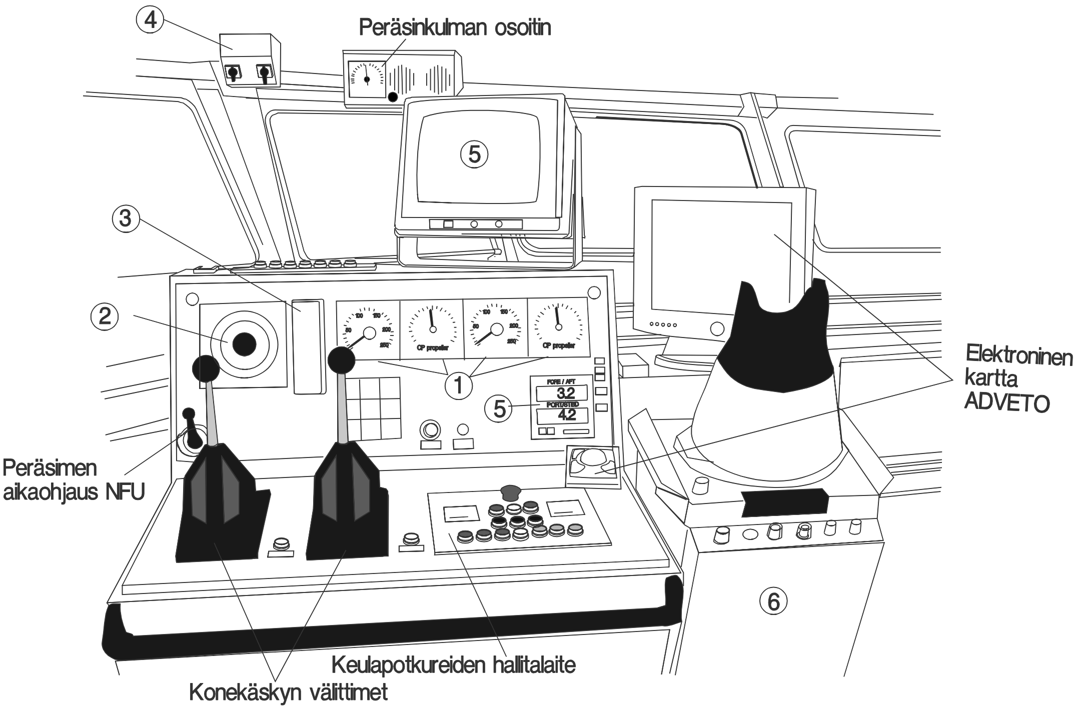


Figure 8. The texts in the figure indicate systems needed in port manoeuvring.

Finnish text in figure 8.	Translation into English
Peräsimen aikaohjaus NFU	Rudder time control, NFU
Peräsinkulman osoitin	Rudder angle indicator
Elektroninen kartta (ADVETO)	Electronic chart (ADVETO)
Keulapotkureiden hallintalaite	The control unit for bow thrusters
Konekäskynvälittimet	Engine telegraphs

Table 5. A list of the devices presented in Figure 8.

Number	Device
1	The number of revolutions and pitch angles of the main engine
2	Gyro-compass display
3	Telephone
4	Window wipers
5	The secondary display of the radar
6	An old radar display

Engine-telergraphs steered propeller revolutions and blade angles simultaneously. The propeller control devices functioned actively from the middle of the bridge and from both bridge wings at the same time. No mechanical selector switches were needed. The levers functioned on the Follow Up-principle, i.e. the propeller effect could be felt from the angle the lever indicated.

The control unit of the bow thrusters was located next to the main propeller controls. The power control of the thruster propellers is divided into three steps by means of push buttons (I, II, III). The master had to concentrate on the panel when he adjusted the desired effect.

The rudder angle was controlled with the help of the Non Follow Up (NFU)-lever which was located next to the propeller controls. The indicator for the rudder angle was located in the ceiling (Figure 5). The NFU-lever switches on the rudder pump. When one lets go off the lever, the rudder stays in that position. When steering, the master had to keep an eye on the rudder indicator in the ceiling.

The electronic chart was located on the right side of the steering console, and it was easy to see from the manoeuvring place. “A mouse” functioned as the user interface, and it can be seen above the bow thruster control device.

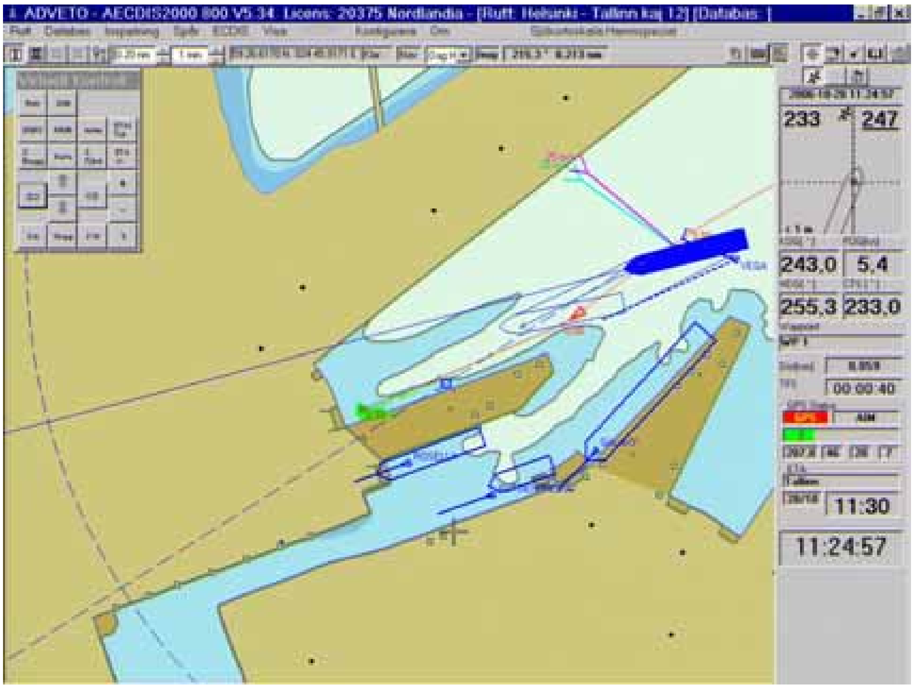


Figure 9. *The electronic chart programme ADVETO. In this figure the NORDLANDIA approaches the quay and the vessel's motion is indicated with the help of a predictor.*

Figure 10. *A side view from the port wing of the bridge. The side was easy to see. There were windows reaching to the edge of the floor, which improved visibility.*

The meters (displays) and control devices were not optimal for backing. The rudder angle indicator remains behind one's back. It is difficult to adjust the bow thruster forces with the help of the push buttons, because they are too far away. In port manoeuvring the control of rudders and bow thursters take up attention from observing the view to the quay. The bow thrusters and rudders would have required levers operating on the Follow Up-principle. When touching the lever by hand, one can feel the given order from the FU-lever, which gives the possibility to concentrate on the good visual view from the bridge.

1.2 The accident event

The description of the accident events is based on the vessel's VDR-record. The master of the vessel did not make a marine casualty report[1] and nor did he give a maritime declaration. Therefore the VDR-record has played an important role in the accident investigation.

1.2.1 Weather conditions

The Estonian Meteorological and Hydrological Institute: Weather forecast for seafarers 28.10.2006 at 09:00[2].

Storm warning. Northern Baltic, Gulf of Finland: westerly-northwesterly winds 20-25 m/s, in gusts 28-32 m/s, wave height 4-6 m, sea level in the Bay of Tallinn can become dangerously high +80-85 cm.

Finnish Meteorological Institute: Weather forecast for shipping 28.10.2006 at 07:50[3].

Storm warning. Gulf of Finland, Northern Baltic, Sea of Åland, Sea of Archipelago, Sea of Bothnia and The Quark: Northwest storm 25 m/s. Forecast for next 24 hours: Gulf of Finland: Northwest 20-25 m/s. Before noon decreasing gradually, in the evening 12-17 m/s, at night 7-12 m/s. Rain or snow showers, first locally poor vis, by day better vis.

[1] The Finnish Maritime Administration has not required the vessel to submit a marine casualty report.
[2] The Estonian Meteorological and Hydrological Institute (Eesti Meteoroloogia ja Hüdroloogia Instituut), hereafter referred to as the Estonian Meterorological Institute.
[3] The Finnish Meteorological Institute, Climate Services.

Table 6. Weather forecasts to the proximity of the Port of Tallinn issued by the Estonian Meteorological Institute and the Finnish Meteorological Institute.

	For the time interval	**Forecast**
Estonian Meteorological Institute 27.10. 20:28 UTC: For the Port of Tallinn	for 24 hours – 28 Oct. till 1900 UTC	W - NW 18-23 m/s gusts 25-30 m/s
Estonian Meteorological Institute 28 Oct. 06:04 UTC: For the Port of Tallinn	for 24 hours – 29 Oct. till 1900 UTC	W - NW 18-22 m/s gusts 25-28 m/s
Finnish Meteorological Institute: forecast for the Gulf of Finland 28 Oct. 05:50	Forecast for next 24 hours	NW 20–25 m/s Decreasing in the morning In the evening 12-17 m/s at night 7-12 m/s
Finnish Meteorological Institute: forecast for the Gulf of Finland 28 Oct. 07:50	Forecast for next 24 hours	The same forecast as above
The Port of Tallinn information to the master at 10:40 (UTC+2)	Inquiry at the buoy no. 1, where a turn is taken to the direction 157°	21 m/s

The weather forecast always means wind speed at ten meters' height. The readings from the vessels' wind meter must be corrected to this height so that the wind observed on the vessel can be compared with this weather forecast.

The error caused by the vessel's hull also affects the wind speed[4]. An investigation done by the Finnish Institute of Maritime Research on MS ARANDA proved that the hull of a vessel causes errors in measuring wind speed.

On a car-passenger ferry it is easy to see that when the wind blows directly from the bow, the hull of the vessel somewhat lessens the impact of the wind, i.e. the wind meter reading must be adjusted upwards.

When the relative wind is 45° from the bow and the front part of the vessel is arched and streamlined, the hull of the vessel increases the wind gauge reading.

When the relative wind blows directly or almost directly from the side, this error does not occur.

When the wind blows from the stern, the superstructures of the vessel make the wind weaker where the wind gauge is located. The wind coefficients can be determined in fairways with major course alterations.

[4] Kimmo Kahma and Matti Leppävirta, On errors in wind observation on R/V ARANDA.

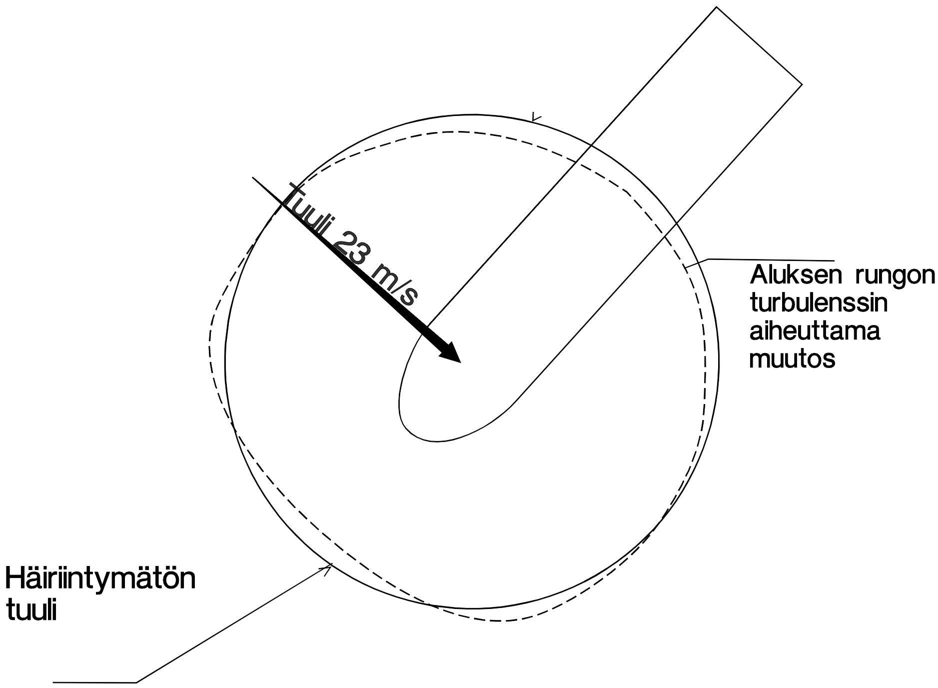


Figure 11. When the wind blew from the side or almost from the side, the NORDLANDIA's superstructure did not cause errors at the wind gauge.

Finnish text in figure 11.	translation into English
Tuuli	Wind
Häiriintymätön tuuli	Undisturbed wind
Aluksen rungon turbulenssin aiheuttama muutos	The change caused by the turbulence of the vessel's superstructure

Values on wind speed were obtained from the VDR-recording. When the NORDLANDIA was proceeding towards the southern tip of Naissaar, the wind blew from the side but somewhat abaft the beam. The relative wind met the wind meter of the vessel almost from the side. In this assessment 51 wind speed values were used in this study, and their mean value gave a wind speed of 23.3 m/s. The wind force variation was ± 5 m/s.

When proceeding southwards in the direction 165°, the wind blew diagonally from behind. Here 56 values were studied, and according to them, the mean velocity of the wind was 22.4 m/s. There were still gusts of ± 5 m/s. The vessel's superstructure somewhat decreases the wind meter reading with a coefficient of 1.0–0.95.

By comparing the measured mean values of wind, one can conclude that the correction coefficient in the case of the NORDLANDIA, with wind blowing from the stern, was 0.96 when the wind blew 23.3 m/s. Figures 11 and 12.

The wind blew from the stern of the vessel when the NORDLANDIA approached the Port of Tallinn. The vessel structures formed wind vortices at the stern, and the wind speeds registered by the vessel were too low. The wind meter readings rose after the vessel had turned towards the side wind. The wind speed in side wind was 21–25 m/s. The gusts were ± 2 m/s and the mean wind was 23 m/s.

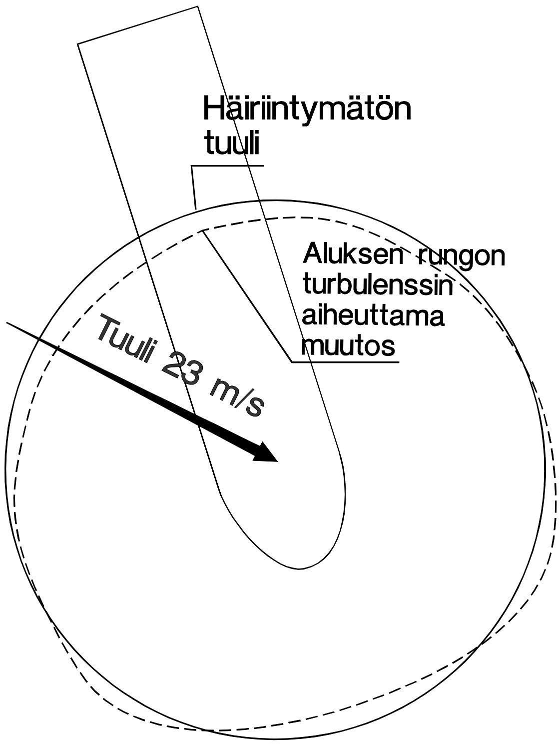


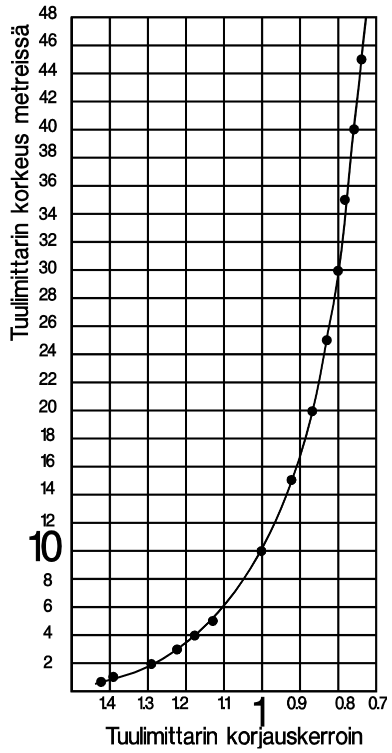
Figure 12. The superstructure of the NORDLANDIA decreased the speed of the wind blowing from the stern with a coefficient of 0.96, in which case the actual wind speed was 23 m/s.

Finnish text in figure 12.	**Translation into English**
Tuuli	Wind
Häiriintymätön tuuli	Undisturbed wind
Aluksen rungon turbulenssin aiheuttama muutos	The change caused by the turbulence of the vessel's superstructure

From the harbour area registered 15 wind speed values were assessed. The mean speed of the wind was 23.3 m/s also in port, but the gusts were only ±2 m/s. This is surprising because the breakwater should have decreased the mean velocity of the wind to a certain extent. The observations were from the area between the tip of the breakwater and the quay.

Between where the vessel collided and where it was moored 20 register values were studied. Their mean value was only 18.3 m/s, i.e. 5 m/s lower than before the collision.

The biggest correction is the correction in the wind meter reading to the height corresponding with the weather forecast, i.e. 10 metres. The sensor of the NORDLANDIA's wind gauge was at the height of approximately 41 metres.



The wind speed was 23.3 m/s between the breakwater and the quay. The correction coefficient is taken from the curve in Figure 13. The height of the wind sensor 41 metres gives 0.75 as the correction coefficient, i.e. one gets the wind speed at the height of 10 metres. **This gives a wind speed of 17.5 m/s at the height of 10 metres**.

In the weather report issued from Finland it was forecasted that the wind would decrease before noon and blow 12–17 m/s in the evening and 7–12 m/s at night. The report was correct because the wind had started to decrease when the NORDLANDIA arrived in the Port of Tallinn.

The wind meter of the NORDLANDIA was technically a good one. The measurements were accurate, because the wind sensor had been placed very high. This guaranteed undisturbed measurement results.

Figure 13. The coefficients to correct the wind meter reading so that it corresponds to the height of 10 meters, which can be compared with the weather forecast[5].

Finnish text in figure 13.	**Translation into English**
Tuulimittarin korjauskerroin	The correction coefficient for the wind meter
Tuulimittarin korkeus metreissä	The height of the wind meter in meters

Table 7. A summary on the registered values of the NORDLANDIA's wind meter recorded by the VDR.

Time interval	The course of the vessel	Mean values for the wind I				Number of observations
		The course	Speed		Gusts	
			Meter	10 metres' height		
09:18–09:30	219°	310°	23.3 m/s	**17.4 m/s**	± 5 m/s	51
09:45–10:20	165°	295°	22.4 m/s	**16.8 m/s**	± 5 m/s	56
10:22–10:26	240°–250°	320°	23.3 m/s	**17.4 m/s**	± 2 m/s	15

5 Nils Norrbin, 1983. Sida 6.8. Basic Ship Theory Vol. 1. page 320.

The weather[6] at Helsinki lighthouse 28.10.2006:

	wind direction	wind speed[7]	the most powerful gust[8]
at 10:00	west	21 m/s	26 m/s
at 11:00	west	21 m/s	29 m/s

The wind speed in the Port of Tallinn was 17.5 m/s and at the Helsinki lighthouse 21 m/s. The wind was decreasing from southwest.

1.2.2 The preparations for entering the port

The master followed the changes in the wind direction and speed and ordered a tug to Tallinn.

1.2.3 The accident event

The accident event has been described according to what the master and chief officer have told and on the basis of the VDR (Voyage Data Recorder) recordings. The VDR had saved the radar picture and the electronic chart display every fifteen seconds. The time of the radar picture was saved only with the precision of one minute, but the vessel's position on the electronic chart was saved with the precision of one second. The electronic chart has been used in the reconstruction of events. The time of the VDR-recording is UTC +3. The time used in the report is the Finnish time UTC +2, which was also used on the vessel.

The NORDLANDIA departed from Helsinki to Tallinn 28.10.2008 at 08.00. The weather was fine at the time of departure. The wind increased during the voyage[9]. The option of waiting for the weather to improve was never discussed.[10].

The radar VDR-recording gave a clear picture of the weather. It was noted that the sea clutter was very strong from northwest. The ARPA-tracking was used on all targets which were approaching the NORDLANDIA's track. The NORDLANDIA did not have any meeting vessels on the inbound track line in the Bay of Tallinn.

The master, the officer of the watch and the helmsman were on the bridge.

At 10:10	The port could be seen on the radar on the scale of 1.5 nautical miles. There was no meeting traffic. The course was 156° and the speed 16.9 knots.
At 10:14	The master said that the stabilizers could be taken in.
At 10:18	The hand rudder was switched on and the start up of the bow thrusters was ordered from the control room.

The vessel started its yaw towards the Port of Tallinn a bit before 10:19:42 (Figure 12). The speed was 12.9 knots.

At 10:20:12	The rudder 10° to starboard.
At 10:21:08	”25” (the helmsman).

6 The Finnish Meteorological Institute, Climate Services.
7 The wind speed is the speed of ten minutes' mean wind.
8 Momentary wind speed.
9 The hearing of the master 7.2.2007.
10 The hearing of the chief officer 7.2.2007.

The chief officer told that he had come to the bridge at 10:30, but his voice can be heard in the discussions on the bridge already at 10:21:15. The master said to the chief officer that he had ordered tug assistance. When the yaw started, the master, the officer of the watch, the helmsman and the chief officer were on the bridge[11].

At 10:21:20	The helm order "35" was given. This caused a major transitory rate of turn to starboard, which can be seen in the VDR-recording after seven seconds.
At 10:21:26	The master gave the helm order "10", which was repeated by the helmsman.
At 10.21:48	The master gave the course order "230", which was repeated by the helmsman. The same bearing could be seen on the ADVETO-chart.
At 10.21:54	The chief officer called the tugboat VEGA on the VHF.
At 10.22:06	The master gave the course order "240", which was repeated by the helmsman.
At 10:22:07	The chief officer called the tugboat VEGA on the VHF.
At 10:22:19	The chief officer repeated the call.
At 10:22:27	The master told the chief officer that he should try channel 14.
At 10:22:38	The chief officer repeated the call on channel 14 and the VEGA answered immediately.
At 10.22:41	The officer of the watch gave the course order "240". The same bearing could be seen on the ADVETO-chart.
At 10:22:43	The chief officer told the tugboat on the radio that it could come to the stern of the NORDLANDIA.
At 10:22:44	The master asked to get the steering of the rudder to the bridge wing. The chief officer to the tugboat: "To the port side".
At 10:22:45	The officer of the watch: "Rudder to the bridge wing".

11 The hearing of the chief officer 7.2.2007.

Table 8. The electronic chart values which correspond with Figure 14.

Time UTC + 2	**HDG**	**SOG**	**Wind gauge**	**comment**
10:19:12	155.6	14.3	292° 23	VEGA is waiting within the breakwater The radar scale is changed 1,5' → 0,75'
10:19:42	158.3	12.9	297° 20	The turn starts. No traffic in the port.
10:20:12	178.9	10.6		VEGA starts slowly moving COG 211°
10:20:42	207.5	9.2		VEGA has stopped.
10:21:12	216.5	9.0	310° 23	The radar is changed to 0.5`scale.
10:21:42	222.1	9.1	315° 25	VEGA is stopped.
10:21:57	229.0	9.5	318° 22	
10:22:27	235.5	9.3	306° 24	ROSELLA, GALAXY, AUTOEXPRESS2 in port.
10:22:42	239.4	9.0	308° 24	VEGA does no move.
10:22:57	241.1	8.7	313° 23	VEGA turns to port.
10:23:27	246.5	8.2	310° 22	VEGA starts moving and increases speed quickly.
10:23:57	250.1	7.7	310° 21	VEGA is by the side and can be seen in the radar.
10:24:27	245.0	6.9	320° 23	VEGA is by the side and its course is 255°.
10:24:57	255.3	5.4	309° 25	VEGA stays at the side and its course is 310°.
10:25:27	254.6	4.7	320° 24	VEGA stays by the side and its course is 310°. The predictor shows the future point of colli-sion.
10:26:12	249.7	4.2	315° 25	VEGA cannot be seen in the picture.
10:26:42	244.5	2.0	310°	The collision has taken place four seconds earlier. VEGA is backing.

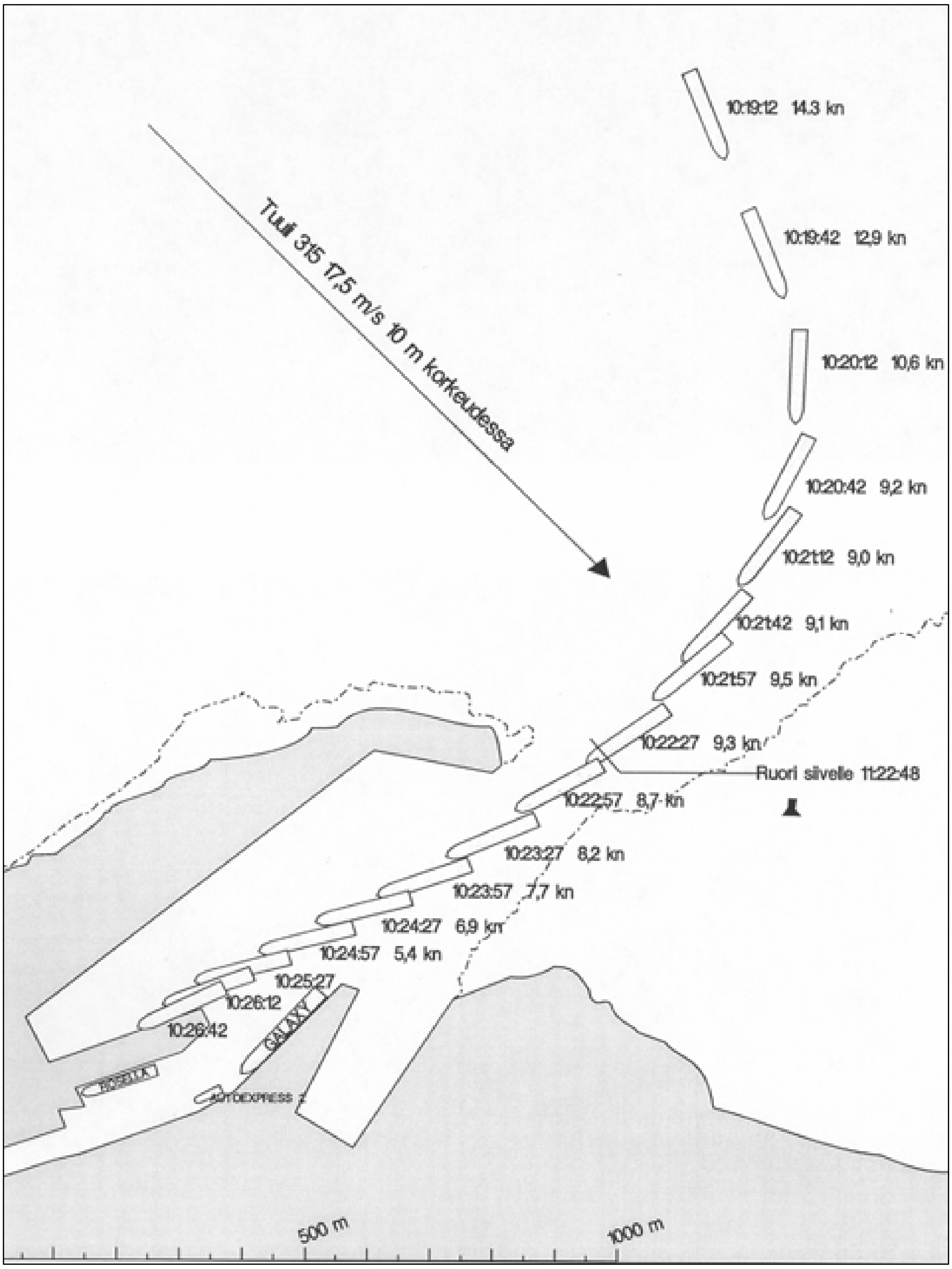


Figure 14. *The track of the vessel according to the electronic chart and the GPS. The time for the coupling of the rudders to the bridge wind has been taken from the bridge speech recording,*

Finnish text in figure 14.	**Translation into English**
Tuuli 315 17,5 m/s 10 m kokeudessa	Wind: direction 315, 17.5 m/s at 10 meters height
Ruori siivelle	Steering to the bridge wing

The GPS-positioning, compass direction, speed over ground and wind direction and velocity have been presented in Figure 14 and Table 8. In addition, the surroundings and other vessels have been observed from the chart and the radar.

At 10:22:51 Tugboat VEGA informs that it is at the stern. The NORDLANDIA passes the tip of the breakwater.

At 10:23:53 The chief officer: ”245”, which is the temporary course over ground.

Below is an enlargement of the engine and rudder orders between 10:20:42-10:22:57.

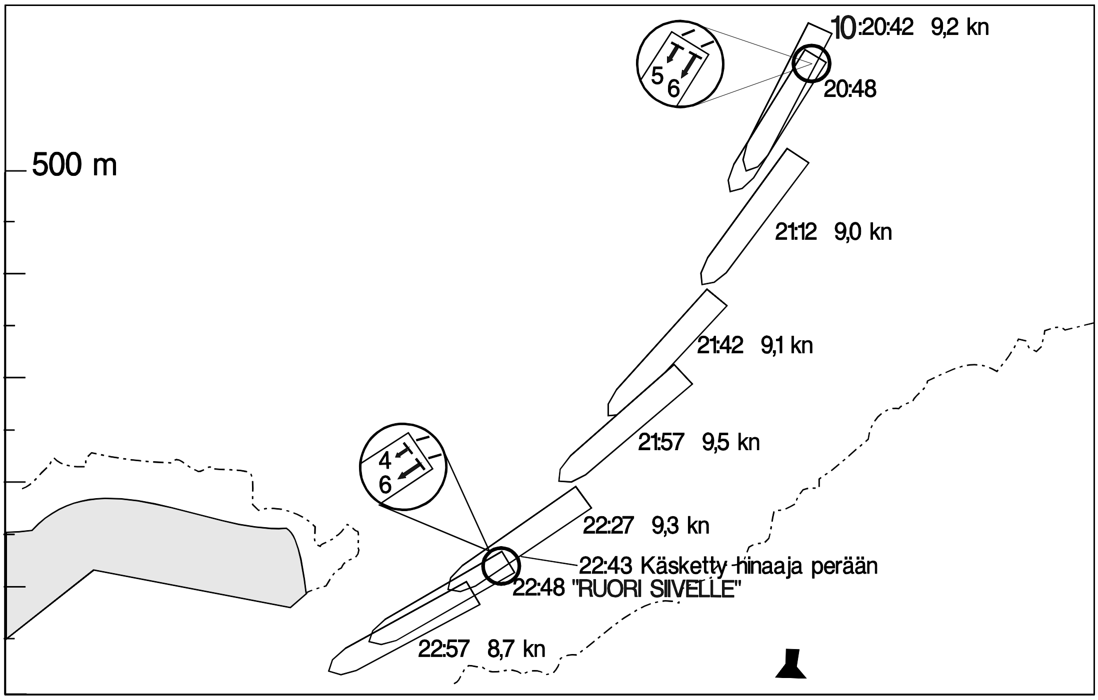


Figure 15. The turn towards the port. The settings of the rudders and propellers can be seen as the enlargements drawn in the circles. The exact values are presented in the table 9. The master took over the manoeuvrings to the bridge wing at the breakwater.

At 10:20:48 The rudders were turned to port so that the angular velocity would decrease. The engine order was still high.

At 10:22:48 Only the power of the starboard propeller has been slightly reduced.

Finnish text in figure 15.	**Translation into English**
Ruori siivelle	Steering to the bridge wing.
Käsketty hinaaja perään	Command to the tug boat to move astern

Table 9. The numerical data from the VDR-recording which gives complementary information with reference to Figure 15.

Time UTC+2	**Rudder angle**	**Pitch Port**	**Pitch Stb**	**Thruster Port** (0-3)	**Thruster Stb** (0-3)	**COG**	**SOG**	**HDG**
10:20:48	-23.8	6	5	-	-	205	9.3	212
10:22:48	-8	6	4	-	-	230	9.1	240

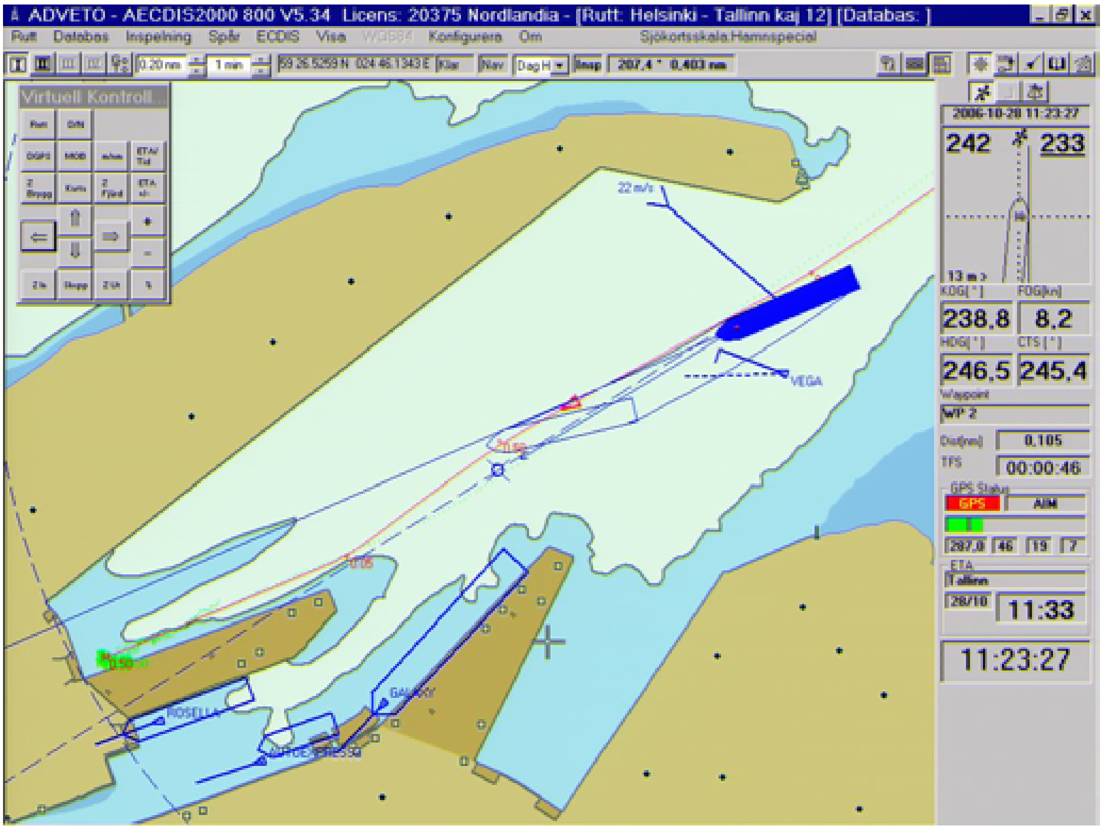


Figure 16. VDR-recorded picture from the electronic chart (ADVETO) 10:23:27.

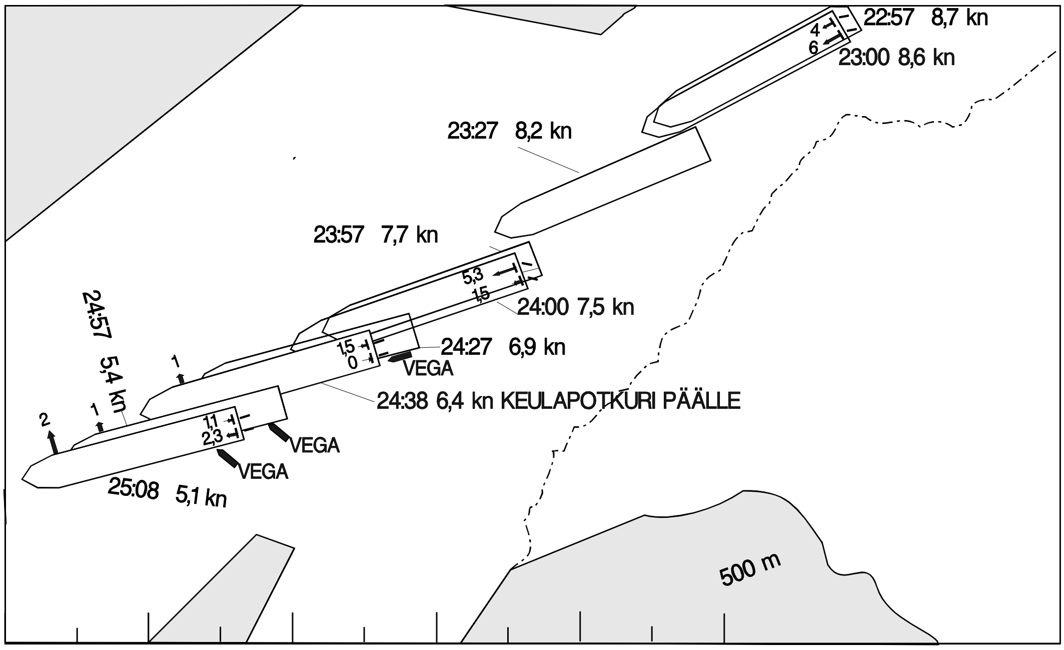


Figure 17. The setting of the propellers and rudders can be seen at the stern and the bow thruster setting 1-3 at the bow. Further details are available in Table 10. The VEGA starts pushing between 10:24:27 and 10:24:57. The data taken from the ADVETO-chart.

Finnish text in figure 17.	Translation into English
Keulapotkuri päälle	Starting of the bow thruster

Table 10. The bow thrusters were started to be used at 10:24:38. Bow thruster: 1=slow, 2=half, 3=full.

Time UTC+2	**Rudder angle**	**Pitch Port**	**Pitch Stb**	**Thruster Port** (0-3)	**Thruster Stb** (0-3)	**COG**	**SOG**	**HDG**
10:23:00	-6	5	4	-	-	235	8.6	242
10:24:00	-13.8	1.5	5.3	-	-	241	7.5	252
10:24:38	1	0	1.5		1	243	6.4	254
10.25:00	1	1	1.1		1	243	5.1	255
10:25:08	-1.2	2.3	1.1		2			

The VDR saves the pictures from the electronic chart (ADVETO) at a time interval of 15 seconds. In the chart are also the position coordinates of the vessel. A recorded picture at 10:23:27 has been presented in Figure 16. The changes in the rudder and propeller effects have been registered and the positions of the vessel when these changes took place have been interpolated to be between the above-mentioned positions in Figures 15 and 17.

At 10:24:30 The bow thruster was started to be used.
At 10:24:50 The chief officer requests VEGA to push 20%.

At 10:25:00	VEGA acknowledges.
At 19:25:02	The master asks to make a request to the tug for 40% pushing power.
At 10:25:03	The chief officer asks for 40% power from the tug on the VHF.
At 10:25:05	The master: ”Full power!”
At 10:25:06	The first officer on the VHF: ”50%”. VEGA acknowledges.
At 10:25:35	The master: ”Full power!”
At 10:25:38	The master: ”100%”.
At 10:25:39	The first officer on the VHF: ”VEGA 100%”.
At 10:26:08	The master: ”STOP”.
At 10:26:10	The first officer on the VHF: ”STOP”
At 10:26:38	Collision sounds can be heard.

According to Figure 17 the manoeuvring orders given 10:23:00-10:24:57 were used to try to prevent the vessel from turning too much towards starboard and to decrease speed at the same time.

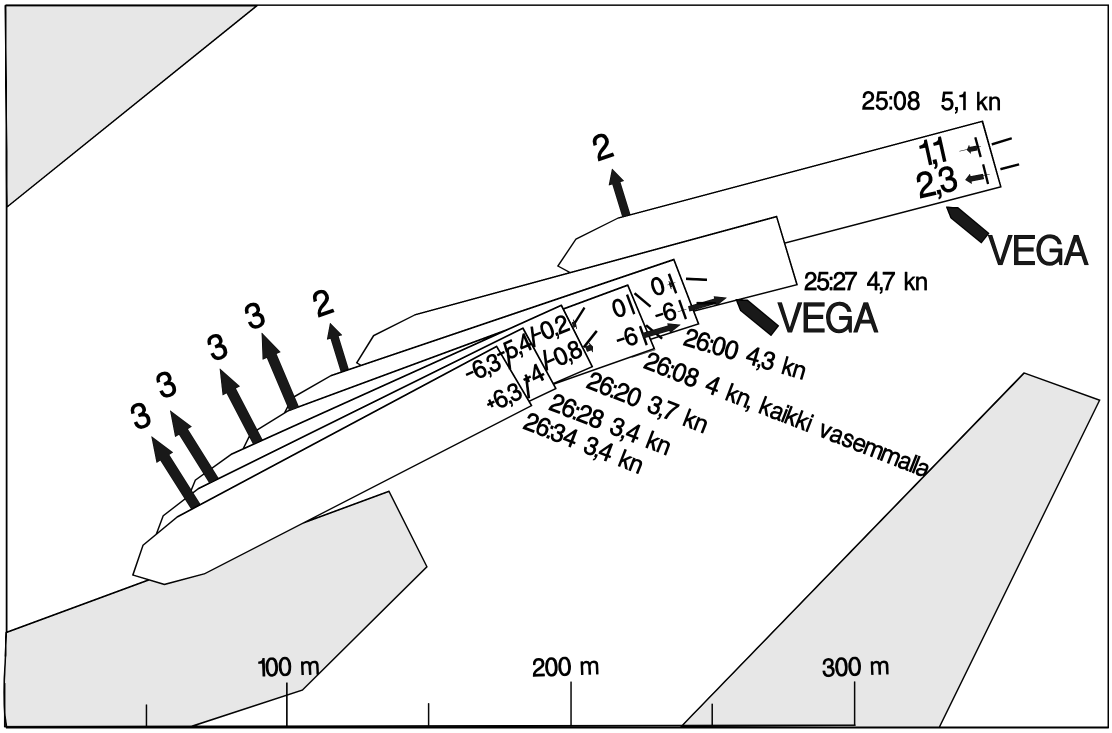


Figure 18. The collision took place 10:26:34. The VEGA did not have enough time to turn the NORDLANDIA. This figure is an illustration of the manoeuvres presented in Table 11.

Finnish text in figure 18.	**Translation into English**
Kaikki vasemmalle	Hard to port

Table 11. The vessel's movement from 10:25:08 onwards to the moment of collision. Bow thruster: 1=slow, 2=half, 3=full.

Time UTC+2	**Rudder angle**	**Pitch Port**	**Pitch Stb**	**Thruster Port** (0-3)	**Thruster Stb** (0-3)	**COG**	**SOG**	**HDG**
25:08	-1.2	2.3	1.1		2			
26:00	-11.2	-6	0		2	234	4.3	252
26:08	-33.6	-6	0		3	231	4.0	249.3
26:20	+16.5	-0.8	-0.2		3	244	3.7	245
26:24	+29.9	2,1	-4.0		3	221	3.6	243
26:26	+29.8	3.2	-4.0		3	221	3.5	243
26:28	-30	4	-5.4		3	220	3.4	242.5
26:30	30	05,0	-1.7		3	220	3.6	242.1
26:32	30	6.1	-6.6		3	222	3.4	242.1
26:34	30.2	6,3	-6.7		3	225	3.3	242.5
26:36	30.4	6.7	-7.4		3	233	3.2	243.4
26:38	30.7	7.1	-8		3	236	2.7	245
26:40	30.5	7.1	-6.5		3	259	2.5	246.5

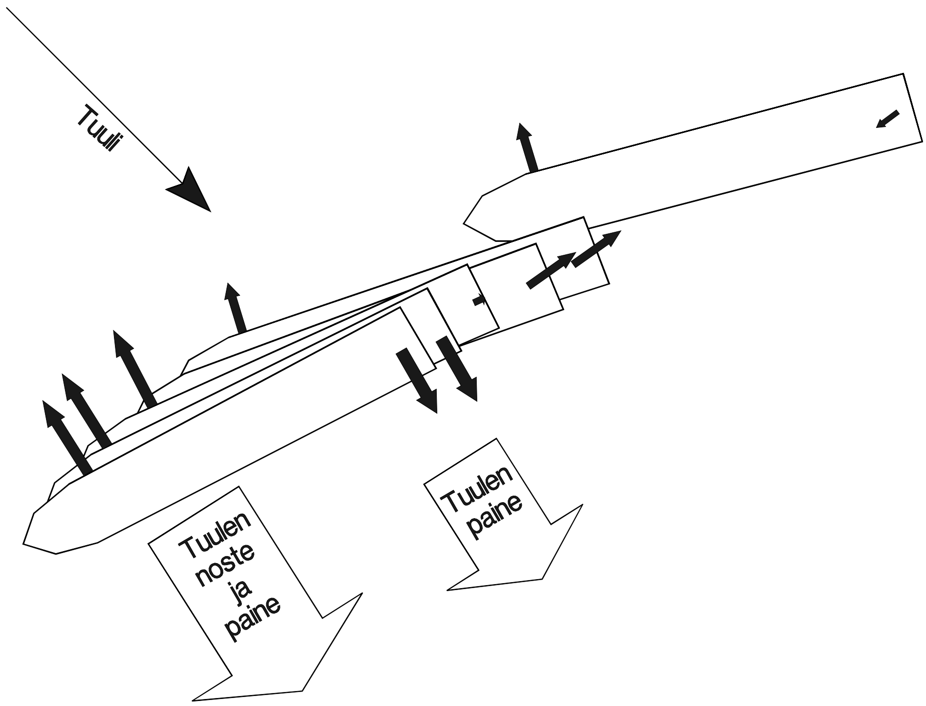


Figure 19. The settings of the vessel's rudders and propeller before the collision corresponding to figure 18 have been presented as approximate force vectors.

Finnish text in figure 19.	**translation into English**
Tuuli	Wind
Tuulen noste ja paine	Wind force and wind pressure
Tuulen paine	Wind pressure

At first the master slowed down the speed by reducing power. After that the deceleration by backing started in such a way that there were attempts to lift the stern and the bow to starboard. It is not possible to discern the push effect of the tug.

At the last stage when it was clear that the bow would collide with the quay, the master tried to turn the stern towards the quay so that the effects of the collision would be minimized.

1.2.4 Injuries to persons

The collision did not cause any injuries to persons.

1.2.5 The various parties' opinions about the causes of the accident

The master of the vessel was the only person who expressed his opinion about the causes of the accident in connection with the investigation. In the interview[12] the master expressed his opinion that the biggest mistake was that the tug pushed at the stern near the quay. According to the master, the mooring would have succeeded if it had not been for the tug.

1.2.6 Vessel recording equipment and the VTS

Recording equipment. There was a VDR on the vessel, and it recorded what happened. This recording has been used in the investigation.

The operation of the VTS and supervision systems. There is a VTS in Tallinn, but it did not participate in the course of events.

1.3 Damages to the vessel and the port and rescue activities

1.3.1 Damages to the vessel

Figure 20. The NORDLANDIA's damage on the port side bow of the vessel. The damage was caused by the collision with the fender of the quay. The shock absorbing part of a similar but an intact fender can be seen to the left in the figure.

[12] 7.2.2007

The port side part of the NORDLANDIA's bow was damaged when it hit the quay fender. A 3-4-metre long and 60-cm-high hole appeared at the frames 153-168, in the plating located next to the stairwell at the bow beside the cardeck (Figure 20). The hole was approximately 2.5-3 metres above the (car)deck. Several frames were damaged. All the damages to the vessel were located above the water line.

The representatives of the Estonian Maritime Administration and the vessel's classification society Bureau Veritas checked the damages on the day the collision had taken place. The classification society gave the vessel permission to move to the dock.

1.3.2 Other damages

The port and port equipment

Figure 21. The damaged quay fender.

Figure 22. In the foreground the passenger gangway of the quay and the fender which were damaged by the NORDLANDIA's collision. In the figure the damaged fender located to the left has been repaired temporarily, and the intact fender can be seen to the right.

Figure 23. Damages to the passenger gangway.

Of the port constructions, the fender and the covered passenger gangway were damaged. The bow of the NORDLANDIA only hit one fender, and its shock absorbing part was damaged beyond repair (Figure 21). Both the damaged, temporarily repaired and an intact fender can be seen in Figure 22.

The wide bow of the vessel reached till the passenger gangway at the point of collision, and the approximately five metres of the tin roof of the passenger gangway collapsed (Figure 23). There is no information as to the manning of the passenger gangway at the moment of the collision, but no member of the ashore personnel was injured.

Rescue activities

There was no need to commence rescue activities, as the collision with the quay did not cause personal injuries and the damages did not endanger the safety of the vessel while it was in port.

1.4 Organisation and management

The shipping company and the vessel had safety management systems with conformed to authority requirements. The International Maritime Organization's (IMO) ISM Code requires that shipping companies draw up a safety management system, the instructions of which are called the SMS-guidelines (Safety Management System). The vessel had valid manuals in accordance with this.

As to the deck personnel, the contents of the manual dealt with bridge activities, mooring, cargo handling and dangerous incidents. As to the engine room personnel, the manual concentrated on the engine room activities, the handling of fuel and dangerous incidents in the engine room. In addition to this, there were instructions on the familiarization routines with reference to new personnel and possible alcohol tests.

The bridge activities were defined in the manual called *Fartygshandbok M/S Nordlandia*[13]. The manual was updated 2004-04-16. As to the tasks and responsibilities of the officer of the watch, e.g. the following was said in the manual:

> ***Summoning the master***
>
> *24 The officer of the watch shall immediately inform the master in the following circumstances:*
>
> *f) ... The officers of the watch shall agree with the master's plans for safe navigation, manoeuvring, approaching the port and departure. If there is anything unclear, the officer of the watch must consult the master on his planned intentions.*

According to f), the master must inform the officer of the watch on the manoeuvring both when arriving in a port and when departing. In the interview, the master emphasized only his own role in the decision-making.

[13] Fartygshandbok: Rederiaktiebolaget Eckerö, **Fartygshandbok M/S Nordlandia**, Område Bryggrutiner, 1.2 instruktioner för vaktbefäl, Version 2, Datum 1998-03-31, Ersätter 1, Rev. Dat. 2004-04-16, Förf. BGD, Godkänd: B-G D, Datum 16/6 04.

1.5 The SOLAS and the STCW

Two important international conventions relating to the accident were in force when the accident happened. The IMO's International Convention for the Safety of Life at Sea, i.e. the SOLAS, stipulates operational limitations to passenger vessels and the IMO's Standards of Training, Certification and Watchkeeping Convention deals with the seafarers' education.

1.5.1 The SOLAS rule on operational limitations

The section 2, "Operational limitations"[14], in the Rule 30 of Chapter V in the SOLAS Convention Chapter reads as follows:

> *"A list of all limitations on the operation of a passenger ship, including exemptions from any of these regulations, restrictions in operating areas, weather restrictions, sea state restrictions, restrictions in permissible loads, trim, speed and any other limitations, whether imposed by the Administration or established during the design or the building stages, shall be compiled before the passenger ship is put in the service. The list, together with any necessary explanations, shall be documented in a form acceptable to the Administration, which shall be kept on board readily available to the master. The list shall be kept updated. If the language used is not English or French, the list shall be provided in one of the two languages." (The underlining by the Investigation Commission.)*

No wind limits as weather restrictions according to SOLAS had been defined for NORDLANDIA.

1.5.2 STCW competency requirement

The STCW Code defines a standard for the competencies of the master and the chief officer[15]. In the standard there is a Table A-II/2, in which e.g. the following requirements are specified:

> "*Manoeuvring and handling of a ship in all conditions, including:*
> *- berthing and unberthing under various conditions of wind, tide and current, with and without tugs."*

This only applies within wind limits which have been specified in advance for a ship.

[14] IMO, SOLAS, 2000 Amendments *effective January and July 2002.* Consolidated Edition 1997, Chapter V, Regulation 23.

[15] IMO, STCW -95, Seafarers' Training, Certification and Watchkeeping Code, Chapter II, Section A-II/2, Mandatory minimum requirements for certification of masters and chief mates on ships of 500 gross tonnage or more.

2 ANALYSIS

The risk management in connection with entering the port in the investigated case is analysed first. After that the communication-related problems between the vessel and the tug are specified. Lastly, the problems connected with the master's decision-making are analysed. The analysis sheds light on e.g. the deficiencies in the regulations and training with reference to determining the wind limit and the vessel control in all circumstances connected with it.

2.1. Preparing for entering the port in demanding conditions

Entering the port must be prepared carefully when the operational conditions are demanding or exceptional. These preparations naturally include the risk analysis of all circumstantial factors and the decisions made thereupon. The factors to be analysed include, besides determining whether it is on the whole sensible to try to enter the port considering the wind conditions, also possible operational limitations and extra factors such as using tugs.

The master of the vessel is responsible for the risk analysis and decision-making, and he/she is supposed to acquire all the necessary information about the circumstances and to know the manoeuvring limitations of the vessel. This information is not easy to acquire, because the master does not have clear operational limiting values for strong winds at his/her disposal. Neither the port nor the shipping company has set such limits. Nor have the authorities considered it necessary to come up with any limitations as to port entry. Because of this lack of precision, it is important that the expertise of the other bridge crew is used according to the good BRM-practice when preparing decisions.

The starting point of the shipping company’s *Fartygshandbok* (Ship Manual) for NORDLANDIA is the officer of the watch’s perspective. The officer of the watch is supposed to understand the master’s plans and intentions, and, if necessary, to consult the master when the situation is unclear. The basic assumptions of the text are correct, but it hardly means that the master does not need to inform the others about his/her plans when he/she has the navigational watch and manoeuvres the vessel. This kind of thought would be contrary to the prevailing BRM-thinking.

After the decisions are made, it is thus essential that the master goes through the plan with the other involved personnel without forgetting e.g. the master of the tug so that all persons involved know what is going to be done and on which operational parameters. Good practice includes that the other persons keeping navigational watch understand the line of thought behind the manoeuvres and that they can monitor it actively and interfere if things do not proceed as agreed.

In demanding conditions there has to be a plan B if the circumstances change. This plan B must be known to all persons involved.

Both the master and the chief officer had attended BRM-training, even though not at the same time. In their opinion the bridge team co-operation functioned well. The chief officer remembered that the master had said that he had ordered a tug to assist in the port.

In the case which is now investigated, the risk analysis of entering the port was made by the master alone. He did not have any ready calculated model solutions for various wind conditions at his disposal. The decision was based on a feeling. Also, the master did not consult the other officers on the matter, but decided alone that it was safe to continue entering the port by using the usual methods and the tug, which he had ordered.

The tug master was not specifically informed about the plans on how to enter the port, so he did not know for sure what was expected from him. What the assistance operation exactly meant was not defined to the tug.

2.2 Communication with the tug

The basic idea of communication with the tug was that the master would inform the chief officer about his intentions or orders and the chief officer in his turn would use the VHF-radio to transmit this to the tug. The chief officer would first repeat the order given by the master and then transmit it to the tug. This way the master still has the possibility to hear what is said on the radio and even hear what is acknowledged from the tug. The tug's working effect in per cents was used as the parameter for orders.

According to the VDR-recording the tug received the first order when there was approximately one minute's journey to the corner of the quay. When the situation developed, the master gave in Finnish an order, by which he requested a power of 40%, and the chief officer transmitted the information to the tug without pressing the tangent of the radio. A couple of seconds later the master clearly wanted to bring all the working effect into use. The chief officer reacted to this by requesting a working effect of 50%, and this was acknowledged by the tug. Half a minute later the chief officer asked the master in Swedish whether he wanted to have more power. After hesitating for a while, the master said again in Finnish that he wanted to have full power and specified quickly, three seconds later as a clarification, that he wanted to have 100%, which he thought that he had already asked for. After this the chief officer said this on the radio. This was acknowledged from the tug but not in a clear way. After about half a minute the master gave the stop order in Swedish, which the chief officer conveyed to the tug in Finnish/Estonian. The tug acknowledged. The collision with the quay took place about half a minute later.

Some problematic factors characterize the communication practices of the incident. Attention is drawn to the mixed use of several different languages. Swedish is the mother tongue of the NORDLANDIA's master and chief officer. The tug master speaks Russian. Because there was no common language, Finnish and somewhat modified Estonian were employed. No standard phrases were used. In addition, conveying the master's orders to the tug required smooth mutual understanding between the master and the chief officer, and this was not the case all the time.

Unclear and multileveled communication in many languages without standard phrases, e.g. the IMO's standard English, unavoidably leads to slow communication and misunderstandings, which could be seen during the course of events. This kind of communication practice is not unusual within seafaring, and the authorities have not deemed it justified to take action against it. Even though poor communication was not the direct causal reason for the collision with the quay, it did impede the master's situational control and as to the manoeuvring, created unnecessary delays in the prevailing demanding wind conditions.

2.3 The prevailing practice in port manoeuvring

Traditionally the master has had to learn port manoeuvring him-/herself. One part of improving one's experience has included asking older colleagues about the correct policies and procedures. This is normal within many sectors of bridge activities. This has resulted in undocumented courses of action, which are difficult to change as there are no instructions.

The IMO, the international maritime administrations, educational organizations and shipping companies have not showed any interest with reference to port manoeuvring. Port manoeuvring seems to be underestimated. The problems are not carefully looked into. This becomes obvious when one considers the design of navigation bridges and control devices. Between the IMO and the master there are many influential actors, who could change the direction of development.

The traditional manner has become a risky port manoeuvring practice. It has been believed that high speed and a quick stop at the quay are the best way to avoid the effects of the wind. Manoeuvring has been characterised by haste. Port entry has always been attempted bow first; the same has applied to the departure from the port. Backing has been considered ”unorthodox”. Navigational bridges have usually been designed in such a way that the intention is not to back long distances. The development of port manoeuvring has been slowed down unintentionally both technically and by the lack of criteria.

The track used by the NORDLANDIA shows that the vessel followed a track which corresponded with the usual track used when the weather was good. Strong wind was compensated by high speed.

Port manoeuvring has also not been considered dangerous, because the consequences of failure are usually small. However, bridge gangways meant for passengers are often damaged in the accidents. Unsuccessful manoeuvring can even lead to the loss of human lives and the economical losses can be considerable.

In the international and national regulations of seafaring the main attention is given to the limitation of the consequences of the accident. The rules aiming at preventing accidents only remain general instructions, in which the power of decision as to courses of action remains with the master. This has also been the case with port manoeuvring.

2.4 The role of organisations in port manoeuvring

The prevailing practice described above is not satisfactory. Port manoeuvring has been up for discussion at the IMO, but it has not been sufficiently taken into account in national maritime administrations or shipping companies.

2.4.1 The International Maritime Organization

The Code on the seafarers' educational requirements was adopted at IMO in 1995[16]. This STCW Code defined port manoeuvring as the new basic skill, which had to mastered in all circumstances. One of the Convention tables[17] defines the requirements set for the master and the chief officers on vessels of over 500 GT[18]. It applies to all masters worldwide. The first column of the table, "Competence", lists the main points of the requirements.

The following requirement with reference to port manoeuvring is expressed in the table:

"*Manoeuvre and handle a ship in all conditions*".

Under this there are individual subpoints, of which point 6 reads as follows:

"*Berthing and unberthing under various conditions of wind, tide and current with and without tugs".*

The requirement "in all conditions" can only be applied if the vessel's operational limitations are taken into consideration. In 1995 the rule 23 **Operational limitations**[19] was added to the SOLAS Convention Chapter V; it came into force in 1997. (The text of the rule can be found in point 1.5.1 of this Investigation Report.)

For passenger vessels built before 1 July 1997 the operational limitations had to be presented in the first annual inspection after this date.

According to the rule a list was to be made up on the traffic limitations of a passenger vessel. This included weather limitations as to all traffic areas of the vessel. The list on the limitations has to be documented in a way approved by authorities, and it must be available to the master. The list must be updated according to traffic and all changes related to the matter. The list must be written either in English or French.

The IMO hastened the coming into force of this SOLAS rule 23, which had been approved in 1995, by Resolution 11 [20]:

16 IMO, STCW Code, Seafarers' Training, Certification and Watchkeeping Code. 1995.
17 STCW Code, Chapter II, Section A-II/2.
18 STCW Code, Section A-II/2, Table A-II/2:
19 Consolidated Edition 1997, Chapter V, Regulation 23. There is new numbering in the amended Chapter V (SOLAS 2000 Amendments): Regulation 30, Operational limitations
20 Resolutions of the Conference of Contracting Governments to the International Convention for the Safety of Life at Sea, 1974, adopted on 29 November 1995. SOLAS Consolidated Edition, 1997. Part 2 annex 5 Res 11.

“Operational limitation on passenger ships.

CONSIDERING that new SOLAS regulation V/23 requires that a list of all limitations on the operation of passenger ships to which SOLAS chapter I applies should be kept on board so as to be readily available to the master.

BEING OF THE OPINION that it would be desirable that, where operational limitations on a passenger ship exist, a list of all limitations on the operation of the ship should be kept on board and updated, when necessary, regardless of weather the passenger ship is engaged on international voyages or not.

URGES Contracting Governments to ensure that lists of all operational limitations are maintained on board and kept up-to-date on all their passenger ships so as to be ready available for the information of the master.”

The SOLAS rules require that wind limits are defined. They cannot go without noticing. The rules do not set operational limitations only to open sea conditions.

The IMO’s STCW subcommittee neither defined a training programme nor how port manoeuvring skills are checked and evaluated. This would have been important so that all states would follow the same criterion. Each state thus acts alone. The IMO member states have not reached consensus on simulator training [21]. The majority of the member states have not given their assent. Measuring experience remains the only criterion.

The above described STCW and SOLAS regulations are connected as regards passenger vessels. The operational limitations create a possibility to solve the STCW requirement on a practical level.

2.4.2 The Finnish Maritime Administration

The inspection instruction Initial Survey Manual[22] issued by the Finnish Maritime Administration does not include the inspection of operational limitations. The inspections are, however, related to the other rules of the SOLAS Convention. The Finnish Maritime Administration does not check the operational limitations required by the SOLAS Convention.

The national guidelines applied in Finland do not take the above-mentioned IMO requirements into consideration with reference to port manoeuvring. The matter has been left to those responsible for the training. It is not the Finnish Maritime Administration‘s task to train masters, but it is its duty to check that vessels have wind limits and that the training of seafarers complies with the STCW Convention. An international level for operational limitations and teaching them has not been set, which has led to such port manoeuvring methods coming into existence which do not meet the IMO requirements.

[21] Councellor of Education Kari Lehtosalo

[22] Initial Survey Manual, 8 February 2005,
Finnish Maritime Administration (FMA), Maritime Survey Department (MSD).

The maritime administrations usually emphasize the master's authority and responsibility in connection with handling the vessel and port manoeuvring.

The master did not submit a marine casualty report required by maritime law and the Finnish Maritime Administration did not specifically request to get one, despite the fact that the vessel had become unseaworthy.

2.4.3 The Finnish National Board of Education

The National Board of Vocational Education became the Finnish National Board of Education in 1991. It coordinated the curricula of the maritime colleges until 1993. After that the maritime colleges could draw up their curricula themselves. This meant that curricula could differ from each other in the same country. After the STCW-95 Convention was published, the colleges had to check that the curricula complied with the convention. Port manoeuvring was presented too vaguely in the code, i.e. drawing up a common programme would not have been possible.

The Finnish Maritime Administration, the Finnish National Board of Education and shipping companies put together an expert group, which audited maritime colleges in 1997 and checked that the curricula complied with the STCW-95 Convention.

2.4.4 Maritime colleges

The STCW-95 Convention was brought into force in Finland in February 1998[23]. The maritime colleges draw up their curricula according to the STCW-95 principles[24]. All training after 1 September 1998 meets STCW requirements. The masters and chief officers who have graduated after 1999 have received training, which fulfils the STCW requirement on handling the vessel in all conditions.

Maritime textbooks do not help when it comes to port manoeuvring. The textbooks which deal with "seamanship" deal with the vessel's hydrodynamics, but not with the effects of the wind on port manoeuvring[25]. There are no clear criteria to support the colleges on how the port manoeuvring requirement *"in all conditions"* is measured and how the skills can be acquired. Maritime colleges copy their own handouts, which may deal quite extensively with hydrodynamics[26]. In literature the effects of wind have not been dealt with that much, and what has been taken up has been presented in a manner which is too scientific for seafarers.

The study guide of Kymenlaakso University of Applied Sciences has been used as material for comparison. The course for master mariners dealing with port manoeuvring

[23] Merenkulun koulutusohjelma 1998 - 1999. Kymenlaakso University of Applied Sciences.
[24] For example at the Kymenlaakso University of Applied Sciences, there are two credits of ship handling in the Master Mariner programme.
[25] Admiralty Manual of Seamanship, Vol. III, ISBN 0 11 771268, 1977.
K.J. Rawson & E.C. Trupper, Basic Ship Theory I, ISBN 582 44523 X, 1977.
George J. Bonwick, Seamanship Handbook, 1952, Loxley Brothers Ltd. Hertfordshire, England.
Axel Blomgren, Sjömanskap, Göteborg 1948, Elanders Boktryckeri Aktiebolag.
[26] Martin Forsén, Manövrering av Fartyg i Begränsade Farvatten, Åbo Navigationsinstitut (handout).

comprises altogether 49 hours. It includes hydro- and aerodynamics, manoeuvring tests, and vessel handling in rivers and restricted areas. The programme includes turns using rate of turn, working with tugs, mooring, using steering systems, anchoring, docking and navigation in icy conditions. A manoeuvring simulator is used as a training tool[27].

When it comes to training, it would be most important to teach the methods on how to define wind limits. Each vessel has an upper limit for wind, and when it is reached, the vessel cannot be handled, no matter how good a person's vessel handling skills are. The wind limit varies from one port and even from one quay to another, i.e. maritime colleges cannot solve this whole problem.

2.4.5 The shipping company

In 2004 the SOLAS Convention[28] Chapter V *Safety of Navigation* Rule 30, Operational limitations, was the same as already in the 1997 edition (Rule 23). According to this the shipping company must see to it that the authority can be provided with a list on operational limitations.

The rule can be interpreted in such a way that shipping companies must define wind limits to all vessels with reference to all those ports where they traffic. The matter should get easier when there are masters who have got STCW-95 training on the vessels. However, the matters do not improve if teaching how to define wind limits is not included in the curricula.

The masters get onboard practise on vessel handling, but it does not correspond with the STCW requirement *"in all conditions"*. The wind limits must be defined so that the limitations for safe manoeuvring are known.

Until now there has not been a single case in connection with accident investigations in which the shipping company would have defined a wind limit for the vessel[29].

Usually shipping companies emphasize the fact that masters decide on port manoeuvring.

Eckerö Line

The shipping company had instructions in accordance with the ISM Code. It had been avoided to give own instructions in the part of the NORDLANDIA's SMS Manual which dealt with bridge operations; it mainly quoted requirements set by authorities. The instructions lacked the shipping company's own instructions on how specifically the NORDLANDIA's modern bridge equipment should be used.

27 Kymenlaakso University of Applied Sciences, Merenkulun koulutusohjelma 1998 – 1999. page 31.
28 SOLAS, Consolidated Edition 2004.
29 According to *Superfast Ferries* shipping company there was no need to determine wind limits, because the shipyard had performed wind strength measurements on the vessel and estimated the push effect of the transverse thrusters. (Investigation Report B7/2004M).

As to bridge operations, the instructions quoted the STCW Convention and the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs). This can be seen in the general part of the bridge operations instructions, in the inspections of navigational instruments and in the attitude to navigational “aids”. There were no instructions on the use of navigational equipment of the bridge. The instructions warned about the risks connected with the use of radar. What must be seen positive is that the instruction urges to adjust after glow to the radar picture, because in a modern radar it can be removed, which leads to a risk that the movement of the target cannot be seen.

In the passage where the OOW is instructed on when the master must be summoned to the bridge, there are also instructions on what the master must tell the officer. *According to this instruction the master must tell the officers how he/she intends to enter the port.* If an officer is uncertain of the forthcoming manoeuvre, he/she must ask the master about it. This instruction is very good, but it was not followed on the NORDLANDIA.

The IMO has not paid attention to the control devices of port manoeuvring. As a consequence of this a mixed practice has emerged and cheap and technically inferior solutions have been favoured because there has not been any criteria. The ergonomically deficient NFP (Non Follow Up) manual steering is nowadays the most common steering lever on the bridge wing. The FU (Follow Up) would be a safe method. Moving the control from one manoeuvring place to another is often done with the help of a mechanical coupling. When the NORDLANDIA had been built, the special requirements of port manoeuvring were not taken into account. This can be seen e.g. from the fact that the ergonomy of control devices was bad for backing the vessel. Control equipment has not received attention in the IMO regulations. The shipping company has bought the vessel second-hand, and is not responsible for the bridge design.

2.4.6 The masters

The Finnish Maritime Act directs the responsibility issues connected with manoeuvring to the masters. The STCW-95 Convention reinforces this. According to the Convention, the requirement is port manoeuvring in all conditions:

> *“Manoeuvre and handle a ship in all conditions. Berthing and unberthing under various conditions of wind with and without tugs”.*

This is a requirement the master cannot fulfil, especially not if he/she does not have information about the vessel’s operational limitations at his/her disposal.

The responsibility moves from top to bottom, and the master has to apply the skills and knowledge he/she has acquired alone. It is impossible for the master to analyse wind limits based on his/her experience alone. Seafarers do not get that much experience of strong winds.

2.4.7 The ports

When defining the wind limit, a port wind model is necessary. The wind limit can be raised, if it is known how land and buildings protect the vessel in the port. For example the Port of Helsinki has let produce a wind model, which has been indispensable for the traffic in the Kustaanmiekka strait and in the South Harbour. The Port of Hanko represents an opposite view on the benefits of a wind model[30]. Port organizations usually emphasize the master's and pilot's authority and responsibility and the fact that ports are not responsible for port manoeuvring.

2.5 A summary on the regulations which affected the accident and their application

In the STCW-95 Convention the International Maritime Organization IMO set a high objective for the vessels' masters and chief officers. They must be able to handle the vessels in ports in all conditions. In the member states the implementation of this was in practice transferred to the national maritime administrations.

The SOLAS Convention requires that the operational limitations are defined, but in practice the maritime authorities do not require this. There is no other explanation connected with this than that a practical method for defining wind limits has not been developed.

The implementation of the decisions was transferred from the Finnish Maritime Administration to the Finnish National Board of Education. The Finnish National Board of Education and the Finnish Maritime Administration checked that the curricula of the maritime colleges were in accordance with the conventions. The maritime colleges were set requirements which they had no chance to fulfil. They could only allocate the available lectures for ship handling. Defining the limiting values as to circumstances would require a large part of the curriculum.

The ISM Code requires that the shipping companies give the master instructions with reference to all dangerous situations. Defining wind limit was mandatory in Chapter V *Safety of Navigation* of the 1997 SOLAS Convention.

Solving the problem is moved downwards from the International Maritime Organization and it finally ends up unchanged to be the problem of the vessel's master. Port manoeuvring is one of the tasks which the masters usually take care of themselves. The master is guided by customs and tradition. Within the culture of seafaring these are respected.

2.6 Defining and voyage-specific checking of the wind limit

It is the shipping company's task to define the vessel's wind limit. After the wind limit has been defined, the shipping company must arrange suitable training for the officers on how to apply the wind limit into practice.

[30] Investigation Report B7/2004M, a statement made by the Port of Hanko 5.5.2006.

A terrain model should be made of the port, because the topography of the port always reduces wind speed. Dangerous wind directions can be analysed with the help of a terrain model. Making the model should belong to the responsibilities of the port.

Planning a voyage requires a more detailed weather forecast than the general public weather forecast. It is important that the forecast is updated often enough. In the port there should be an automatic weather station, which could be contacted with the help of the Internet. When approaching the port, the changes in wind strength can be followed. This affects the preparations for port arrival.

2.6.1 Options for defining the wind limit

Meetings between masters are the easiest way to chart the need for wind limits. The wind limit can even be defined on the basis of the opinions. If the opinions differ a lot, it is a sign that the wind limits must be analysed in more detail. Meetings between masters are necessary as to port manoeuvring.

A static model can be used to define the transverse forces of the vessels' bow thrusters and rudders. This gives a picture of whether the vessel has power to get away from the quay. The static model is most suitable when the vessel is designed, i.e. when the decisions on the effects of the steering propellers and rudders are made. The wind limits and tracks must be analysed with the help of a simulator, in which the vessel is in a dynamic state.

Simulation with the help of a workstation computer is the cheapest way to define the wind limit. The shipping company personnel run all the simulations themselves. The simulations can be done in the shipping company office, on the vessel or at home. The summaries and documentation of the simulations take more time than the simulations themselves. When doing desktop computer simulations one has to observe that after each simulation the tester learns more. If one notices dangerous features in the vessel's behaviour during the simulation, one is prepared for them in the next simulation. The technical wind limit then becomes the wind limit. In the real world the master has not completed a series of simulations to analyse how the vessel reacts when the wind speed increases 1 m/s from one simulation to the other. In a real situation a storm hits the vessel suddenly, and the master does not have the same experience behind him as in simulations. A work station simulator can be used to define the technical wind limit. The human wind limit is at least 1 m/s lower.

"Fast time" simulation is the fastest way to define the wind limit. The work is performed at a research institute. The vessel's tracks are first decided with the help of usual simulations. After that a computer is programmed to run the simulations automatically. The wind speed is increased 1 m/s after each simulation until the wind limit is reached. The wind direction is changed 10°, and after that the simulations are restarted from the wind speed of e.g. 10 m/s. The simulator analyses all wind directions during the night, and the wind limit of one port can be analysed in twenty-four hours. The preparation work takes more time. This method is the easiest one for the shipping company.

Ship handling simulators are available at all maritime colleges. They can be used to define wind limits, but it is time consuming. Approximately 50-60 simulation runs are needed to define a wind limit. Each simulation takes about 20 minutes. A vessel simulator also ties up personnel. A positive side is the documentation which is obtained from the simulator. Each simulation is described graphically and numerically. A ship handling simulator is a good tool for port manoeuvring training when the wind limits are first defined with the help of workstation simulation.

2.6.2 Checking the wind limit in the prevailing weather conditions

The shipping company can control the problems related to port manoeuvring in the changing traffic situations when it chooses a workstation simulator for the testing of wind limits. In the future this will be the most economic and flexible method. The objective could be that each master has a vessel simulator in his/her portable computer. The IMO stipulates that a master must be provided with basic education in hydro- and aerodynamics. The shipping company must help the master in acquiring the necessary devices and programmes.

Database for the simulator program includes mathematical models, vessel radar maps (user maps), electronic charts and recorded simulations and possibly simulations recorded by the vessels' navigational instrument. A vector chart is the best chart base for simulations, but a radar chart used in an integrated navigation system can also be used. In the simulation program there should also be an option to create a chart to be used on the radar.

The vessel's mathematical model The hydrodynamic part of the model can be made on the basis of the vessel's technical data, manoeuvring tests and line drawing. New hydrodynamic model tests are thus not necessarily needed. A model is also needed on the aerodynamic properties of the vessel, and the quickest way to produce one is on the basis of information on a similar vessel. A vessel's aerodynamics can be modelled exactly with the help of wind tunnel tests which are done on a scale model based on the part of the vessel which is above water. The test is used to analyse the impact the wind has on the vessel's hull from variable relative directions. A mathematical model should be compiled on the all vessel types of a shipping company.

It is difficult to estimate the wind force so that it corresponds with the port conditions because the structures and terrain change wind speed and its direction. **A terrain model** must be compiled for an exact simulation. A port terrain model for simulation purposes can be done with the help of wind tunnel tests, because it cannot be modelled numerically with the help of e.g. a topographic map. Wind speed and changes in wind direction are registered in the model's harbour basin and at points on the vessels' tracks. Coefficients are calculated for the measuring points, and they proportion wind directions and speeds at the measuring point at ten metres' height to an undisturbed wind.

Having a terrain model made is something that is mainly the port holder's duty. Ports usually try to provide good services and a terrain model could be an indication of this. A terrain model is the most realistic alternative solution and it usually increases the wind limit.

Weather forecasts which are generally available are too approximate. What is needed in maritime traffic is a weather forecast which applies to the whole route and is divided into periods according to the voyage timetable (ETA). The weather forecast should be updated many times in a day.

The master must also get realistic information about the wind direction and speed in the port. The most common practice is that the master calls the pilot station or the port operations and inquires about the wind conditions. What are needed in ports are **automatic weather stations**. Most inquiries are received when the weather is stormy. Then the pilots and port operations personnel are busy with other duties. Momentary wind information is not reliable. There should be a wind meter in the port or nearby, and in this wind meter there should be a recording and Internet connection. The device could automatically provide a couple of hours' weather history, which would tell the mean value of the wind speed, the maximum and minimum speed of the wind and the changes in wind direction at a ten-minute interval. This would give clarification to how the weather changes. In the case of the NORDLANDIA it would probably have shown that the wind was decreasing.

3 CONCLUSIONS

The NORDLANDIA was approaching the port and hit the quay construction in wind conditions which exceeded the performance of the vessel. No information as to the vessel's operational limitations had been produced to the master.

The speed at which NORDLANDIA entered the port, the track and the lack of advance discussion suggest a traditional and established procedure in good weather conditions. The fact that the circumstantial factors were taken into consideration can be seen mainly in the vessel's high speed, which was used in order to try to control the effects of the wind.

The port manoeuvring method used by the master was based mainly on his own and his colleagues' experiences. In the background there was no researched information about the vessel's manoeuvring characteristics in strong wind, the significance of the conditions in the port and neither were there shipping company instructions or authority regulations.

The shipping company has no standard procedures for mooring. Each master has to develop his/her own routines. This means that the advance discussion on the distribution of work and communication which is essential for bridge co-operation becomes more difficult or non-existent. In the same way there should be a common, pre-agreed plan of action with the tugs. According to the prevailing practice, the routines can vary within one shipping company and as the masters change, even on one vessel.

The responsibility for port manoeuvring has been allocated to the master alone, but he/she has been left without support in the decision-making. The environmental limitations for port manoeuvring have not been set, and there are no minimum requirements for the steering devices.

The SOLAS Convention rule on the operational limitations for a passenger vessel has not been applied to the wind limits of port manoeuvring. The Finnish Maritime Administration has not required this from the shipping companies. The operational limitations can be used as the basis for defining the port-specific wind limits for vessels. In their training ship officers can be provided with port manoeuvring skills only within a vessel's operational limitations. The approximate character of the training requirements set in the STCW Convention is the reason for the fact that the present ship officer training does not include adequate preparedness for port manoeuvring control.

4 SAFETY RECOMMENDATIONS

4.1 To the Finnish Maritime Administration

In the SOLAS Convention regulation a list of all operational limitations of passenger-vessels are required to be compiled before they enter traffic. These should also include port manoeuvring. The operational limitations give the STCW objectives, with reference to ship officers' skill levels in port manoeuvring, a realizable and realistic framework.

The investigators recommend that

1. *the Finnish Maritime Administration checks the passenger-vessels' operational limitations in accordance with Rule 30 in Chapter V in the SOLAS Convention. It should be checked whether the operational limitations defined for vessels also cover port manoeuvring.*

The text "*in all conditions"* of STCW Convention is too approximate to be applied into practice.

The investigators recommend that

2. *the Finnish Maritime Administration moves for an amendment in the IMO's STCW Convention (STCW Code Table A-II/2 Competence) by which the expression "Manoeuvre and handle ship <u>in all conditions</u>" is changed into "<u>within operational limitations</u>" thus referring to SOLAS Ch V Reg 30.*

4.2 To the shipping companies

In the investigation it came up that the shipping company had not defined operational wind limits connected with port manoeuvring to support the master in his decision-making, which is typical for the trade.

The investigators recommend that

3. *shipping companies define port manoeuvring limitations for their vessels and standard routines to be used on the basis of these limitations including bridge co-operation and tug usage.*

Helsinki, 19 December 2008

Sakari Häyrinen | Matti Sorsa

Martti Heikkilä | Kari Larjo

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APPENDIX

STUDYING WIND LIMITS WITH THE HELP OF SIMULATIONS

Wind limits and correct tracks can quickly be determined with the help of a work-station simulator. The track is tested on a certain direction by increasing the wind until the wind is too strong. The effect of the wind varies according to the vessels' aerodynamics.

Wind gusts are approximately ± 5 m/s when the wind is strong. This was established also from the data obtained from the NORDLANDIA's VDR-recording. According to observations, wind direction changes max. approximately ± 20° in gusts. Most commonly the direction only changes ± 10°. Gusts which are one second in duration do not affect the manoeuvring of the vessel, but five-second gusts do. Five seconds was chosen as the maximum duration of the gusts[31]. The changes in the strength, direction and time were made to vary according to a random variable which stayed within the above-mentioned limits. Gusts are a disturbing factor in mooring. Wind is never even.

A mathematical model of the car ferry has been used in the investigation. Its measurements are close to the measurements of the NORDLANDIA.

Table A1. A comparison between M/S NORDLANDIA and the mathematical ship model used in the investigation.

	NORDLANDIA	**The mathematical model**
Vessel's length	153.4 m	168 m
- breadth	24.7 m	27.5 m
- designed draught	5.82 m	6.3 m
wind surface	4,900 m²	5,053 m²
bow thruster effect	1,500 kW	2,648 kW
rudders	The rudders always have the same rudder angle	The rudders can be steered separately

The ratio of the NORDLANDIA's wind surface to the effect of bow thrusters is 3.3 m²/kW. The corresponding ratio as to the mathematical model is 1.9 m²/kW. On the basis of this, the defined wind limit for the NORDLANDIA is too high.

At first manoeuvring to the port was tested when the wind was 17.3 m/s (at 10 metres' height) and the direction 315°. The model was used to proceed near the breakwater so that the vessel would have space to make leeway in the wind. The wind blows from starboard quarter and turns around the vessel's bow thus forming a strong wind force to the port side of the hull[32]. On car carriers the wind force is stronger diagonally from the bow than diagonally from the stern[33].

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[31] Seppo Huovila, 1967, page 14.
[32] L.L. Martin, 1980, page 3.
[33] Nils Norrbin, 1983, Figure 6.15.

The large drift angle is used to compensate for the effects of the wind. The pressure of the water, i.e. hull effect, resists both the wind force and its turning effect on the vessel (Figure A1). The wind force has the tendency to turn the bow of the vessel to port. Gusty wind causes manoeuvring problems. Bow thrusters do not react to the gusts quickly enough. This reduces the wind limit. The speed of the vessel must not be too high. High speed multiplies manoeuvring errors' consequences and reduces the effect of the bow thrusters. Low speed is easy to correct.

The model vessel did not reach the quay without damage when there were northwesterly (NW) winds of 17 m/s. If the quay is approached exactly in a parallel direction with the quay, a wind gust can "toss" the bow to port and the bow hits the quay constructions. The quay must be approached in such a way that the stern hits the quay first, but a too large angle in relation to the quay can lead the stern against the stone structure between the fenders.

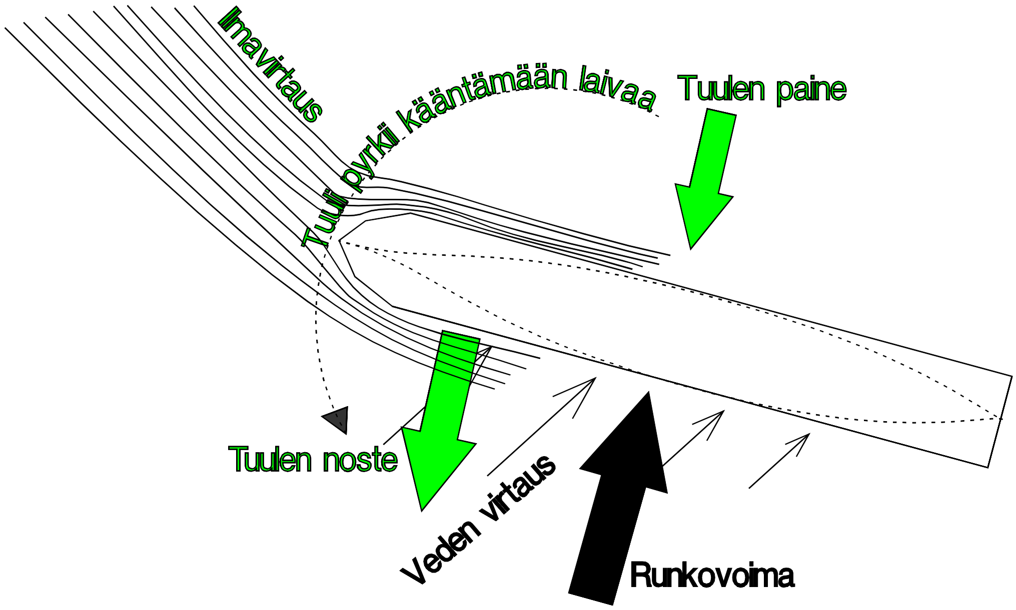

Figure A1. The vessel is manoeuvred at a large drift angle in such a way that the effects (forces) of wind and water are equal. The wind has the tendency to turn the vessel.

Finnish text in Figure A1	**Translation into English**
Ilmavirtaus	Air flow
Tuulen noste	Wind Force
Veden virtaus	Water flow
Runkovoima	Hull force
Tuulen paine	Wind pressure
Tuuli pyrkii kääntämään alusta	Wind tends to turn the vessel

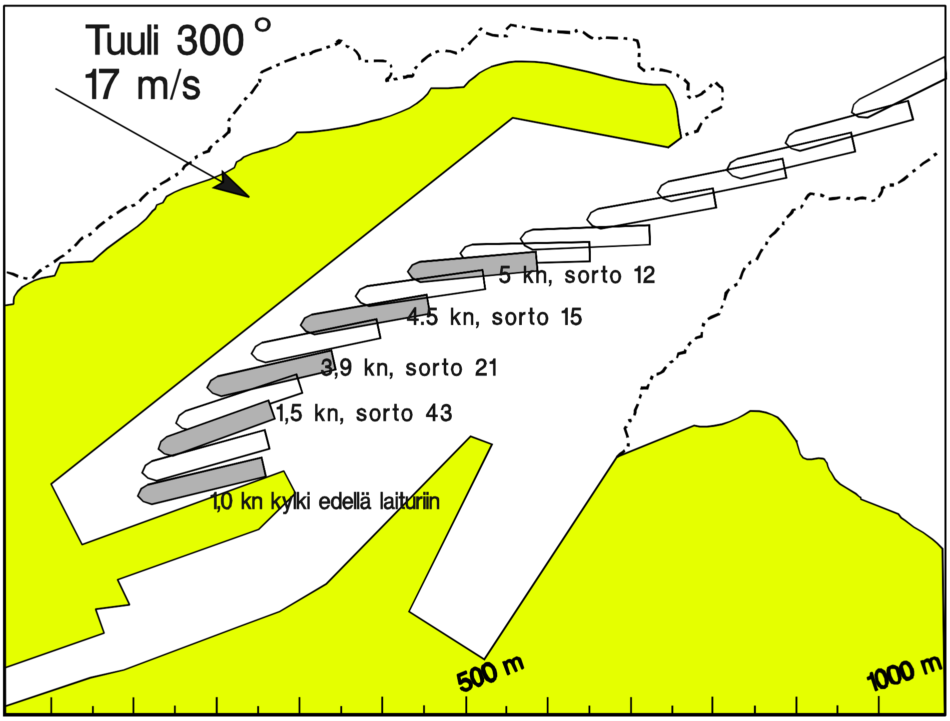

Figure A2. The quay cannot be reached without damage when there are north-westerly (NW) winds of 17 m/s.

Finnish text in Figure A2	Translation into English
Tuuli	Wind
Kylki edellä laituriin	Side to quay ways
Sorto	Drift

Figure A2 presents the situation on the day of the accident. The accident could not have been prevented even if the vessel had been manoeuvred near the breakwater. The vessel approached the quay in a controlled way in the simulations when the wind speed had been reduced to 12 m/s.

29 simulations were performed to determine the wind limit. The wind limit curve is presented in Figure A3. The wind affects the vessel most when the wind direction is 50°- 90° from the bow. When the wind turns to the aft side, the vessel can sustain more wind. The real wind limit of the NORDLANDIA is lower than the curve shown in the figure. In the mathematical model the bow thrusters were stronger. Therefore the wind limit must be defined 1-2 m/s lower than in Figure A3.

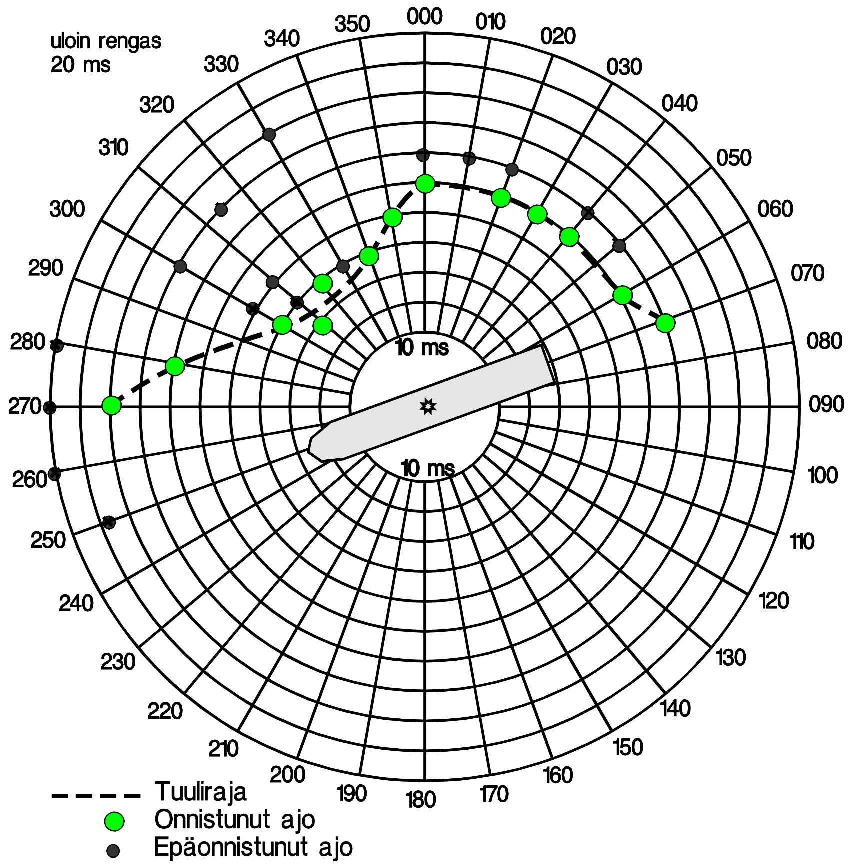

Figure A3. The wind limit determined with the help of simulation.

Finnish text in Figure A3	Translation into English
Uloin rengas	Outer ring
Tuuliraja	Wind limit
Onnistunut ajo	Succesful run
Epäonnistunut ajo	Unsuccesful run

When the wind blows from the stern between the directions 000°-070°, the wind has the tendency to turn the vessel's bow towards the breakwater when the vessel is approaching the quay. The model vessel did not manage a wind speed of over 15 m/s.

When the wind blew from the bow from between the directions 250°-300°, the vessel was difficult to manoeuvre because of the wind gusts. On land in direction of the bow there are superstructures which protect the port. Therefore westerly and southwesterly wind could not be examined in a reliable way.

Leaning against the corner of the quay

If the manner of manouvring is changed, the vessel can proceed to the quay when there are stronger winds. The wind limit can be increased by using the quay corner protected by fenders and the tug.

If the vessel is turned in the basin headwind and it leans against the corner of the quay, the wind limit can be increased. Figure A4 shows the corner of the quay used by the NORDLANDIA. A fender, which the vessel can lean against, has been built in the corner. The corner may not been sufficiently strengthened, but because a fender has been built there, this means that the corner can be leaned against when the vessel is turned towards the quay.

Figure A4a. The quay used by NORDLANDIA.

Figure A4b. There is a fender at the corner of the quay, and it can be used as support when the vessel is turned parallel with the quay.

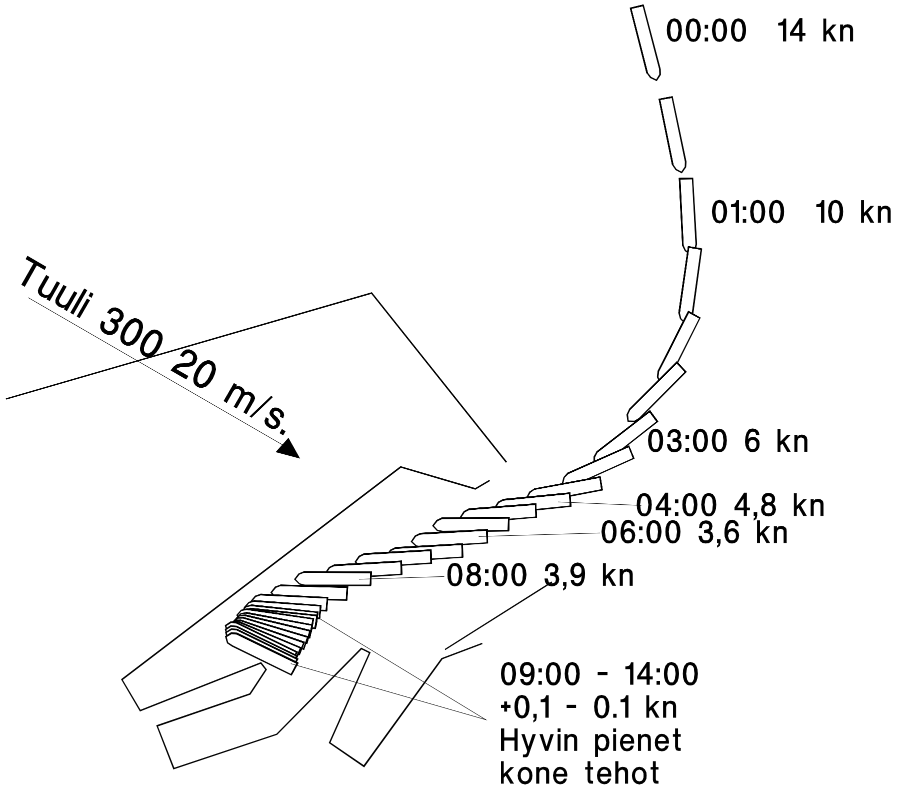

Figure A5. The last five minutes the vessel has to proceed slowly side first. Engine powers are very low. Using a tug is an important safety factor.

Finnish text in Figure A5	Translation into English
Tuuli	Wind
Hyvin pienet konetehot	Very low engine powers

When the wind blows from between the directions 280°-030°, the vessel is turned against the wind in the port and then it proceeds sideways slowly to the corner of the quay. Figure A5 shows the track at a southwesterly wind of 20 m/s. This requires the use of a tug. How the vessel is manoeuvred is something that has to be agreed upon in advance with the tug. The length of the towing-line and where it is to be fastened are also factors which can be agreed on in advance. The towing-line should not be let go before the vessel is at the quay so that the cable does not foul the bow thruster. The language used when towing should be English and there should be an agreement on the terminology used in the communication.

In the simulation shown in Figure A5 the arrival to port took 14 minutes. During the last five minutes the vessel moves very slowly side first towards the quay. During the last minutes the vessel was almost still because the wind gusts almost pushed the vessel against the corner. A wind gust turns the vessel quickly in which case the vessel can be damaged. Therefore it is always safe to use a tug when a strong wind is blowing directly from the bow. In a way the vessel “hangs” on the towing-line in the wind. A tug reduces the effects of the gusts, and the bow thrusters are given time to fix the problem.

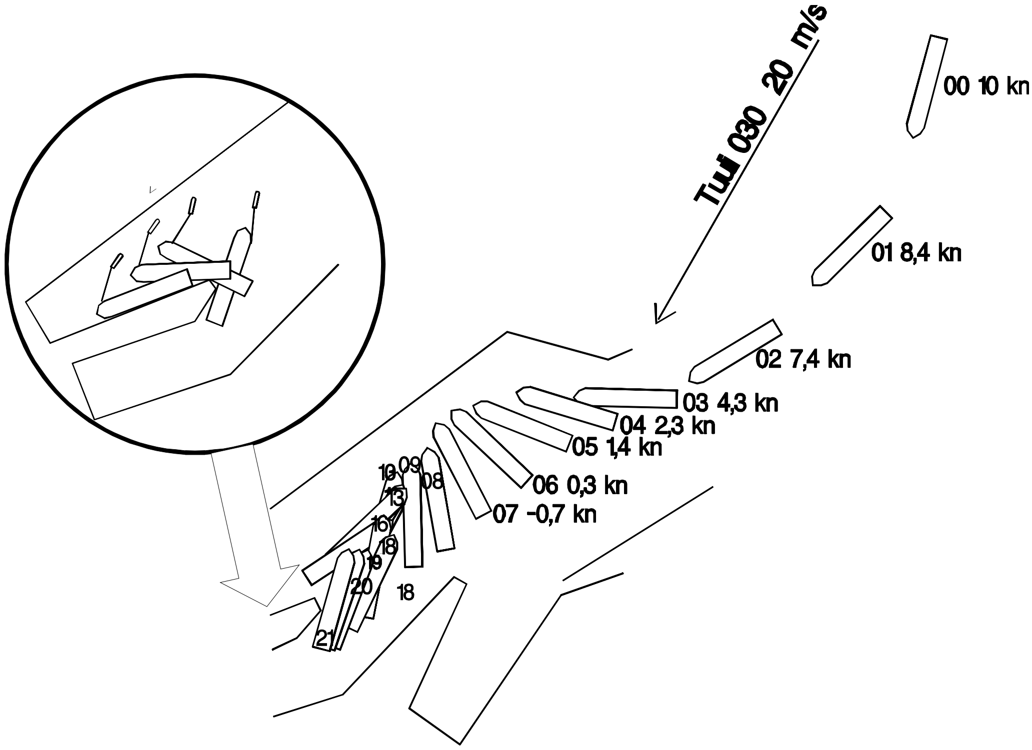

Figure A6. The vessel is turned against the wind. Without a tug it is difficult to keep the bow of the vessel in the wind. Between the times 09-19 in the simulation clock the vessel almost slipped out of the hands. A tug would keep the movements of the vessel steady. The tug helps the vessel around the corner of the quay.

Finnish text in Figure A6	Translation into English
Tuuli	Wind

When the wind blows 20 m/s from the direction 030°, the vessel is turned bow against the wind in the port. It is difficult to keep the heading of the vessel, i.e. it is necessary to use a tug.

It is difficult to manoeuvre the vessel when the wind blows directly from the bow. If a manoeuvre fails, it is impossible to proceed ahead or astern. Therefore a tug must be used.

Leaning against the corner of the quay increases the wind limit to 20 m/s.

A systematic use of a tug requires that the working methods and radio communication are clarified.

Aft first to the loading ramp

When proceeding bow first to Tallinn, one notices that strong winds come from the bow. If one does not want to use tug assistance, it is possible to back to the port. This also requires that the corner of the quay is used as support in the middle of port manoeuvring. Cars should be loaded from the bow in Helsinki and from the stern in Tallinn. The passenger gangway must be moved.

A wind blowing from the stern does not cause as strong wind force as a wind blowing diagonally from the bow. There are rails, gangways and other irregularities at the stern, and they cause whirlwind. When backing, the wind forces stay small. It is easier to manoeuvre the vessel in the basin in a wind blowing from the stern than in a wind blowing from the bow.

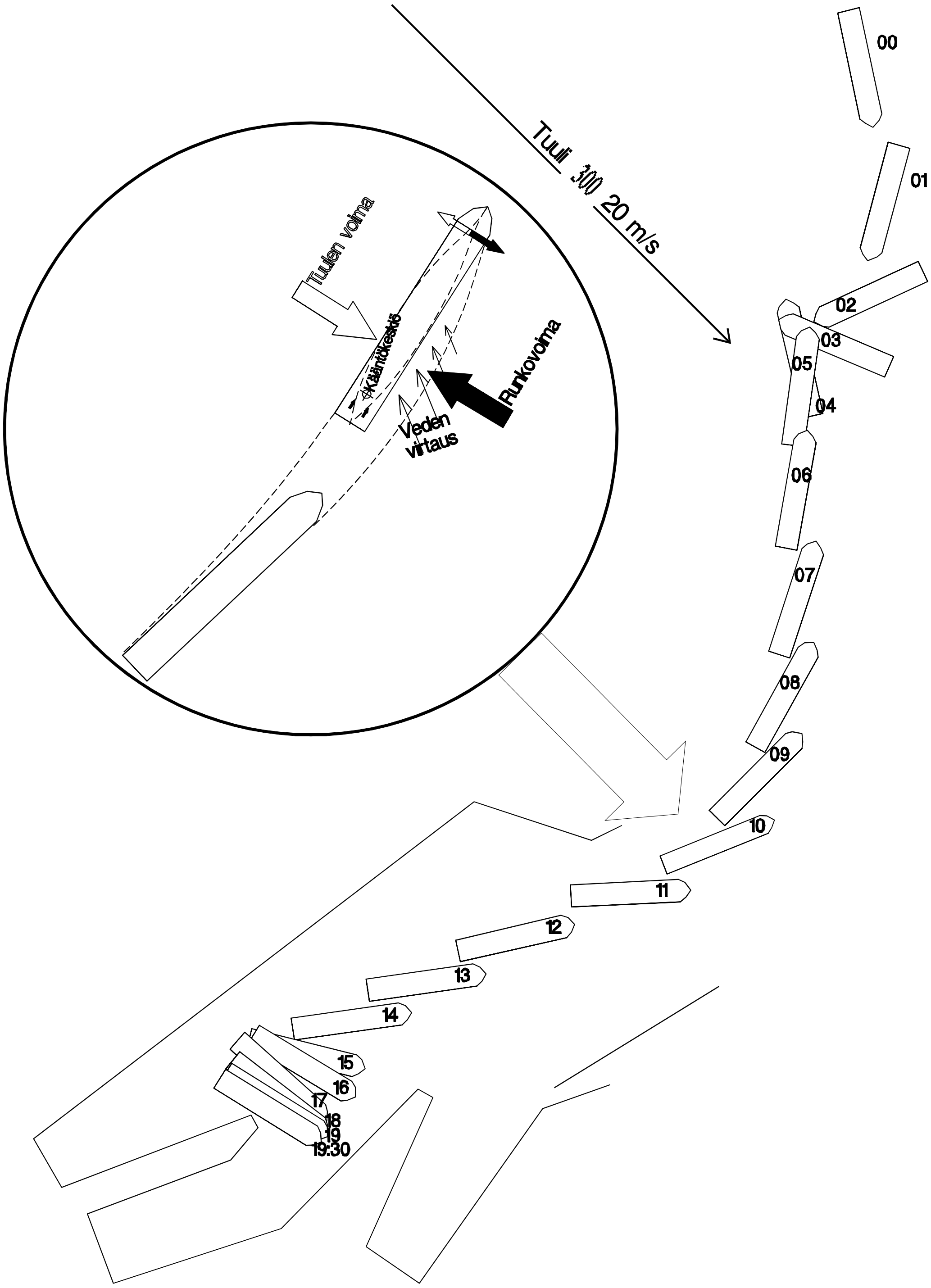

Figure A7. The vessel is first turned outside the port and then backed to the corner of the quay stern against the wind. From there the vessel is backed alongside the quay to the ramp.

Finnish text in Figure A7	Translation into English
Tuulen voima	Wind force
Kääntökeskiö	Pivot point
Veden virtaus	Water flow
Runkovoima	Hull force
Tuuli	Wind

The way of manoeuvring described above allows port entry when the wind blows 20 m/s from between the directions 270°-360°.

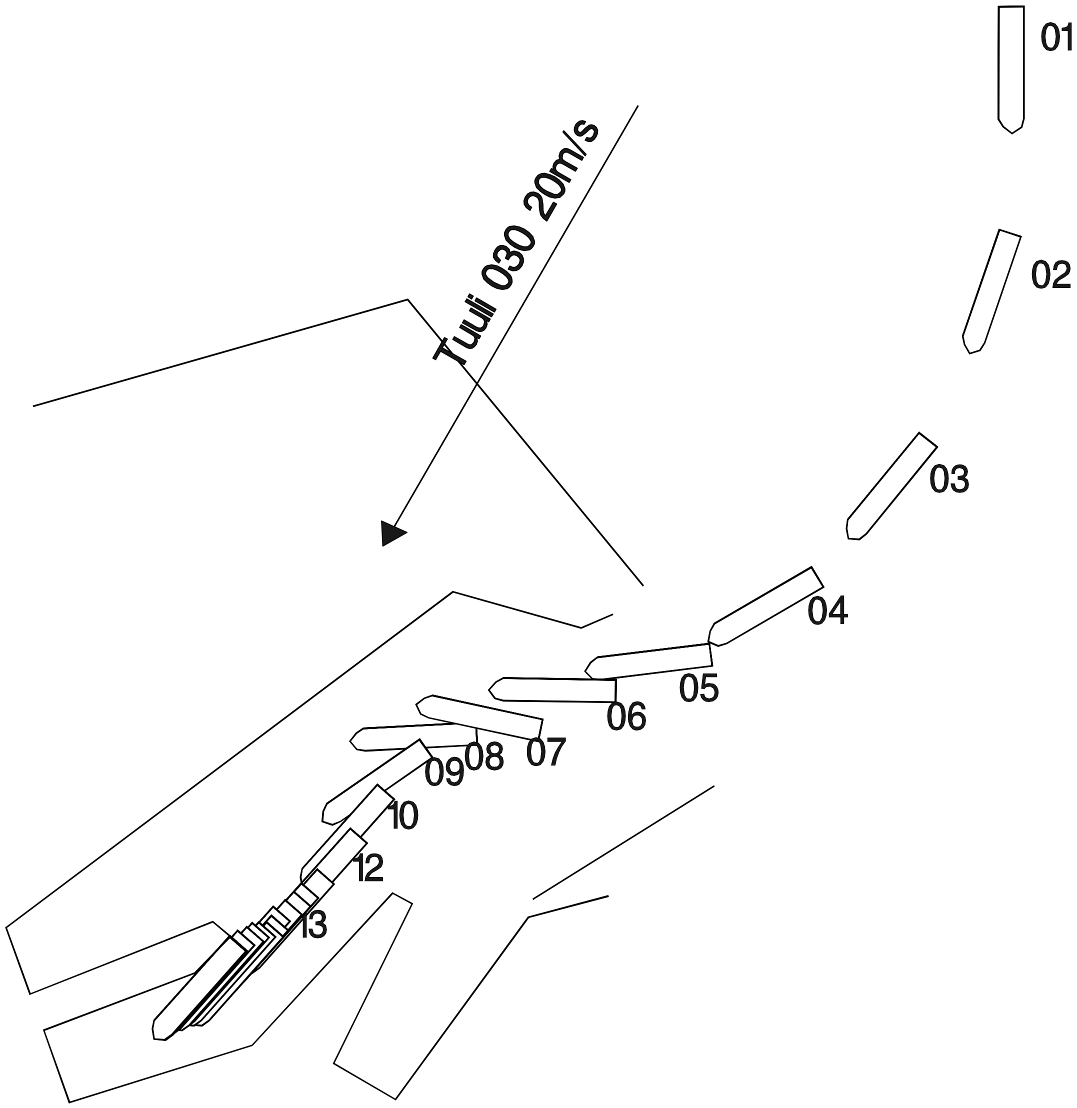

Figure A8. When the wind blows 030°, the vessel is turned in the port area in such a way that the corner of the quay is approached using the 210° counter direction of the wind.

Finnish text in Figure A8	Translation into English
Tuuli	Wind

It is possible to back around the corner of the quay without tug assistance by using the vessel's own engines.

Lausunnot/ Utlåtandena / Statements

Lausunto 1.	Merenkulkulaitoksen Meriturvallisuus-toiminto (suomeksi)
Utlåtanden 1.	Sjöfartsverkets Sjösäkerheten (på finska)
Statement 1.	Finnish Maritime Administration’s Maritime Safety function (in Finnish)
Lausunto 2.	Eckerö Line (ruotsiksi)
Utlåtanden 2.	Eckerö Line (på svenska)
Statement 2.	Eckerö Line (in Swedish

Merenkulkulaitos

Merituryallisuus

10.10.2008

2240/311/2008

SAAPUNUT

27 -10- 2008

463/5m

Onnettomuustutkintakeskus
Martti Heikkilä
Sörnäisten rantatie 33 C
00580 Helsinki

Lausuntopyyntönne 26.9.2008, 417/5M

**MATKUSTAJA-AUTOLAUTTA MS NORDLANDIA,
TÖRMÄYS LAITURIIN TALLINNAN SATAMASSA 28.10.2008**

Onnettomuustutkintakeskus on lähettänyt lausuntoa varten luonnoksen tutkintaselostuksesta C 6/2006M. Merituryallisuuden merenkulun tarkastusyksikkö on tutustunut luonnokseen ja toteaa, että tutkinta on suoritettu huolellisesti ja johtopäätökset ovat johdonmukaisia.

Merenkulkulaitoksen Merituryallisuus-toiminto haluaa kuitenkin esittää seuraavat kommentit;

1. Turvallisuussuosituksissa esitetty kohta 1, SOLAS-yleissopimuksen luvun V säännön 30 mukaisiin operatiivisiin rajoihin voidaan ainoastaan kirjata sellaisia rajoituksia, jotka pohjautuvat sääntöihin tai standardeihin sekä niissä oleviin rajoituksiin. Satamakohtaiset tuulirajoitukset tai hinaajan käyttövelvollisuus tulee sataman asettaa lähtien paikallistuntemuksestaan.
2. Merenkulkulaitos ei kannata esitettyä muutosta. Alusten päälliköiden tulee hallita alusta myös odottamattomissa tilanteissa sekä äärimmäisissä olosuhteissa. Täten on tärkeää, että harjoitellaan myös *in all conditions* eikä ainoastaan hallituissa olosuhteissa.
3. Merenkulkulaitos kannattaa esitystä, että varustamot tukevat alusten päälliköitä käyttämään hinaajia tarvittaessa ja että tämä ohjeistus tulee viedä heidän turvallisuusjohtamisjärjestelmään (ISM).

Merenkulkulaitoksen Merituryallisuus-toiminto toteaa, että tutkinta on huolellisesti tehty ja siinä on huomioitu tapahtumien kulkuun vaikuttaneet seikat kattavasti ja ammattimaisesti.

Yhteistyöterveisin,

Merenkulun tarkastusyksikön päällikkö — Tapio Gardemeister

Merenkulunylitarkastaja — Marko Rahikainen

MR/AV

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

Rederiaktiebolaget ECKERÖ

Centralen för undersökning av olyckor

Sörnäs strandväg 33 C

FIN- 00580 HELSINGFORS

Mariehamn, 31.10.2008
515T

Ärende: Passagerarbilfärjan M/S Nordlandia, kollision mot kajen i Tallinns hamn 28.10.2006.

Bifogat översänds kommentarer till undersökningsrapport C6/2006 M.

Torggatan 2, PB 158, AX-22101 Mariehamn Åland
Tel. +358 (0)18 28 000, fax +358 (0)18 12 011, www.rederiabeckero.ax
Hemort: Eckerö, FO-nr: 0280703-5

Rederiaktiebolaget
ECKERÖ

31-10-2008
Brev 514T

Centralen för undersökning av olyckor
Sörnäs strandväg 33 C
FIN-00580 HELSINGFORS

Kommentarer till undersökningsrapport C6/2006 M.

Rederiaktiebolaget Eckerö har fått enligt sändlista undersökningsrapport C6/2006 M för utlåtande samt för kommentarer.

Befälhavaren, som var i tjänst vid tillfället ombord på M/S Nordlandia, har bedömt att inte kommentarer rapporten. Däremot har tidigare befälhavaren , som varit i tjänst ca 7 år ombord på M/S Nordlandia fram till sin pensionering, givit rederiet sin yrkesmässiga och sjömansmässiga värdering på rapporten.

Rederiet är mycket tacksam för Sjökapten Kari Larjos utomordentliga redogörelse för värderingar kring vindbegränsningar och simulatorträning för befäl på passagerarfartyg, vilket måste anses som ytterst viktig information internationellt. I rapporten, sid 33 stycke 4 nämns att IMO:s medlemsländer inte kom överens om simulatorträning. Men med den övergripande analys som presenteras i kapitel 2, så rekommenderar rederiet att fortsatt arbete skall göras för att påverka medlemsländer att fastställa internationella och likvärdiga regler. Möjligheten att rapportera detta via andra forum än rapport om olyckor eller incidenter bör utvärderas. Centralen för undersökning av olyckor bör omvärdera sitt beslut att skriva rapporterna på finska och översätta dem till svenska (vid behov). Istället bör rapporterna skrivas direkt på engelska, vilket skulle leda till att den internationella sjöfarten kan ta del av rapporterna på ett mera ändamålsenligt sätt samt översättningsproblem undviks.

Övriga kommentarer till undersökningsrapporten redovisas nedan i punktform:

- sid 2, fel typbeteckning och kapacitet på "räddningflottar".
- sid 6, nämns att det inte finns girhastighetsmätare medan på sid 7 nämns det hur girhastigheten kalkylerades.
- sid 6, dopplerloggen var i funktion
- sid 7, GPS:en kopplad till ADVETO har 5Hz uppdatering
- sid 16, olyckshändelsen har beskrivits från inspelningar på VDR och från inspelningar på ADVETO, vilket är ett underordnat sjökortssystem ombord.
- sid 17, skall en inspelning med exakt tid inspelad på VDR jämföras med det som en person kommer ihåg efteråt? Risken finns att intervjuade personer kommer att bli tveksamma till att försöka minnas och istället kommer att säga att man inte kommer ihåg. Som alternativ

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skall, vid intervjutillfället, all fakta redovisas och sedan skall man gemensamt gå igenom händelseförloppet.
- sid 17, förvirring mellan styrman och överstyrman i text.
- sid 18, förvirring mellan styrman och överstyrman i text.
- sid 18, fel order i textruta
- sid 24, även ADVETO-systemets inspelning har använts.
- sid 24, fartyget gick aldrig till dock, utan till reparationskaj
- sid 26, landgången som nämns i rapporten, användes inte vid tillfället av något fartyg som gick till kaj 12. Därav fanns det inte personer i närheten.
- sid 31, enligt hamnförordningen skall fartyg inte angöras med aktern till kaj i Tallinn, därav skall detta inte beskrivas som "oortodoxt". Stryk stycket.
- sid 35, manualer om fartygets navigationsutrustning finns i fartygets karthytt
- sid 37, rederiet har idag passagerarfartyg som trafikerar ett flertal kryssningshamnar runt hela Östersjöområdet. Att kunna göra en studie med vindgränser för alla hamnar med specifikt fartyg och att ha möten mellan befälhavarna kan vara på gränsen till omöjligt.
- sid 38, att utföra alla simulatorkörningar för rederiets personal på rederiets kontor, på fartyget eller hemma kommer att behöva omvärdera kollektivavtalet för rederiets personal då deras fastställda ledighet är kontrollerad enligt lag.
- sid 38, i tillägg till nämnda simuleringar så kan även ADVETO användas som analysredskap för inspelade seglingar. Då kan tidigare seglingar utvärderas och diskuteras på plats ombord. De relevanta dynamiska rörelserna med vind, ström och påverkan av bottenstruktur finns dokumenterade med rätt data.

Konklusion av rapporten är att fokusering görs på operativa gränser vid hamnmanövrering samt operativa vindbegränsningar för hamnmanövrering. Det nämns även att myndigheter samt IMO har svårt att definiera dessa gränser generellt. Orsaken kan vara många men några faktorer som inte berörs i rapporten kan nämnas nedan.
- Användande av bogserbåtar i hamnar är avgörande för att de operativa gränserna i hamnområden skall värderas rätt. Värdering av detta nämns inte i rapporten. Det finns inga begränsningar att använda bogserbåtar inom rederiet.
- Möjligheten att avvakta angöring, att vända om till avgångshamn eller även att ställa in avgång är alltid ett beslut som tas av befälhavaren. Värdering av detta nämns inte i rapporten. Rederiet har goda erfarenheter av dessa värderingar inom de trafikområden som trafikeras.
- Användandet av fartygssimulatorer för att värdera vindbegränsningar kan vara bra i öppen sjö med begränsad inverkan av vattendjupet under köl. Av erfarenheter, som simulatorinstruktör på sjöbefälsskolor i både Finland och i Sverige kan undertecknad verifiera att en databas som liknar hamnegenskaperna i en specifik hamn är mycket krävande arbete att färdigställa. Ibland kan det vara omöjligt, fast det har gjorts

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mycket avancerad databehandling och egen fartygsmodell använts, att simulera på ett tillfredställande sätt så att simuleringen överensstämmer med verkligheten.

Bilagor Bilaga 1, kommentarer från sjökapten

Med vänlig hälsning,

B-G Donning

Rederiaktiebolaget Eckerö
Bo-Gustav Donning

Bilaga 1.

Kommentarer till undersökningsrapport m/s Nordlandia.

I rapporten saknas 3 viktiga uppgifter:

1. Bogserbåtens kapacitet och möjlighet att arbeta som pushing tug. Jag känner inte till Vega men eftersom man tar order i procent kan det vara en av de nyare på över 1500 kw med propellern mitt under. Som pushar bra även då den ligger alongside vid framfart, men effekten ökar betydligt vid lägre framfart och vinkel mot utsidan. Kl 10.25.39 fick Vega ordern 100% vilket gör att Nordlandia kastas som en vante under följande 30 sek. med Vegas hästkrafter.

2. Bogpropellrarnas möjligheter att välja: motor 1, motor 2, eller motorer 1 & 2. Hur användes dessa knappar? Troligtvis motorer 1 & 2, i det vädret. Borde framgå av rapporten.

3. Möjligheterna för fartygen att överhuvudtaget få någon bogserbåt i hamnarna utan flera timmars varsel. Vid blåsigt väder brukar ofta bogserbåtarna i Tallin arbeta i Muuga eller Paldiski och det kan vara fråga om många timmar innan någon är i Tallin igen. Då kan man kanske få tag i någon av dom gamla båtarna som man gott kan vara utan.

I rapporten användes simulator jämförelse med ett annat fartyg, som ej är jämförbart och därför helt irrelevant för att bedömma manöverförmågan hos Nordlandia.

2002 var vi ett antal däcksbefäl från Nordlandia till VTT och körde i simulator med Silja festival som modifierats gällande maskinkraft och bogpropellerkraft till Nordlandia.
Detta för att pröva om styrmännens lots resor kunde köras i simulator. Jag som då redan fört Nordlandia under ett par år jämförde och kunde konstatera att Nordlandia manövrerade på ett helt annat och lättare sätt. Även farten vid ankomsten tillbassängen var helt annan.
På den tiden använde vi kaj 10 alltså andra sidan av piren med st.b. sida till kaj. Mycket besvärlig plats. Denna modell var ej värd att fortsätta med, utan att modellen helt hade ändrats till Nordlandia.

I bilaga 1.2(9) Bild där vinden vill vrida fören åt babord. På Nordlandia tvärt om, fören lovar upp i vind p.g.a. större vindyta akteröver. (På Nordlandia den stora skorstenen.)

I bilaga 1.3 (9) Detta exempel hade Nordlandia klarat av även i denna vind. Med facit är det lätt att säga hur man borde gjort. Jag hade iakttagit avdriften genast då fören passerat piren och gått upp med kurs 255 grader istället för de normala 235grader. Fart ca 10 knop och under gång inne i bassängen reducerat farten och låtit henne falla sakta neråt mot kajen. Vid ankomst till kaj kan man gott ha fart 5 knop när det återstår en båtlängd till rampen. Back effekten är mycket god och man behöver bara läge 5 på spakarna för detta.
Bogserbåten skulle endast varit med som säkerhet tills drygt halva fartyget låg mot fendrarna. Att sedan glida mot fendrarna fram till rampen hade inte gjort någon skada, fartyget har en väl formad och väl dimensionerad avvisarlist längs hela raka utsidan.

Ett annat sätt att angöra med Nordlandia till kaj Nr 12 med god säkerhetsmarginal hade varit att genast innanför piren gå upp i vindögat och legat helt stilla mot vinden och gjort fast bogserbåtar i för och akter på st.b.sida och sedan låta bogserbåtarna föra fartyget till kajen, fartygets egna utrustning skulle endast assisterat för att anlöpa så paralellt som möjligt med fenderlinjen. Att göra fast bogserbåtar utanför vågbrytarn går inte vid denna vind.

De övriga exemplen i bilaga 1.6, 1.7, 1.8, 1.9, är inte användbara då man skall till kaj 12 och det finns andra fartyg vid kaj 7, som i detta fall då Galaxy låg där.

Fendern på kajhörnet är inte rundad och sattes dit för att man vid avgång från kaj 12 skulle kunna vrida fartyget runt hörnet och fören upp i vind. Detta något riskfyllt om det ligger fartyg vid kaj 7.
Kajhörn som ritats med linjal och vinkel i Tallinn och i Västra hamnen I Helsingfors borde förbjudas och rundas av eller fendras av med fendrar som har stor träffyta. Ett sådant kajhörn är hörnet kaj 6 och isbrytarkajen i Västra hamnen, som består av betong och sten och till och med kan göra hål under vattenytan på passagerarfartygen som angör 10 tals gånger per dygn. Det behövs bara att en bogpropeller slår ur eller att en bogsertross brister så kan vi ha en färja eller ett kryssningsfartyg som sjunker vid inloppet till hamnen.

<u>Beträffande rutinerna på bryggan och rederiets möjligheter att tala om för befälhavaren hur han skall förfara vid angöring av hamnar:</u>

I detta fall med Nordlandia är det ett stort fel som man ser idag av oerfarna styrmän och befälhavare på alla fartyg och speciellt på färjor som driver mycket i vinden det kan man se även när man sitter i baren eller matsalen som passagerare och otaliga gånger när man är på bryggan.
Det är att de INTE redan vid ändring till den nya kursen direkt iakttar en beräknad avdrift och även ökar avdriften ifall man saktar ner. Idag är det som om man kör på sitt streck eller sin gata och korrigerar ett par grader när man ser att båten inte följer strecket, sen tar man upp mer och mer och innan du är framme vid bojen, kajhörnet eller udden är det risk för att du slår i aktern eller propellrarna.
Är detta något som borde tas upp mera i utbildningen. Nya styrmän har även svårt att ta det åt sig fast man säger till upprepade gånger.

Befälhavaren var i detta fall erfaren och hade även före sitt befälhavar jobb under många år varit överstyrman på fartyget och därmed närvarande på bryggan vid angöring. Under min tid, jag blev pensionär 2006 , använde vi estnisk lots vid angöring och avgång i Tallinn. I stort var lotsens uppgift att sköta kontakterna per VHF och speciellt då vi använde bogserbåt. Då var engelska inte så vanligt utan språket var ryska eller estniska, ofta på bogserbåtarna bara ryska. Det kan förekomma att man även idag är ganska dåliga på estniska, engelska eller finska på bogserarna, missförstånd kan förekomma.
Bogserbåten borde man ha pratat med mycket tidigare och komma överens om arbetskanal och hur man har tänkt sig bogserbåtens hjälp.
Arbetsspråket på Nordlandia är svenska och därför bör detta användas och speciellt mellan befälhavaren och överstyrman. Att överstyman inte uppfattat alla order verkar konstigt dom borde ju ha varit invid varandra.

Det förekom även annan osäker ordergivning mellan befälhavaren och rorsman. Dessa bör vara tydliga och klara. Tyder på att bryggrutiner blivit slappa och måste skärpas.
Befälhavaren framförde även fartyget enligt principen jag skrivit om ovan (avdrift) detta trots att predictorn visade att det skulle gå på tok. Predictorn visar endast hur det kommer att gå på den inställda tiden om sväng och fart bibehålls.

För rederiet att ge direktiv om hur fartyget skall framföras i olika hamnar är ju nästan en omöjlighet det kan inte ens en erfaren befälhavare göra till en kollega då alla hamnar är olika och fartyg kan ju vara i trafik var som helst. Kanske sjöfartsmyndigheterna av det skälet inte ställer sådana krav på rederiet.
Förhållandena är även väldigt olika i samma hamn varje resa. I Tallin är vindriktningen väldigt avgörande. En annan faktor är även fartyg i hamnen. Om det ligger kryssningsfartyg vid kaj 14-25 alltså den långa yttre piren, påverkas man nästan inte alls av NV vind då kan det istället vara backsug bakom fartygen vid kaj så man dras emot dom när man passerar.

Ofta stämmer inte väderleksrapporterna och från Finland har man tendens att man kör samma varningar över hela weekenden även om vädret slagit om helt. Till veckosluten på sommarn går man ofta ut med vindvarningar för säkerhetsskull. Troligen p.g.a. småbåtstrafiken. Detta gör rapporterna svåra att ta på allvar.
Ibland blåser det i Helsingfors och en bit ut i viken och i Tallin är vackert och ibland tvärt om Detta gör det svårt att avgöra även ombord, hur det ser ut vid ankomst. Bogserbåts beställning kan därför ofta göras i ett sent läge.

Sjökapten/pensionär
Mariehamn 4.10.08

Tjänstgjort som Befälhavare i 32 år pensionär sedan 2005/2006 Senast 11år befälhavare i Eckerö Line varav 7 år på Nordlandia