Voyage Reconstruction Technical Report

8 September, 2025 (rev. 3)

The **Eagle S** crude oil tanker anchor incident in the Gulf of Finland on 25 December, 2024

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1 Change history

29 Aug, 2025 Revision 1	• Updated graph "Bridge command: Second Officer", img36 at page 75, to contain additional bridge actions. Also added these to table in 7.3 Chronological voyage log 18.10 2024 – 26.12 2024 at page 54. • Corrected typo (erratic time stamp) in Second Officer's Conclusion from the statement at page 73 (calculations were however correct). • Removed the words "and subject to travel ban" in section 5.6 Vessel crew at page 17, as it was irrelevant for the reconstruction or report. • Added full section 13.9 Logical problem in graph with comparison of vessel speeds at page 170. • Added accident reason reason #5, "Weak lashing wire implementation" in section 11 Overall conclusion at page 139, this was mistakenly omitted previously. • Added four images of lashing wire implementations on other ships, in section 8.3.3 Pictures of brake 3: The anchor lashing at page 112.
8 Sep, 2025 Revision 3	• Changed erratic "80%" to "45%" at page 101 row 13 (part of section 8.2.7 The logic of the SDMBL standard at page 100)

About the investigator/report author:

The investigator/report author is an engineer and an expert in maritime geometry and dynamics, as well as the creator of the "Stormwind Simulator", which has been used during this investigation to perform calculations and create simulations. Stormwind is a highly respected and accurate representation of maritime conditions, with users in Scandinavia and other European countries; Finnish users include rescue departments, the Marines, the Sea Salvage, schools and instructors, industrial manufacturers, and numerous others.

The investigation and its conclusions are supported by an undisclosed team of professionals.

1 REQUEST

We have been appointed by Finnish attorney-at-law Herman Ljungberg, on behalf of the ship owner Caravella Llc., to conduct an investigation on the events leading to the incident on 24-25 December, 2024, involving the Eagle S crude oil tanker. At the time of the incident, the Eagle S was travelling from St Petersburg, Russia, to Skagen, Denmark, and planning to continue to Port Said, Egypt.

While in the Traffic Separation System in the Gulf of Finland - roughly some 36 kilometres south of the Finnish mainland coast and in the EEZ - the vessel dragged its port side anchor for a distance of approximately 90 kilometres over a time of 7½ hours (from 10:16 to 17:48 UTC).

We have been asked to make a voyage re-construction, including a technical and logical investigation of the incident, covering all relevant details.

2 PUBLICITY OF THIS REPORT

This report is public.

Chapters 1-12 of this report are based on data that we own, data that we have permission to use in public, or public data.

Chapter 13 uses data from the Pre-Trial Investigation Report 2400/R/941/24 26.05.2025 by the Finnish Police. This data became public on 25 August, 2025.

3 FORMAT OF THIS REPORT

At a later date, this report will be supported by videos of voyage and weather simulations. There may be references between the videos and this report.

3.1 TIME STAMPS

Unless otherwise mentioned, this report uses UTC (Coordinated Universal Time) for time stamps. The Finnish time zone is UTC+2, the Russian is UTC+3. The Eagle S vessel changed its local clocks by the VTS area it entered.

Some of the vessel's clocks, for example, the one in the engine command printer, are permanently set to UTC.

4 DATA SOURCES

4.1 FINTRAFFIC VTS RECORDINGS

On 8 January, 2025, we sent a request to the ship owner requesting the fully-detailed recordings of significant data relating to the Eagle S tanker from the responsible handler of VTS Helsinki, Fintraffic Ltd:

"In order to define the geometry and logic of this case, it would be of uttermost importance for us to get details of the event at 25 Dec 2024, from ca 11:50 ... 12:50am (UTC), when the ship was in the TSS and located south of the city of Porvoo. The ship slowed down, and according to the AIS track, made a series of manoeuvres for a duration of ca one hour. Simultaneously, the ship's Master informed the Finnish VTS of an event that was earlier classified as a ME problem. I include a screenshot of AIS to pinpoint the location."

On 16 January, 2025, Fintraffic responded. They stated that only a video recording would be given, not the recording of the VHF radio traffic. Fintraffic's decision can be found in 12 Attachments, public / 12.1 Fintraffic reply to VTS request (3 pages) at page 142.

The video recording that was provided (Eagle S 25.12.2024 1150-1250 UTC.mp4) is a manually-made AIS recording replay. It lacks information about positions, has no grid, no corner co-ordinates, no projection information, and no speed information for the vessels in the vicinity of the Eagle S.

4.2 VISIT ON BOARD THE EAGLE S

For the first two months after the incident, only the owner's attorney was allowed to visit the ship. We were not given permission to accompany them, so these visits were conducted without technical assistance.

On Friday 28 February, 2025 (65 days after the incident) we were allowed to board the ship for a technical inspection. The detention on the Eagle S was lifted the same day, and two days later, on Sunday 2 March, 2025, the ship departed from Svartbäcksfjärden, Porvoo, and set course for Port Said, Egypt.

This delay meant that we were only able to inspect the ship and to interview the crew (except the three now-detained officers) on one occasion.

4.3 VDR – THE VOYAGE DATA RECORDER

The VDR records relevant data on board a ship on an ongoing basis. This includes the ship's telemetry, bridge commands, and radio traffic. More information about VDR can be found at https://en.wikipedia.org/wiki/Voyage_data_recorder.

According to the ship's crew, The Finnish Police confiscated the VDR from the ship on Thursday 26 December, 2024.

The Finnish Police retained the VDR for five months, before handing it to the ship's owner on Friday 23 May, 2025 with a protocol regarding the findings on the device.

The International Maritime Organisation (IMO) has made a guideline document regarding the recovery of a VDR:

GUIDELINES ON VOYAGE DATA RECORDER (VDR) OWNERSHIP AND RECOVERY (Ref. T1/2.02 MSC/Circ.1024 29 May 2002).

The document can be found among the attachments in this report: 12 Attachments, public / 12.2 IMO Guidelines on VDR ownership and recovery (3 pages) at page 145.

Quotes from the IMO document:

Ownership of VDR information

- The ship owner will, in all circumstances and at all times, own the VDR and its information.

Recovery of VDR and relevant information

1. Recovery of the VDR information should be undertaken as soon as possible after an accident to best preserve the relevant evidence for use by both the investigator and the ship owner.

Read-out of VDR information

- In all circumstances the investigator is responsible to arrange down loading and read-out of the information and should keep the ship owner fully informed.

Access to the VDR information

- A copy of the VDR information must be provided to the ship owner at an early stage in all circumstances.

Indications are that the VDR information was recovered by the Police before 24 January, 2025:

- According to the Second Officer, VDR content was re-played to him during a police interrogation on 24 January, 2025.
- According to the First Officer, VDR content was re-played to him during a police interrogation on 24 January, 2025.
- According to the Master, VDR content was re-played to him during a police interrogation on 31 January, 2025.

The “investigator” in the above references is the Finnish Police. The five-month delay, coupled with the investigator not providing the ship owner with information or a copy of the VDR data, hindered the investigation required for this report and does not comply with the IMO guidelines.

We also note, that the VDR contains files dated in January 2025, when it was already confiscated. This implies that the investigator powered up the device before making a non-destructive copy of its storage media.

4.4 The Eagle S Bell Book

We have taken copies of pages in the Bell Book (the Eagle S's log book) and publish details from those with the permission of the ship owner and crew.

4.5 AIS data

At 30 April, 2025, we received a database containing the AIS data for Eagle S for the time period of 20.12.2024 00:17:13 to 25.12.2024 19:59:59. This data was passed to us by the ship's Master. The data set contains 6,771 records. Most relevant columns in the AIS data are:

- Date and time
- Latitude and longitude
- SOG (Speed Over Ground), HDG (Heading), COG (Course Over Ground)
- AIS transponder location on the ship

This data was submitted to the Eagle S Master from the ship's Flag State, Cook Islands.

4.6 Cable information

We have a detailed set of information regarding the cables and pipelines in the Gulf of Finland. This data originates from commercial and free sources according to the EU *INSPIRE* directive (see https://knowledge-base.inspire.ec.europa.eu/legislation/inspire-directive_en).

4.7 TSS information

We have the data points for the Traffic Separation System in the Gulf of Finland; this is open data from Finnish Traficom.

4.8 Depth information

We have the "sparsified" depth points originating from the Finnish Traficom and the Finnish National Land Survey; these are open data.

4.9 Weather information

We use three open data sources for the weather during the incident. We are mainly interested in:

- The strength and direction of the wind, and the wind peak values
- The significant wave height and its peaks
- The wave period
- The water current's strength and direction

The data sources are:

- EU/Copernicus ERA5 re-analysis from the European Centre for Medium-Range Weather Forecasts, ECMWF.
- Similar data from the Finnish Meteorological Institute.
- Eagle S log entries and crew recollections.

4.10 Materials provided by the ship's crew

This material is used and published in accordance with agreements with the copyright holders and the ship's owner.

The themes of this material include:

- Photographs
- Bridge equipment, for example, ECDIS
- The main engine governor
- The anchoring and mooring arrangement
- Reports from ship crew to Police

4.11 Interviews with the Master, First Officer and Second Officer

We have interviewed the above mentioned highest-ranking crew members on several occasions.

4.12 ISM Code and excerpts from the Ship Manager's manuals

The ISM Code (International Safety Management Code) is an international standard for the safe management and operation of ships and for pollution prevention. It's a crucial part of the International Maritime Organization's (IMO) efforts to enhance maritime safety and environmental protection. The code requires companies to establish a Safety Management System (SMS) that ensures safe operations, pollution prevention, and compliance with relevant regulations.

https://www.imo.org/en/ourwork/humanelement/pages/ismcode.aspx

The ship manager for the Eagle S vessel is the **Peninsular Maritime, Plc**, based in Mumbai, India.

https://www.peninsularmaritime.com

The company manages a multitude of ships and crews, and provides a comprehensive set of security standards and manuals for its vessels.

We have included, in the attachments of this report, some excerpts from the manuals that pinpoint responsibilities on board the vessel:

- The responsibility for ship safety, found in section 12.4.1 Safety, safety inspections and accident investigations at page 158.
- The crew demand for anchoring and mooring operations, found in section 12.4.2 Moorings and anchoring (crew demand etc.) at page 159.

4.13 Iltalehti / Finnish president's press conference

On 27 December ,2024 the Finnish president revealed in Iltalehti's video below that he became informed of the Eagle S incident at 15:02 Finnish time (13:02 UTC), while the incident was ongoing.

https://www.iltalehti.fi/politiikka/a/1fec2a3e-05a3-443b-aa04-9254c9e999ed

We have used this information to insert markers in the included graphs, in order to clarify the situation awareness of varying parties involved in the incident.

From the video, starting at 6:12:

"Viestienvaihtio omalta osalta lähti liikkeelle kello 15:02, jolloinka saimme tilannekuvan siitä mitä oli tapahtumassa ja sen jälkeen sitä seurattiin noin viidentoista kolmenkymmenen minuutin välein ja kun nopeasti näimme että tilanne oli hallussa niin emme nähneet tarvetta TP-Utvalle* mutta pääministerin kanssa sovimme että, jätimme niin sanotun placeholderin sille, että jos TP-Utvalle on tarvetta kokoontua niin se tehdään mahdollisimman pian, sen jälkeen päätimme seuraavana aamuna että annetaan ensin tilannekatsaus sisäisesti valtiosihteeri Artion johdolla, sen jälkeen keskustelin uudemman kerran pääministerin kanssa, sain tilannekatsauksen rajalta, poliisilta ja tuota… Robin Lardot:lta, eli KRP:ltä, ja josta viestimme, sen jälkeen järjestettiin lehdistötilaisuus ja poliittisesta viestinnästä eilen vastasi pääministeri ja tänään presidentti."

* TP-Utva = ulko- ja turvallisuuspoliittisen ministerivaliokunnan ja tasavallan presidentin yhteinen kokous

https://fi.wikipedia.org/wiki/Hallituksen_ulko-_ja_turvallisuuspoliittinen_ministerivaliokunta

Translation in English:

"The exchange of messages, for my part, started at 15:02, when we got a situational picture of what was happening and after that it was monitored every fifteen to thirty minutes and when we quickly saw that the situation was under control, we saw no need for TP-Utva*, but we agreed with the Prime Minister that, we left a so-called placeholder for it, that if TP-Utva needed to meet, it would be done as soon as possible, after that we decided the next morning that we would first give a situation review internally under the

leadership of State Secretary Artio, after that I spoke with the Prime Minister once again, I got a situation review from the border, the police and uh... from Robin Lardot, KRP that is [the National Bureau of Investigation], and with whom we communicated, after that a press conference was organized and the Prime Minister was responsible for political communication yesterday and today the President."

* TP-Utva = the common meeting of: "TP" = President of the Republic and "Utva" = Ministerial Committee on Foreign and Security Policy

https://en.wikipedia.org/wiki/Ministerial_Committee_on_Foreign_and_Security_Policy

5 EAGLE S DATA



Eagle S deck seen from the command bridge, by front window, in front of command consoles [visit on board 28.02.2025]

5.1 VESSEL BUILDER, REGISTRATION, OWNER

Builder/shipyard	New Century Shipbuilding Co Ltd - Jingjiang, China https://www.shipspotting.com/photos/1583955
Ship type	74,034 DWT Oil/Products 'LR1' Tanker https://www.norstar-group.com/2015/04/13/new-vessel-enters-management-19/
Build year	2006 https://www.vesselfinder.com/vessels/details/9329760
IMO / MMSI	9329760 / 518998865 https://www.vesselfinder.com/vessels/details/9329760
Owner (11.6 2025)	Caravella LLC-FZ, Dubai, UAE, see https://www.caravellafz.com/
Flag State (11.6 2025)	Cook Islands https://www.vesselfinder.com/vessels/details/9329760
Manager (11.6 2025)	Peninsular Maritime India Pvt Ltd - Maharashtra, India https://www.shipspotting.com/photos/3797180

5.2 VESSEL CHARACTERISTICS

Dimensions	Double-hulled, 228.6m long, 32.2m in beam, ca 21m deep, 14.5m summer draught https://www.shipspotting.com/photos/1583955
Tonnage	74035 DWT https://en.wikipedia.org/wiki/Eagle_S
Displacement	89381 tonnes (ca 210×32×13.3m) https://en.wikipedia.org/wiki/Eagle_S
Engine	Two-stroke/slow-speed (bi-directional) MAN-B&W 5S60MC-C crosshead, compact https://en.wikipedia.org/wiki/Eagle_S
Propulsion	Single-screw, fixed-pitch (no reduction, no de-coupling)

5.3 ENGINE PERFORMANCE

The MAN-B&W 5S60MC-C engine has a nominal Maximum Continuous Rating (NMCR) of 10200 kW (13900 bhp) at 105 rpm, according to www.cmc-mtu.com. It is a two-stroke diesel engine used in large ships. The letter "C" in the designation indicates a compact design.

Rated Power	10200 kW (13900 bhp)
Revolution	105 rpm
Bore	600 mm
Stroke	2292 mm
Bunker consumption	27 – 30 tonnes per day
MCR	The engine is rated to operate at 110% of the MCR for one hour, according to ResearchGate.
Engine Type	Two-stroke diesel engine
Design	Compact design ("C" designation)

5.4 ENGINE CONTROL



Eagle S engine telegraph [visit on board 28.02.2025]

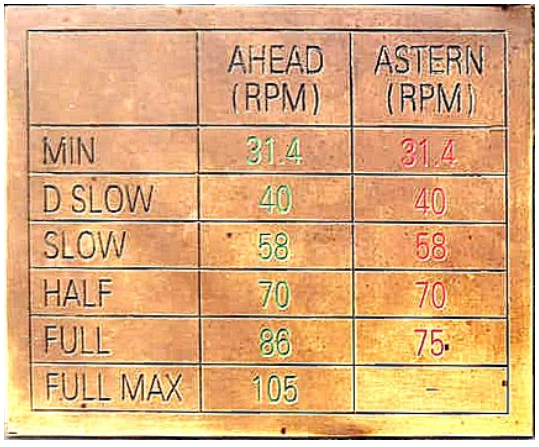
5.5 VESSEL PERFORMANCE

The Eagle S engine can be used at 105 rpm for a maximum duration of one hour, according to the previous table ("ResearchGate"). "MCR" is short of "Maximum **Continuous** Rating"; the 105 rpm for one hour is not continuous – it is for one hour.

From interviews with the Eagle S Master, the bridge command never exceeded the "full" rating. This had, according to his knowledge, rarely been done, and only for testing purposes. It is a common preference among large ships to maintain a reasonable fuel economy.

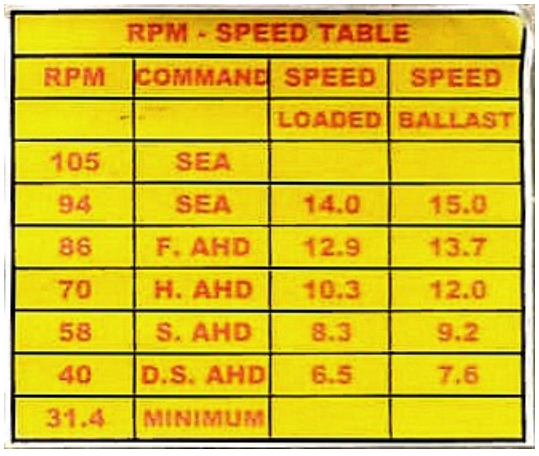
The Eagle S crew aimed at using 84-86 rpm, which is sufficient to fulfil the charter party speed requirements. This gives the ship a speed of 12-12.5 knots, depending on load and weather conditions. By studying AIS data, it can be concluded that 9-13 knots is a common speed among large cargo ships in the Gulf of Finland and Baltic Sea TSS.

	AHEAD (RPM)	ASTERN (RPM)
MIN	31.4	31.4
D SLOW	40	40
SLOW	58	58
HALF	70	70
FULL	86	75
FULL MAX	105	



Eagle S engine command vs. engine RPM table [visit on board 28.02.2025]

RPM – SPEED TABLE			
RPM	CMD	SPEED	SPEED
		LOADED	BALLAST
105	SEA		
94	SEA	14.0	15.0
86	F. AHD	12.9	13.7
70	H. AHD	10.3	12.0
58	S. AHD	8.3	9.2
40	D.S. AHD	6.5	7.6
31.4	MINIMUM		



Eagle S engine RPM vs. ship speed table [visit on board 28.02.2025]

5.6 Vessel crew

The ship has 24 crew members working in 4-hour watches. Each crew member has 8 hours of work, 8 hours of free time, and 8 hours of sleep in every 24 hour period. At any time, at least 4 crew members are on duty.

At the time of writing this report, the three highest-ranking officers remain suspects for sabotage:

- The Master entered the ship at OPL Skagen on 15 October, 2024 (2.5 months before the incident). His education is:
    1. Magister Diploma from Batumi State Maritime Academy, Marine Navigation Faculty, Batumi, Georgia.
    2. Bachelors Diploma in Organisation and Management from Batumi State Maritime Academy, Business Faculty, Batumi, Georgia.
- The First Officer entered the ship at Ust-Luga inner anchorage on 14 December, 2024 (11 days before the incident). His education is:
    - Bachelor Degree in Maritime Science from Batumi State Maritime Academy, Marine Navigation Faculty, Batumi, Georgia.
- The Second Officer entered the ship at Port Mundra, India, on 23 August, 2024 (4 months before the incident). His education is:
    - Diploma BSc. In Nautical Science from ARI Delhi (Applied Research International Maritime Collage), Delhi, India.

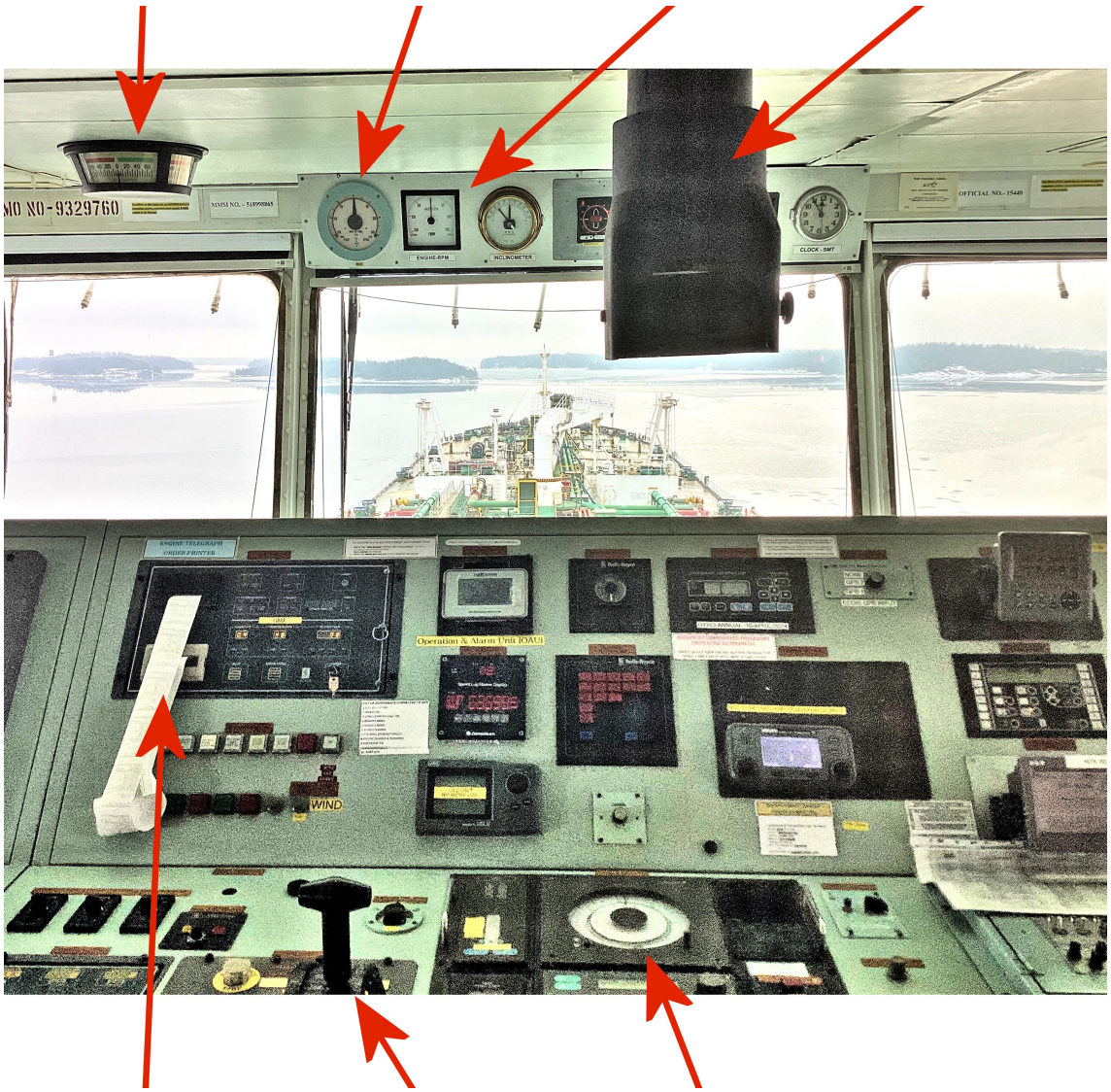
Of the other 21 crew members:

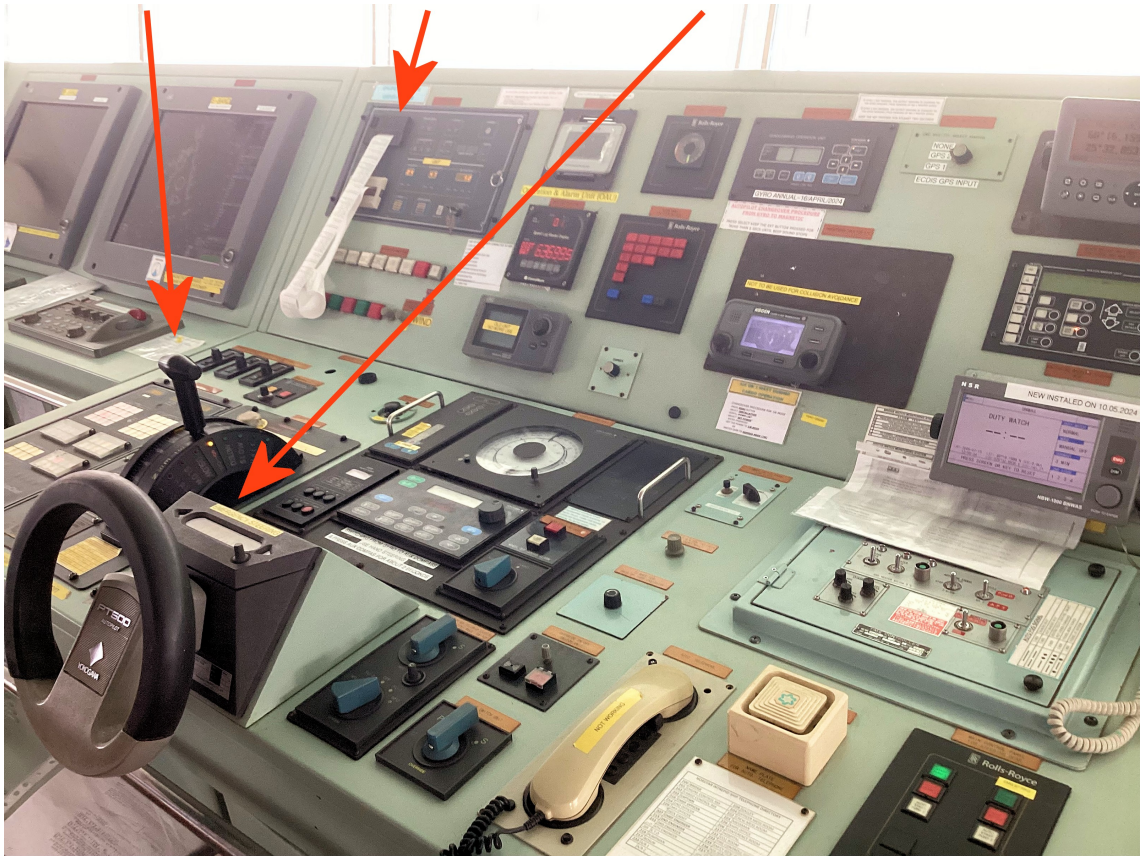
- 15 crew members were initially detained but released prior to the end of February.
- 6 crew members were initially detained but released with the ship on 28 February, 2025.

5.7 THE BRIDGE

The following pictures are taken during our visit on board 28.02.2025.

X-band radar (JRC – Japan Radio)	S-band radar (JRC – Japan Radio)	X-band radar (JRC – Japan Radio)	Primary ECDIS (Wärtsilä)
			

Rudder indicator P70° ... S70° × 3/4	ROT meter P30° ... S30 °/min	Engine RPM meter -150 ... +150 rpm	Magnetic compass vertical extension
			
Engine command printer	Engine telegraph	Gyro compass repeater	

Engine telegraph	Engine command printer	Steering and autopilot	
			

	Engine control panel	Engine command printer	Engine telegraph
			

	Master/Pilot	Master/Pilot	



5.8 ONBOARD NAVIGATION EQUIPMENT

The Eagle S has a standard set of navigational equipment as by requirements. On 16 June, 2025, the Master provided us with a detailed protocol (a list describing this equipment) as of 21 February, 2025.

Remarks related to this list:

- One of three radars (one of the two X-band radars) was not working at the protocol date. This is highlighted in yellow in the table that follows.
- The vessel had earlier (before 25 December, 2024) ordered some maintenance parts, to be delivered in Skagen, Denmark.

We find the Eagle S set of navigation equipment to be appropriate for the given purpose.

Description	Maker/ Model/Type	Software/ Firmware version	Last Date of Software update	Recommended Onboard Test Period	Last Shore based Maintenece visit	Condition Good /Fair/Bad	Remarks
Gyro 1	YOKOGAWA / CMZ700D	SR NO. 27190	N/A	Monthly	16.apr.2024	GOOD	Gyro Sphere changed Feb 2023
Gyro 2	YOKOGAWA / CMZ700D	SR NO. 30997	N/A	Monthly	16.apr.2024	GOOD	Gyro Sphere changed May 2021
Auto Pilot	YOKOGAWA/ PM-208	N/A	N/A	Monthly	N/A	GOOD	
Magnetic Compass/ Off Course Alarm	L & G/ SESTREL SR4	N/A	N/A	Daily	26.sep.2021	GOOD	Tested Daily Working Good
Radar No. 1 (S Band)	JRC / JMA - 9932 - SA	No.01.17		Monthly	18.apr.2024	GOOD	Magnetron changed: 19-02-2025
Radar No. 2 (X Band)	JRC / JMA - 9922 - 9XA	No.01.17		Monthly	18.apr.2024	GOOD	Magnetron changed: 18-04-2024
Radar No. 3 (X Band)	JRC / JMA - 9922 - 9XA	No.01.17		Monthly	8.apr.2023	Not Working	Magnetron changed: 05-03-2023
ECDIS 1 (STBD)	WÄRTSILÄ NAVI SAILOR 4000	V.3.01.350	18.apr.2024	Monthly	18.apr.2024	GOOD	Remote Access
ECDIS 2 (PORT)	WÄRTSILÄ NAVI SAILOR 4000	V.3.01.350	18.apr.2024	Monthly	18.apr.2024	GOOD	Remote Access
GPS 1	JRC NWZ 4610	N/A		Monthly	Not know	GOOD	
GPS 2	JRC JLR-7700MK II	12 YD		Monthly	Not know	GOOD	
GPS 3	N/A	N/A		N/A	N/A		
AIS	KODEN/ KAT-100	030200.05.15.02		Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
BNWAS	NSR/ NBW-1000BNWAS	N/A	N/A	Monthly	10.maj.2024	GOOD	NEW BNWAS INSTALLED ON 10.05.2024@ YALOVA TURKEY
LRIT	JRC/JUE-87C	N/A	N/A	Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
VDR/SVDR	NETWAVE/ NW6000	N/A	N/A	Monthly	11.maj.2024		AT SHORE WITH FINLAND AUTHORITY
Speed Log	CONSILIUM SAL -R1	N/A	N/A	Monthly		GOOD	
Navtex Receiver	JRC / NCR333	4,07	7.feb.2023	Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
Anemometer	KONGSBERG -OMC 139	N/A		Daily	N/A	GOOD	NEW DISPLAY INSTALLED ON 02.05.2024 AT

							YALOVA TURKEY
Echo Sounder	JRC/JFE-680	1,00		Monthly	N/A	GOOD	TRANSDUCER CLEANE AT YALOVA DRY DOCK
Weather Facsimile	JRC/JAX-9A	N/A	N/A	Monthly	N/A	GOOD	
VHF 1	SAILOR 7222	1,09	7.feb.2023	Daily, Weekly, Monthly	8.maj.2024	GOOD	Bridge Port ANNUAL ON 08.05.2024
VHF 2	SAILOR 6222	2,2	N/A	Daily, Weekly, Monthly	8.maj.2024	GOOD	Bridge STBD ANNUAL ON 08.05.2024
VHF 3	JRC/ JHS-32B	N/A	N/A	Daily, Weekly, Monthly	8.maj.2024	GOOD	CCR ANNUAL ON 08.05.2024
DSC MF/HF Unit	JRC/JSS-596	2,12		Daily, Weekly, Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
Inmarsat 'C'	JRC/JUE-87C	N/A	N/A	Daily, Weekly, Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
FBB 250	THARNE & THARNE/ SAILOR 250	N/A	N/A	Monthly	N/A	GOOD	
FBB 500	THARNE & THARNE/ SAILOR 500	N/A	N/A	Monthly	N/A	GOOD	
V-SAT	JRC JUE 60 GX	N/A	N/A	N/A	1.sep.2020	GOOD	
GMDSS Survival Craft Walkie-	JRC / JHS-7	N/A	N/A	Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
NBDP Radio Telex	JRC/ NDZ-127J	3,01	N/A	Monthly	8.maj.2024	GOOD	ANNUAL ON 08.05.2024
IBS UNIT	N/A	N/A	N/A	N/A	N/A	GOOD	Not on board
Fax Unit	JRC/JAX-831	N/A	N/A	-	-		
Antenna Equipment	N/A	N/A	N/A	Monthly	N/A	GOOD	Checked Monthly
P.A. System with Talk-back	SERIES/ AW 8000	N/A	N/A	Weekly, Monthly	N/A	GOOD	
Radio Batteries	EXIDE	N/A	N/A	Monthly	N/A	GOOD	
Day Signals (Ball) X 3	N/A	N/A	N/A	Monthly	N/A	GOOD	Checked Monthly
Day Signals (Cylinder) X 2	N/A	N/A	N/A	Monthly	N/A	GOOD	Checked Monthly
Day Signals (Diamond) X 1	N/A	N/A	N/A	Monthly	N/A	GOOD	Checked Monthly
Navaids Spares/Tools		N/A	N/A			GOOD	
Window Wiper		N/A	N/A	N/A	24-April-23 SHIP STAFF	GOOD	
Bridge Telegraph Printer	KONGSBERG MARITIME AS OPU 8810	N/A	N/A	N/A	15-March-23 SHIP STAFF	GOOD	Checked Daily
Air Horn		N/A	N/A	Daily	N/A	GOOD	Checked Daily
Aldis Lamp		N/A	N/A	Weekly	N/A	GOOD	NEW ALDIS LAMP RECVD ON

							20.04.2024 AT YALOVA TURKEY
Barometer	DYM 3	N/A	N/A		18.mar.2021	GOOD	Compared with Shore Authorities & other vsl @regular intervals



The display screen of the other (of two) Wärtsilä NaviSailor 4000 ECDIS

5.9 THE VOYAGE DATA RECORDER

The VDR works like a "black box" for the ship, recording relevant information about the ship's telemetry, status, and crew. It consists of three physical units:

- The CPU
  This is a minicomputer on bridge. It has data ports, a one terabyte SSD drive, and internal battery power backup.
- The EPIRB (Emergency Position Indicating Radio Beacon)
  The EPIRB is a buoy that disconnects automatically from its stand once it is some 2-4 metres under water. It then transmits radio signals for a minimum of 48 hours to SARSAT and other SAR satellite systems, which relay the signals to the closest maritime rescue co-ordination centre, which, in turn, activate the needed rescue operations.

- A fire-proof hardened storage server, the “VDR Capsule” (HSS)
  This is mounted at the top of the ship. It contains a subset of the full VDR data set, and is intended to be accessed with diving operations. It sends an acoustic signal for a minimum of 48 hours.

5.9.1 Missing data in the VDR

Part of the most recent data is missing from the VDR, specifically, data from the week before the cable incident until approximately one hour after passing Estlink 2.

There are two interacting reason for this:

1. The VDR uses a GPS made by Japan Radio Co., Ltd (JRC) for date and time input (see https://www.jrc.co.jp/en/). Some of its GPS models, including the one supplying time data to the Eagle S VDR, have a limit of 1,024 weeks, that is, they use 10 bits for this information, probably as part of memory usage optimisations

   Once the number of weeks reaches 1,024, the GPS performs a **rollover** and then continues normally.

   This causes the GPS to send date information to the VDR that is 1,024 weeks old instead of current date information. 1,024 weeks equals 7,168 days, which corresponds to approximately 19.64 years.

   This rollover happened in Q3 or Q4 of 2024. From that point on, the data collected from the ship was saved in the VDR with a date that was 19.64 years too early.

1. The VDR software does not have a mechanism to react to this. Instead, it saved the incoming data as expected. By its built-in automation, it then **deleted data from the oldest end of the database** to free memory. This meant that the newly-saved data was deleted automatically, not by user action or erratic settings.

The Eagle S ship manager/owner was aware of this problem, and had issued instructions to the ship. A replacement GPS was ready and waiting to be installed in a few days, when the ship would arrive at Skagen, Denmark.

Information about JRC rollovers can be found with the following Google phrase:

jrc bulletin for gps week number rollover

7,168 days before the incident day was 11 May, 2005. According to JRC and other bulletins, a rollover was expected on 8 September, 2024, which implies a GPS manufacture (or initialisation) date of 23 January, 2005. As Eagle S was laid down in 2004 and delivered in 2006, this fits well. There may, however, have been also other rollover dates.

We could not investigate this GPS ./.. VDR rollover effect more in detail as we were only allowed to visit the ship once and were only granted access to the VDR on 23 May, 2025, after the ship had left Finland.

The described phenomenon is neither relevant for this technical report nor for the cause of the incident. The ship's navigation equipment did at all time work correctly, irrespective of how the VDR kept the data.

5.10 THE ANCHORING AND MOORING ARRANGEMENT

The Eagle S anchoring arrangement appears to be Finnish-made in 2006, by what was originally "Rauma-Repola Deck Machinery Works" and is now the Norwegian Kongsberg-owned "Rauma-Brattvaag".

The following description was obtained by asking Google AI about "Rauma-Repola Deck Machinery Works" – it has not been independently verified, but is peripheral to this investigation and included for general interest.

Rauma-Repola Deck Machinery Works was a division of Rauma-Repola Oy that designed and manufactured deck equipment, primarily for the company's shipbuilding and marine technology division. They started in the 1940s and became a significant exporter of this equipment. The division later merged with Hollming Ltd. Engineering Works to form Aquamaster-Rauma Ltd. in 1988.

Here's a more detailed breakdown:

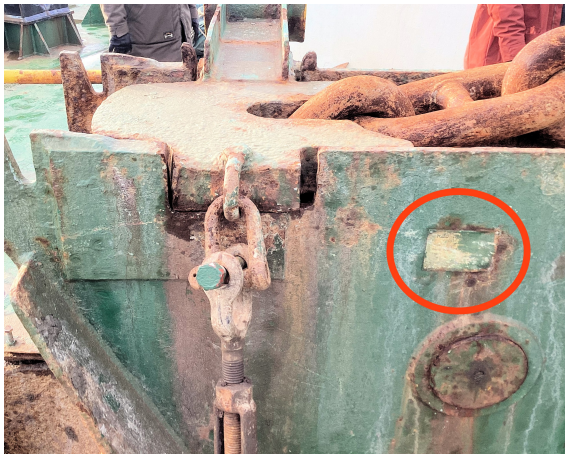
Core Business: Rauma-Repola Deck Machinery Works focused on designing and manufacturing deck equipment such as winches, windlasses, and cranes.

Part of a Larger Entity: It was a part of Rauma-Repola Oy, a major Finnish industrial company with a shipbuilding division.

Export Focus: A significant portion of their production was exported, indicating a global reach for their products.

Merger: In 1988, the Deck Machinery Works merged with Hollming Ltd. Engineering Works to form Aquamaster-Rauma Ltd., which became part of Kongsberg Maritime.

Legacy: The company's work in deck machinery is part of the larger history of Rauma shipyard, which has continued to specialize in shipbuilding and marine technology.





The metal plate with manufacturer ("Rauma-Brattvaag"), year and serial number on the port side anchor brake. Left-hand image taken during the visit 28 February 2025, right-hand image part of the portfolio taken and provided by the ship's Master.

The Eagle S is fitted with two hydraulically-driven combined anchor windlass/mooring winches forward. The arrangement uses dog clutches to clutch in or out the windlass and either or both winch drums. Each winch drum is fitted with a mooring wire rope. The winch drums and the anchor windlass gypsy (or cable-lifter) are each fitted with a band brake, which is tightened or eased by a system of linkages controlled by a threaded spindle and handwheel. From the chain locker, each chain passes up through the spurling pipe, over the cable-lifter, then forward and down through a guillotine chain stopper, before passing down through the hawse pipe.

The guillotine chain stoppers comprise a heavy stand welded to the deck immediately aft of the hawse pipe, containing a roller over which the anchor chain passes before it leads down through the hawse pipe. The guillotine itself is essentially a heavy, counterweighted, steel bar that is hinged on the inboard side. The guillotine can be rotated down into a horizontal position and located into a crutch forming part of the stand, so that the guillotine lies on top/around of a vertical chain link and prevents the adjoining horizontal link from passing through. The guillotine is secured in the horizontal locked position by a turnbuckle attached to pad-eyes on the head of the guillotine and the deck.

When the anchors are secured for sea, a wire rope pennant is run through the anchor chain link immediately above the hawse pipe and secured to pad-eyes on the anchor windlass frame on either side of the guillotine chain stopper. The lashing incorporates a turnbuckle for tightening.



The Eagle S port side anchoring arrangement [image from ship Master's portfolio]

6 WEATHER DURING THE VOYAGE

We have analysed the weather for the time period 20.12 2024 00:00 – 26.12 2024 23:00 UTC. This period represents 7 full days (168 hours). All weather observations are hourly.

We have used three data sources for weather information:

- Historical data from the Finnish Meteorological Institute (FMI): https://www.ilmatieteenlaitos.fi/havaintojen-lataus
- Historical data from the European Centre for Medium-Range Weather Forecasts (ECMWF) and its Copernicus Climate Change Service (C3S). Below is a short extract, published in April 2017 at the start times of the programme, from https://www.ecmwf.int/en/newsletter/151/meteorology/climate-service-develops-user-friendly-data-store

  "*The European Commission has entrusted ECMWF with the implementation of the Copernicus Climate Change Service (C3S). The mission of C3S is to provide authoritative, quality-assured information to support adaptation and mitigation policies in a changing climate. At the heart of the C3S infrastructure is the Climate Data Store (CDS), which provides information about the past, present and future climate in terms of Essential Climate Variables (ECVs) and derived climate indicators.*"

  The main web address for the ECMWF/Copernicus is https://www.ecmwf.int.
- Historical data from Copernicus Marine Data Store, which focuses of the marine data part of the Copernicus programme: https://data.marine.copernicus.eu

6.1 WATER CURRENTS

We have not been able to resolve the water currents infallibly. Water currents represent a very complex science. Their behaviour in the Gulf of Finland may have significant local variations due to the shallowness of the sea and the large archipelago. The available historical data is calculated with computer models that might not be accurate for very specific time intervals or locations, despite being correct at a larger scale.

In addition, the water currents in the Gulf of Finland typically have variations between different, but dense, water layers. The currents may have opposite directions at layers only a few metres from each other. The water depths in the incident area vary from 40 to 70 metres, and these depths changed rapidly as the vessel moved. As the vessel itself had a draught of 14.5 metres, we cannot precisely resolve how the currents affected the vessel.

By crew statements, the water current was 1-2 knots against. This was determined by the ships standard evaluation methods. For the ship, the currents are meaningful only for fuel economy and keeping to agreed schedules.

We find it reasonable to assume that the vessel experienced a “one knot against” water current, and emphasise that the currents may have significant variations depending on precise time and position.

6.2 WIND CLASSIFICATIONS

The table below shows the classification convention for various wind speeds (10 minute averages) according to the Finnish Meteorological Institute. Note that:

- The Finnish classifications may differ from ones used in other countries.
- The table (and the web page) is not available in Swedish, hence we have provided the translation shown.

Source: https://www.ilmatieteenlaitos.fi/tuulet

Speed m/s	Eng	Fin	Swe
0	Calm	Tyyntä	Lugnt
1–3	Gentle wind	Heikkoa tuulta	Svag vind
4–7	Moderate wind	Kohtalaista tuulta	Måttlig vind
8–13	Strong breeze/near gale	Navakkaa tuulta	Frisk vind / hård bris
14–20	Gale	Kovaa tuulta	Hård vind
21–32	Storm	Myrskyä	Storm
≥ 33	Hurricane	Hirmumyrskyä	Orkan

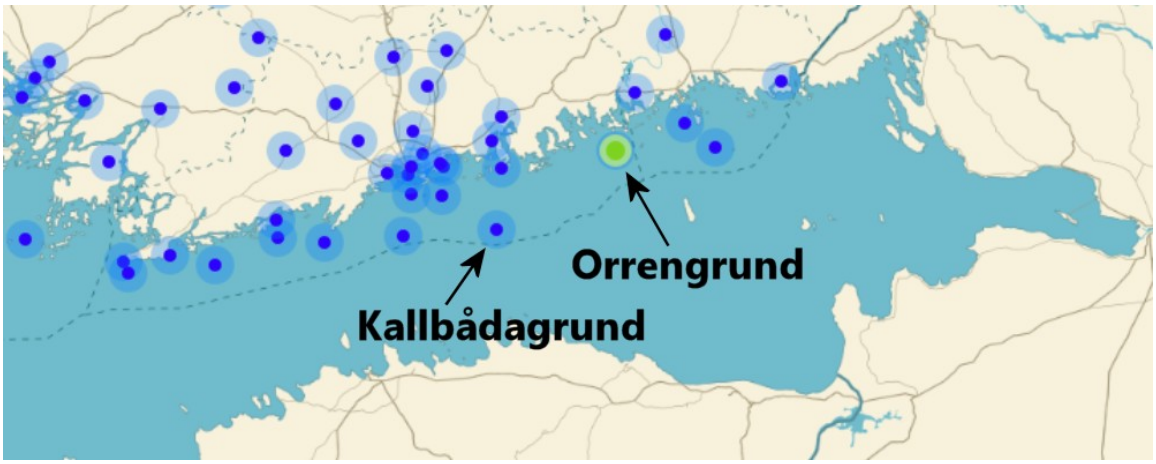
From the same page, a description of the sea water surface at 14-16 m/s wind speed can be obtained:

	At land	At sea
Eng	The trees are swaying. It's difficult to walk against the wind.	The tops of the waves break. The foam arranges itself in stripes in the direction of the wind. The noise is heard far away.
Fin	Puut heiluvat. Tuulta vasten kulkeminen vaikeaa.	Aaltojen huiput murtuvat. Vaahto järjestyy tuulen suuntaisiksi juoviksi. Kohina kuuluu kauas.
Swe	Träden svajar. Det är svårt att gå mot vinden.	Vågtopparna bryts. Skummet lägger sig i ränder i vindens riktning. Ljudet hörs långt bort.

6.3 COLLECTED WEATHER INFORMATION

6.3.1 Historical data from the Finnish Meteorological Institute

We have obtained historical weather data from two observation stations, the Kallbådagrund beacon (lat, lon = 59.985235000, 25.598466944) and Orrengrund (lat, lon = 60.274472222, 26.445137222) [paikkatietoikkuna.fi].



The two FMI weather stations used

The table below shows historical weather data collected from the Finnish Meteorological Institute. Times are UTC. The event window for the cable incident is highlighted in yellow.

		Kall	Orre	Kall	Orre	Kall	Orre	Orre	Kall	Orre	Orre	Orre
Date	Time	Wind direction		Wind gust		Wind speed		Visibility	Temperature		Cloud cover	Dominating weather remarks (Finnish)
	UTC	° avg		m/s avg		m/s avg		m	°C avg		0...8X	
20	00:00	250,0	215,3	9,4	10,4	8,1	7,1	17706,2	5,5	5,4	XXXXXXXX	
20	01:00	286,6	220,3	6,6	9,9	5,8	6,7	19252,9	4,4	5,1	XXXXXXXX	
20	02:00	277,0	243,4	6,5	6,4	5,8	4,3	14733,7	4,3	4,4	XXXXXXXX	Heikkoja vesikuuroja
20	03:00	261,3	255,6	7,6	4,4	6,6	2,8	19978,0	4,4	4,0	XXXXXXXX	Heikkoja vesikuuroja
20	04:00	259,7	242,6	12,0	6,1	10,0	3,8	14007,5	4,2	3,8	XXXXXXXX	Heikkoa vesisadetta
20	05:00	248,8	247,8	9,4	8,1	8,2	5,0	15647,1	4,4	3,6	XXXXXXXX	Heikkoa vesisadetta
20	06:00	225,5	242,5	11,3	7,4	9,6	4,5	15698,0	5,1	3,4	XXXXXXXX	Heikkoa vesisadetta
20	07:00	244,4	228,1	14,0	9,2	11,3	5,4	17778,7	3,8	3,9	XXXXXXXX	Kohtalaisia vesikuuroja
20	08:00	229,6	232,0	12,5	11,5	10,2	7,2	18868,0	4,6	3,7	XX	Vesisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
20	09:00	224,6	222,4	14,3	9,4	11,8	6,4	20000,0	4,3	3,8	XXXXXXX	
20	10:00	226,9	236,4	13,1	9,5	11,1	6,0	14903,0	4,1	3,3	XXXXXXX	Vesisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
20	11:00	250,7	234,2	12,8	7,7	10,4	5,0	17953,8	3,3	3,1	XXXXXXX	Heikkoja vesikuuroja
20	12:00	238,0	224,4	11,7	9,0	10,1	6,1	20000,0	4,0	3,3	XXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
20	13:00	240,8	244,2	9,6	8,8	8,3	5,7	20000,0	4,1	3,7	XXXXXXX	
20	14:00	266,6	259,4	8,9	6,6	7,7	4,2	20000,0	4,1	3,0	XXX	

		Kall	Orre	Kall	Orre	Kall	Orre	Orre	Kall	Orre	Orre	Orre
Date	**Time**	**Wind direction**		**Wind gust**		**Wind speed**		**Visibility**	**Temperature**		**Cloud cover**	**Dominating weather remarks (Finnish)**
	UTC	**° avg**		**m/s avg**		**m/s avg**		**m**	**°C avg**		**0...8X**	
20	15:00	294,4	270,3	8,9	7,1	7,8	4,7	20000,0	3,2	2,9	XXXXXXX	
20	16:00	305,5	295,5	10,5	8,5	9,3	7,3	20000,0	2,5	2,5	XXXXXXXX	
20	17:00	305,4	298,4	13,9	11,1	12,0	9,2	20000,0	1,3	1,9	XXXXX	
20	18:00	303,1	308,8	14,6	13,8	13,0	11,7	20000,0	0,1	0,8	XXXXXXXX	
20	19:00	297,7	308,1	17,1	13,8	14,2	11,4	20000,0	-1,9	-0,3	XXXXXXXX	
20	20:00	295,8	302,7	15,4	16,0	13,1	13,5	18277,5	-2,0	-1,4	XXXXXXXX	Lumisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
20	21:00	287,0	302,5	16,5	14,2	13,5	11,4	20000,0	-1,5	-2,4	XXXXXXX	
20	22:00	284,1	288,6	17,0	12,9	13,9	9,7	19174,5	-1,6	-2,5	XXXXXXX	Heikkoja lumikuuroja
20	23:00	292,3	293,0	18,2	14,9	15,7	12,1	17975,8	-2,7	-2,7	XXXXXXX	Heikkoja lumikuuroja
21	00:00	287,7	290,2	16,4	15,6	13,8	11,9	19518,0	-2,8	-3,3	X	Lumisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
21	01:00	276,8	278,8	15,8	12,7	12,7	8,6	20000,0	-2,4	-3,5	X	
21	02:00	280,0	270,3	15,2	13,8	12,4	8,9	20000,0	-1,9	-3,2		
21	03:00	275,3	269,9	16,3	14,1	13,6	9,4	20000,0	-1,2	-2,7		
21	04:00	269,5	259,1	15,4	12,6	13,0	7,6	20000,0	-0,4	-2,1		Lumisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
21	05:00	262,0	259,0	16,3	13,0	13,6	8,2	19345,9	1,2	-1,2	XXXXXXXX	Heikkoja lumikuuroja
21	06:00	260,2	272,6	20,9	11,1	18,0	7,2	8191,8	2,4	-1,2	XXXXXXX	Heikkoa lumisadetta
21	07:00	261,2	269,6	19,4	12,4	16,6	7,8	20000,0	2,4	0,0	XXXXXXX	
21	08:00	265,8	271,9	15,5	11,7	13,4	7,5	20000,0	2,3	0,6	XXXXXXX	
21	09:00	259,7	258,2	13,5	10,3	11,7	6,5	20000,0	2,6	1,0	XXXXXXX	
21	10:00	252,9	253,2	13,0	9,5	9,9	5,6	20000,0	2,8	1,5	XXXXXXXX	
21	11:00	0,0	266,3	0,0	10,4	0,0	6,7	12787,0	1,4	1,2	XXXXXXXX	Heikkoa lumisadetta
21	12:00	0,0	281,7	0,0	5,8	0,0	3,7	1596,5	0,3	-0,3	XXXXXXXX	Heikkoa lumisadetta
21	13:00	0,0	128,2	0,0	2,0	0,0	1,2	1845,3	0,3	-0,6	XXXXXXXX	Heikkoa lumisadetta
21	14:00	0,0	46,5	0,0	4,3	0,0	3,5	7286,1	0,6	-0,6	XXXXXXXX	Heikkoa lumensekaista vesi- tai tihkusadetta (räntää)
21	15:00	40,1	46,6	7,2	6,4	5,7	5,4	4846,9	0,8	-0,5	XXXXXXXX	Heikkoa lumisadetta
21	16:00	16,8	30,6	8,3	7,5	6,7	6,2	2159,8	0,4	-0,4	XXXXXXXX	Heikkoa lumisadetta
21	17:00	17,1	18,7	6,3	6,3	4,9	5,2	9418,6	0,3	-0,6	XXXXXXXX	Heikkoa lumisadetta
21	18:00	10,2	20,4	4,2	4,6	3,1	3,6	19135,4	0,3	-1,1	XXXXX	Lumisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
21	19:00	41,9	22,5	3,7	2,1	2,6	1,3	20000,0	0,3	-1,3	XXXXXXXX	
21	20:00	84,7	89,9	3,1	1,4	2,3	0,9	20000,0	0,6	-1,2	XXXXXXXX	
21	21:00	116,9	133,1	3,1	2,6	2,3	1,8	20000,0	1,2	-0,9	XXXXXXX	
21	22:00	120,0	131,2	2,9	3,1	2,1	2,3	20000,0	1,8	0,1	XXXXXXXX	
21	23:00	105,7	128,0	2,9	4,2	2,3	2,7	19004,2	2,3	0,6	XXXXXXXX	Heikkoja vesikuuroja
22	00:00	145,3	124,2	4,1	4,5	2,8	2,8	12541,6	2,8	0,8	XXXXXXXX	Heikkoja lumikuuroja
22	01:00	195,9	141,8	10,2	4,8	8,6	3,4	11866,2	4,4	1,9	XXXXXXXX	Heikkoa vesisadetta
22	02:00	194,2	147,0	12,8	5,4	11,0	4,0	5641,4	4,7	2,9	XXXXXXXX	Heikkoja vesikuuroja
22	03:00	187,5	192,3	12,6	10,8	10,6	8,2	20000,0	4,7	3,7	XXXXXXX	
22	04:00	180,9	192,4	13,5	12,5	11,7	9,3	19633,6	4,7	3,9	XXXXXXX	Heikkoja vesikuuroja
22	05:00	180,1	184,8	15,2	13,4	13,1	10,7	20000,0	4,6	4,0	XXXXXXXX	
22	06:00	181,4	182,8	15,2	14,5	13,0	12,0	20000,0	4,6	4,1	XXXXXXXX	Heikkoja vesikuuroja
22	07:00	180,0	182,5	16,2	14,7	13,7	12,2	18854,6	4,5	3,9	XXXXXXXX	Heikkoa vesisadetta
22	08:00	176,6	184,9	15,6	14,8	13,5	11,8	20000,0	4,5	3,9	XXXXXXXX	Heikkoja vesikuuroja
22	09:00	175,0	181,5	15,9	15,5	13,7	13,0	20000,0	4,3	3,9	XXXXXXXX	Vesisadetta edellisen

		Kall	Orre	Kall	Orre	Kall	Orre	Orre	Kall	Orre	Orre	Orre
Date	Time	Wind direction		Wind gust		Wind speed		Visibility	Temperature		Cloud cover	Dominating weather remarks (Finnish)
	UTC	° avg		m/s avg		m/s avg		m	°C avg		0...8X	
												tunnin aikana, mutta ei enää havaintohetkellä
22	10:00	171,2	181,1	16,5	17,4	14,2	14,3	18215,5	4,0	3,8	XXXXXXXX	Heikkoja vesikuuroja
22	11:00	170,0	178,5	16,0	17,5	13,8	14,5	12570,0	4,1	3,5	XXXXXXXX	Heikkoa vesisadetta
22	12:00	166,7	175,8	16,0	16,8	13,5	14,2	15596,4	4,1	3,5	XXXXXXXX	Heikkoja vesikuuroja
22	13:00	166,0	171,7	15,6	17,0	13,5	14,0	9829,5	4,0	3,4	XXXXXXXX	Heikkoa vesisadetta
22	14:00	173,4	172,2	15,6	17,3	13,5	14,3	15541,4	3,8	3,6	XXXXXXXX	Heikkoa vesisadetta
22	15:00	174,2	174,6	15,6	16,9	13,2	14,4	12102,5	3,8	3,5	XXXXXXXX	Heikkoa vesisadetta
22	16:00	179,1	179,6	14,8	16,6	12,8	14,0	9525,0	3,8	3,5	XXXXXXXX	Heikkoa vesisadetta
22	17:00	180,3	183,0	14,5	15,8	12,5	12,9	7684,3	3,3	3,4	XXXXXXXX	Heikkoa vesisadetta
22	18:00	180,9	183,8	13,8	14,9	12,0	12,0	9070,1	3,1	3,3	XXXXXXXX	Heikkoa vesisadetta
22	19:00	184,7	187,8	13,6	13,8	11,6	10,3	8403,3	2,8	2,9	XXXXXXXX	Kohtalaista vesisadetta
22	20:00	184,3	187,3	13,2	12,9	11,3	9,7	9598,3	2,6	2,7	XXXXXXXX	Heikkoa vesisadetta
22	21:00	189,2	185,1	12,6	12,6	11,0	9,5	10630,0	2,4	2,6	XXXXXXXX	Kohtalaista vesisadetta
22	22:00	187,9	190,4	11,8	11,8	10,4	9,0	12480,4	2,4	2,5	XXXXXXXX	Heikkoa vesisadetta
22	23:00	190,7	191,4	11,8	11,2	10,5	8,2	13474,5	2,5	2,4	XXXXXXXX	Heikkoa vesisadetta
23	00:00	198,2	195,8	12,2	11,9	10,7	8,9	11322,7	2,9	2,6	XXXXXXXX	Heikkoa vesisadetta
23	01:00	204,1	202,1	10,7	10,7	9,5	8,0	19392,0	3,2	3,0	XXXXXXXX	Heikkoja vesikuuroja
23	02:00	211,9	204,6	10,0	8,9	8,6	6,3	17073,2	3,7	3,2	XXXXXXXX	Utua
23	03:00	208,2	213,9	11,1	8,0	9,5	5,3	12706,9	4,2	3,4	XXXXXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
23	04:00	211,8	213,9	11,2	7,5	9,8	4,9	2998,1	4,6	3,7	XXXXXXXX	Tiheää tihkusadetta
23	05:00	212,9	209,6	10,3	9,8	9,3	6,6	17750,0	4,6	4,1	XXXXXXXX	Vesisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
23	06:00	206,6	207,6	9,6	10,4	8,4	6,7	19178,0	4,6	4,3	XXXXXXXX	
23	07:00	197,0	209,7	9,9	8,7	8,5	5,8	18625,2	4,7	4,3	XXXXXXXX	
23	08:00	194,8	198,5	9,8	8,5	8,8	6,6	18628,0	4,7	4,1	XXXXXXX	Vesisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
23	09:00	196,4	196,5	8,5	8,5	7,3	6,4	19652,6	4,7	4,2	XXXXXXXX	
23	10:00	191,1	197,5	8,4	7,0	7,3	5,5	20000,0	4,8	4,2	XXXXXXXX	
23	11:00	184,3	188,3	8,1	7,9	6,9	5,8	19229,6	4,7	4,1	XXXXXXXX	
23	12:00	181,8	188,5	7,9	7,7	6,9	5,7	15577,4	4,7	4,1	XXXXXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
23	13:00	178,0	187,4	7,2	7,5	6,3	5,5	14053,7	4,6	3,9	XXXXXXX	
23	14:00	187,7	193,7	7,0	6,4	6,0	5,1	19560,8	4,5	3,9	XXXXXXX	
23	15:00	187,1	189,8	5,7	5,5	4,9	4,2	17794,5	4,5	3,5	XXXXXXX	
23	16:00	176,3	180,0	5,7	5,6	5,0	4,8	19867,6	4,3	3,9	XXXXXXXX	
23	17:00	164,3	174,8	6,4	6,1	5,8	5,4	20000,0	4,0	3,8	XXXXXXXX	
23	18:00	163,2	181,2	6,6	6,2	5,8	5,2	20000,0	3,6	3,7	XXXXXXXX	
23	19:00	160,6	183,0	4,9	5,3	4,3	4,3	16188,1	3,5	3,6	XXXXXXXX	Heikkoa vesisadetta
23	20:00	156,6	179,8	3,7	3,8	3,2	3,2	12222,1	3,3	3,4	XXXXXXXX	Heikkoa vesisadetta
23	21:00	158,3	165,4	3,6	3,9	3,1	3,0	13770,3	3,2	3,4	XXXXXXXX	Heikkoa vesisadetta
23	22:00	153,2	147,8	4,1	4,5	3,6	3,4	12864,3	3,0	3,3	XXXXXXXX	Heikkoa vesisadetta
23	23:00	153,6	140,2	2,9	5,0	2,3	3,7	14213,3	2,8	2,7	XXXXXXXX	Heikkoa vesisadetta
24	00:00	154,9	150,5	3,0	4,5	2,2	3,4	17877,3	2,5	2,2	XXXXXXXX	Heikkoa vesisadetta
24	01:00	167,8	151,4	2,4	3,1	1,9	2,1	20000,0	2,0	1,9	XXXXXXXX	Heikkoa vesisadetta
24	02:00	192,0	128,5	2,0	2,3	1,5	1,5	20000,0	1,9	1,7	XXXXXXXX	Heikkoa vesisadetta
24	03:00	219,5	124,0	1,7	1,7	1,2	1,1	17141,1	1,8	1,4	XXXXXXXX	Heikkoa vesisadetta
24	04:00	235,8	116,8	1,5	2,0	1,1	1,3	17077,1	2,0	1,4	XXXXXXXX	Heikkoa vesisadetta

		Kall	Orre	Kall	Orre	Kall	Orre	Orre	Kall	Orre	Orre	Orre
Date	Time	Wind direction		Wind gust		Wind speed		Visibility	Temperature		Cloud cover	Dominating weather remarks (Finnish)
	UTC	° avg		m/s avg		m/s avg		m	°C avg		0...8X	
24	05:00	324,8	112,8	1,7	1,6	1,1	1,1	16168,9	2,2	1,3	XXXXXXXX	Heikkoa vesisadetta
24	06:00	299,4	79,5	1,4	0,9	1,0	0,6	9903,5	2,4	0,9	XXXXXXXX	Heikkoa lumensekaista vesi- tai tihkusadetta (räntää)
24	07:00	233,0	180,2	2,7	1,9	2,1	1,4	14293,5	2,8	1,0	XXXXXXXX	Heikkoa vesisadetta
24	08:00	297,0	26,8	2,7	2,1	2,3	1,7	13199,8	3,2	0,9	XXXXXXXX	Heikkoa vesisadetta
24	09:00	308,0	72,8	2,2	1,3	1,7	0,9	18536,9	3,3	0,8	XXXXXXX	
24	10:00	309,8	316,7	2,0	1,7	1,7	1,2	19695,5	3,4	1,2	XXXXXXXX	
24	11:00	288,9	297,8	3,6	2,7	2,8	2,0	19077,9	3,4	1,6	XXXXXXXX	
24	12:00	268,2	266,0	3,1	2,0	2,4	1,2	5750,5	3,4	1,6	XXXXXXXX	
24	13:00	270,4	255,2	3,6	2,8	3,1	1,8	20000,0	3,4	1,9	XXXXXXXX	
24	14:00	249,8	245,5	4,2	2,8	3,6	1,8	20000,0	3,3	2,3	XXXXXXX	
24	15:00	236,0	214,4	5,5	4,1	4,5	2,8	20000,0	3,7	2,9	XXXXXXXX	
24	16:00	238,3	223,3	7,7	5,0	6,4	3,2	18877,7	3,9	3,1	XXXXXXXX	
24	17:00	242,8	227,0	8,3	6,3	7,4	4,0	17825,7	4,0	3,3	XXXXXXXX	
24	18:00	228,4	237,4	8,7	7,7	7,4	4,8	20000,0	4,1	3,4	XXXXXXXX	
24	19:00	220,2	235,3	9,6	6,4	8,5	4,0	20000,0	3,8	3,2	XXXXXXX	
24	20:00	213,1	234,9	10,6	5,5	9,5	3,5	20000,0	3,5	3,2	XXXXXXXX	Heikkoa vesisadetta
24	21:00	209,1	220,1	11,4	8,0	10,2	5,2	17852,6	3,4	3,1	XXXXXXX	Vesisadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
24	22:00	215,0	216,0	13,3	10,2	11,6	7,0	20000,0	3,5	3,2	XXXXXXX	
24	23:00	215,6	216,2	13,7	12,4	12,0	8,1	19576,4	3,4	3,4	XXXXXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
25	00:00	220,2	218,2	14,6	12,3	12,9	8,1	20000,0	3,7	3,4	XXXXXXX	
25	01:00	221,4	220,2	14,4	12,1	12,5	8,0	20000,0	3,7	3,6	XXXXXXXX	
25	02:00	218,2	223,5	14,0	11,5	12,3	7,6	18990,6	3,5	3,6	XXXXXXXX	Heikkoja vesikuuroja
25	03:00	220,1	219,3	14,5	12,3	12,6	8,2	17873,1	3,6	3,6	XXXXXXXX	
25	04:00	219,7	221,0	14,3	13,0	12,4	8,5	20000,0	3,8	3,7	XXXXXXXX	
25	05:00	216,1	216,9	14,5	13,0	12,7	8,5	20000,0	4,0	3,8	XXXXXXXX	
25	06:00	218,5	218,3	15,0	13,0	12,5	8,6	20000,0	4,4	3,9	XXXXXXXX	
25	07:00	215,8	218,6	13,8	12,4	11,8	8,4	20000,0	4,4	4,1	XXXXXXXX	
25	08:00	222,4	215,1	15,4	11,7	13,1	7,9	12012,8	4,7	4,0	XXXXXXXX	Heikkoa tihkusadetta
25	09:00	224,9	215,6	14,9	11,6	12,8	7,9	4280,7	4,6	4,0	XXXXXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
25	10:00	223,2	218,0	15,7	13,0	13,3	8,4	6556,3	4,7	4,4	XXXXXXXX	Utua
25	11:00	224,9	218,1	15,8	13,8	13,5	9,1	3222,8	4,9	4,6	XXXXXXXX	Heikkoa tihkusadetta
25	12:00	224,4	220,6	16,5	13,3	14,2	8,9	2821,7	5,0	4,7	XXXXXXXX	Heikkoa tihkusadetta
25	13:00	230,6	228,0	15,6	11,8	13,3	7,6	4970,6	5,3	4,7	XXXXXXXX	Heikkoja vesikuuroja
25	14:00	236,2	229,1	14,1	12,4	12,3	7,7	12110,2	5,5	4,9	XXXXXXXX	Heikkoa tihkusadetta
25	15:00	238,3	236,5	15,4	11,8	13,1	7,4	6495,9	5,5	4,9	XXXXXXXX	Utua
25	16:00	242,4	238,1	14,8	11,5	12,7	7,3	14842,8	5,5	4,8	XXXXXXXX	
25	17:00	241,6	244,2	13,6	10,3	11,6	6,2	7249,1	5,5	4,8	XXXXXXXX	Utua
25	18:00	240,6	245,3	14,2	8,9	12,1	5,3	3101,5	5,5	4,7	XXXXXXXX	Utua
25	19:00	244,6	249,8	13,3	8,2	11,7	5,0	4430,9	5,5	4,6	XXXXXXXX	Utua
25	20:00	237,4	242,7	12,7	8,7	11,0	5,2	6562,9	5,6	4,5	XXXXXXXX	
25	21:00	237,5	248,4	12,6	9,0	10,9	5,4	15605,9	5,7	4,6	XXXXXXXX	
25	22:00	239,6	247,4	12,3	8,3	10,9	4,8	12295,8	5,7	4,8	XXXXXXXX	
25	23:00	233,5	249,2	12,4	7,0	10,9	4,1	10243,0	5,7	4,8	XXXXXXXX	Utua
26	00:00	227,7	236,6	12,0	6,4	10,6	4,2	4574,2	5,8	4,7	XXXXXXXX	Utua
26	01:00	235,3	239,3	12,6	6,1	10,9	4,0	3421,2	5,8	4,7	XXXXXXXX	Sadetta edellisen

		Kall	Orre	Kall	Orre	Kall	Orre	Orre	Kall	Orre	Orre	Orre
Date	**Time**	**Wind direction**		**Wind gust**		**Wind speed**		**Visibility**	**Temperature**		**Cloud cover**	**Dominating weather remarks (Finnish)**
	UTC	**° avg**		**m/s avg**		**m/s avg**		**m**	**°C avg**		**0...8X**	
												tunnin aikana, mutta ei enää havaintohetkellä
26	02:00	241,9	239,5	13,2	6,9	10,8	4,3	3652,4	5,9	4,9	XXXXXXXX	Utua
26	03:00	247,6	243,1	12,4	5,6	10,8	3,4	2909,1	5,9	4,6	XXXXXXXX	Utua
26	04:00	236,4	249,6	12,7	5,8	11,0	3,4	6537,2	5,9	4,6	XXXXXXXX	Utua
26	05:00	233,3	256,9	13,8	8,0	12,1	4,8	10598,5	6,1	4,6	XXXXXXXX	Heikkoa tihkusadetta
26	06:00	231,1	227,9	13,6	6,4	12,0	4,2	1559,2	6,0	4,6	XXXXXXXX	Sadetta edellisen tunnin aikana, mutta ei enää havaintohetkellä
26	07:00	228,8	235,3	12,8	9,9	11,1	6,7	5036,1	5,9	5,1	XXXXXXXX	Utua
26	08:00	227,7	235,0	14,1	11,7	12,1	7,8	7602,3	5,9	5,2	XXXXXXXX	Utua
26	09:00	234,6	234,3	13,5	11,9	11,6	8,1	9604,3	5,8	5,3	XXXXXXXX	
26	10:00	241,2	242,4	13,6	11,2	11,6	7,1	13528,1	5,9	5,1	XXXXXXXX	
26	11:00	240,1	238,2	14,4	10,5	12,4	6,6	11319,1	5,9	4,8	XXXXXXXX	Utua
26	12:00	245,4	237,7	16,2	10,9	14,1	6,8	10485,3	5,9	4,9	XXXXXXXX	
26	13:00	247,6	249,7	14,7	9,1	12,7	5,5	14667,9	5,6	5,0	XXXXXXXX	
26	14:00	248,8	248,1	12,9	6,8	11,4	4,2	4412,6	5,4	4,8	XXXXXXXX	Utua
26	15:00	251,8	240,2	11,5	7,3	10,3	4,9	5204,1	5,6	4,6	XXXXXXXX	Utua
26	16:00	258,0	248,9	10,3	6,6	9,3	4,6	15238,1	5,6	4,8	XXXXXXXX	
26	17:00	273,4	287,0	8,3	7,1	7,3	5,7	20000,0	5,9	5,2	XXXXXXX	
26	18:00	283,8	274,2	7,1	6,4	6,2	4,6	20000,0	6,0	5,1	XXXXXXX	
26	19:00	277,1	293,9	7,7	9,8	6,9	7,5	20000,0	5,8	4,7	XXXXXXXX	
26	20:00	285,8	299,3	8,1	7,3	6,8	6,0	20000,0	5,2	4,2	XXXXX	
26	21:00	290,4	303,2	7,8	7,5	6,9	5,8	20000,0	4,6	3,9	XXXXXXX	
26	22:00	283,3	295,5	5,8	6,9	5,0	5,6	20000,0	4,4	3,6	X	
26	23:00	270,6	271,4	5,9	4,5	5,4	3,0	20000,0	4,2	3,0		

Note that, in the above table:

- Visibility, cloudiness, and "dominating weather remarks" are missing from the Kallbådagrund weather station data.
- The Kallbådagrund weather station is 9.5 km from the Eagle S route and the TSS at its closest point, while the Orrengrund station is 29 km from the route at its closest point, and closer to the coast and the archipelago. As the Kallbådagrund weather station is closer to the incident location, it represents the weather conditions in effect at the incident time and location better than the Orrengrund station.
- During the incident, the wind speed was approximately 14 m/s and the wind gust speed was approximately 16 m/s.
- During the incident, the visibility was poor and there was light rain and haze.

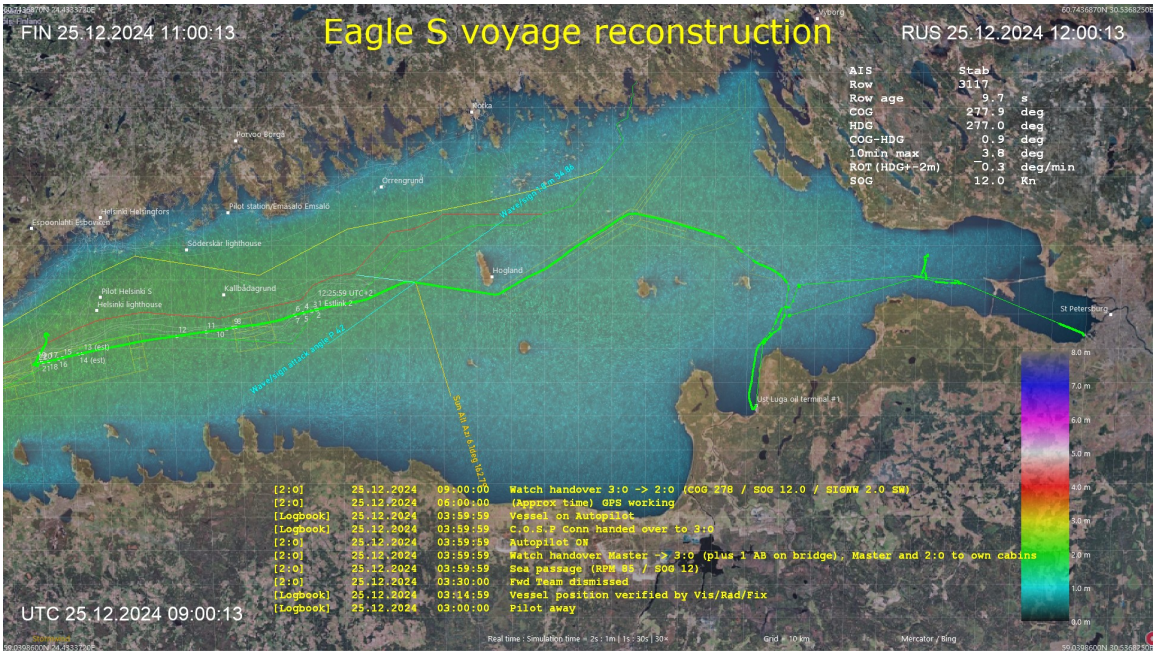
6.3.2 Historical data from the Copernicus weather and marine programme

We have accessed the ECMWF Copernicus ERA5 re-analysis and Copernicus Marine databases for the Baltic Sea physics and fetched the numerical data for:

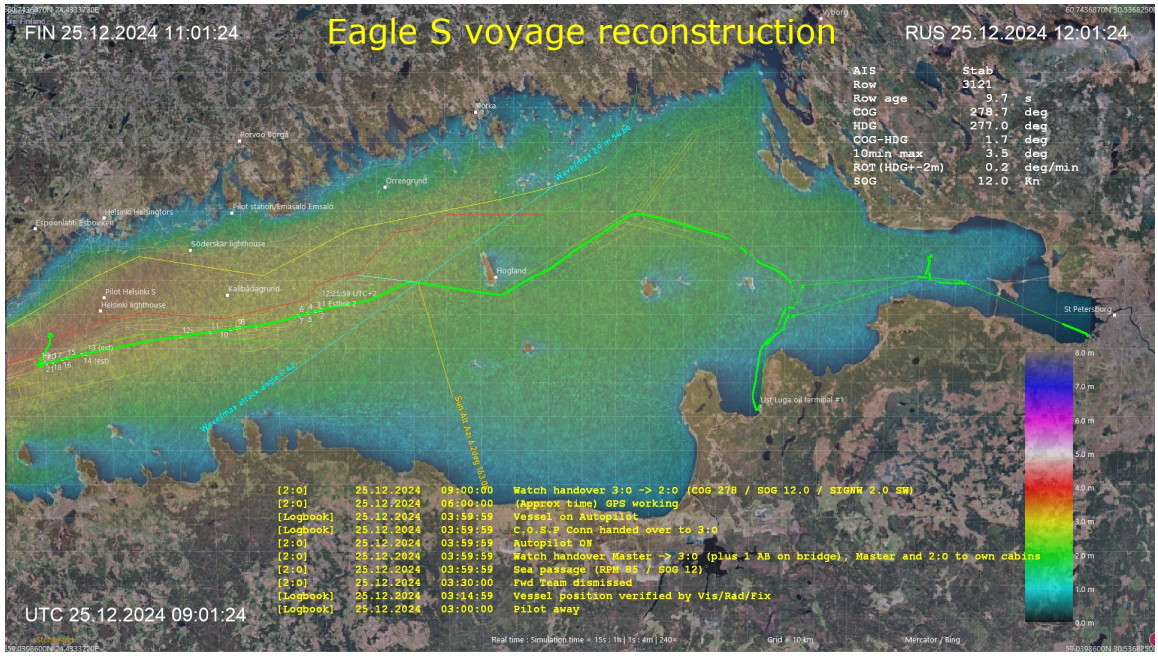
- Wind speed (10 metre and gust) and direction
- Wave size (significant and maximum), direction, period (spectral peak), and Stokes effect
- Cloudiness, temperature (sea surface), and precipitation

The time density of the data is one hour.

The video accompanying this report shows the weather conditions as a simulation covering 168 hours.



Example of weather simulation; the image shows the significant wave height (and, by pixel movement, the direction of the waves) at approximately 09:00 UTC, when the Second Officer took over the bridge watch. At this moment, the significant wave height was 1.8 metres and the wave direction was 55°.

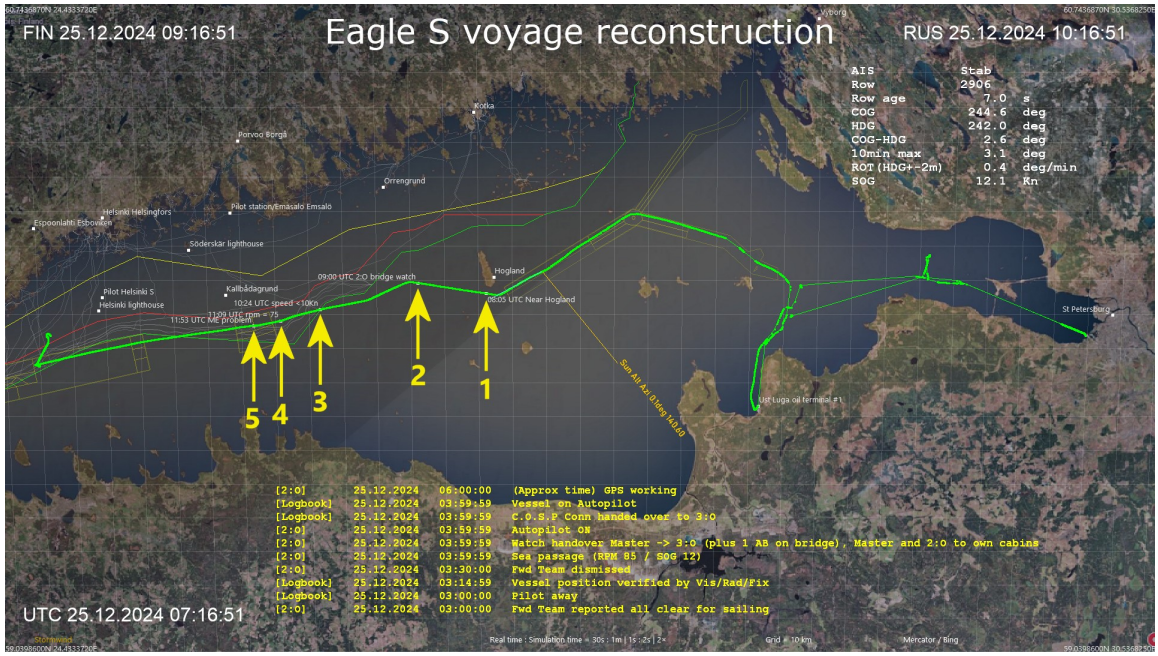


The maximum wave height (2.9 metres) at approximately 09:00, when the Second Officer took over the bridge watch.

We examine the weather data from the Copernicus programme for five different locations/times:

1. When the ship passed Hogland
2. When the Second Officer took over the bridge watch
3. When the ship's speed dropped below 10 knots
4. When the Second Officer noted that the engine rpm was 75 and called the Master
5. When the ship stopped to investigate the reason for the main engine's decrease in rpm

These locations are marked 1-5 in the image below.



The locations for examining the wave conditions by the Copernicus data

The sun height is taken from the real-time simulations created for this report.

The combined weather information for the above mentioned locations/times is shown in the table below.

#	Time UTC	Lat	Lon	Ship Spd	Wav atak	Wav sign	Wave max	Wnd avg	Wnd gust	Cloud	Temp	Visi	Sun
1	08:05	59.995	26.984	12.1	P37	1.7	2.9	13.1	15.4	100	4.7	12013	3.5
2	09:00	60.022	26.623	12.0	P42	1.8	2.9	12.8	14.9	100	4.6	4280	6.1
3	10:24	59.953	26.105	10.0	P13	2.1	3.3	13.3	15.7	100	4.8	4890	7.4
4	11:09	59.923	25.894	7.6	P12	2.3	3.6	13.5	15.8	100	4.9	3223	6.9
5	11:53	59.909	25.752	0.9	S10	2.3	3.6	14.2	16.5	100	5.0	2821	5.4

6.4 CONCLUSIONS CONCERNING THE WEATHER

For the examined 4-hour period (see previous table) we conclude that:

- **The weather deteriorated over this period, culminating in a "bad weather" peak at around 12:00 UTC.**
- **The water current affected the ship's advance from the Hogland vicinity.**
- **The wind was at gale level, increasing to 14.2 (avg) and 16.5 (gust) m/s.**
- **The significant wave height increased from 1.7 to 2.3 metres.**
- **The maximum wave height increased from 2.9 to 3.6 metres.**
- **There was a full cloud cover and the visibility was poor.**
- **The ship met the waves with its port side bow.**

Although the worsening weather during the Eagle S voyage was rough, it was not a threat for a tanker of the Eagle S's size. It did, however, affect the ship's speed.

According to the ship's crew, there was a moderate bow heave, of some 2 metres on average. The ship's crew has repeatedly stated that the ship's bow was most of the time covered with spray, originating from the waves slamming into the bow.

6.5 LIGHT CONDITIONS

According to the calculator at https://latlongdata.com/sunset-sunrise-calculator/, the following applies for the 25 December, 2024, at the Estlink 2 location 59.9516° lat, 26.0963° lon. (calculation by sun midpoint):

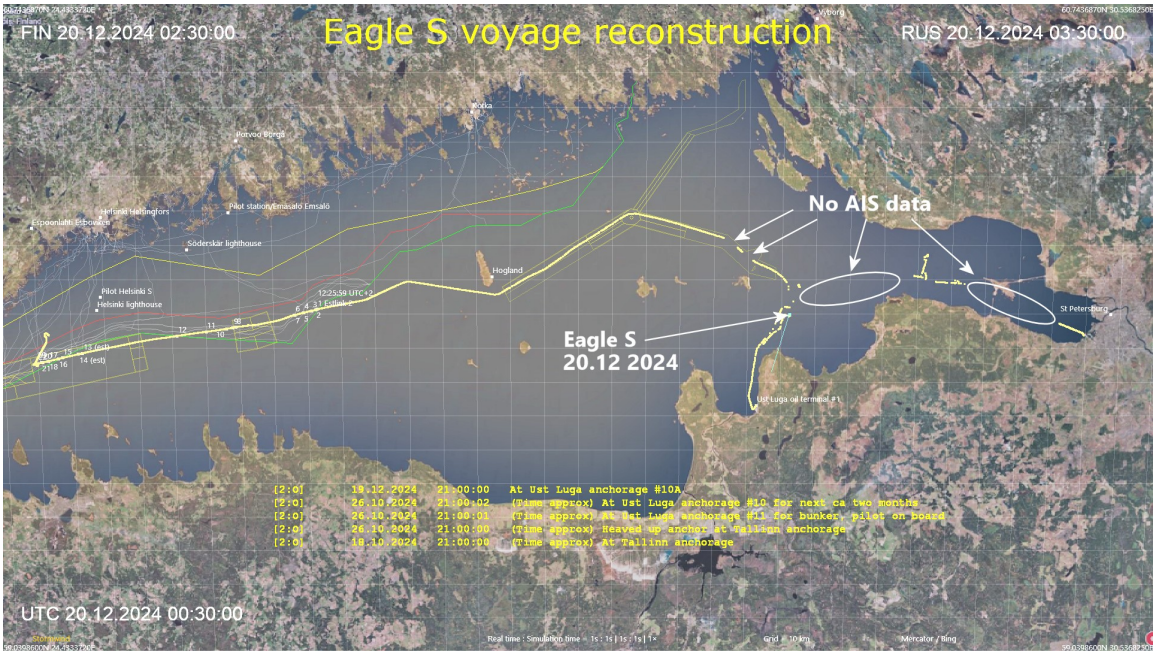
- Sunrise at 09:23:16 UTC+2 (07:23:16 UTC)
- Sunset at 15:10:43 UTC+2 (13:10:43 UTC)
- Length of day 5:47:26

According to our calculations, the sun's altitude (midpoint) was 7.4° over the horizon at 10:26 UTC, when the Eagle S passed the Estlink 2 cable. This was near the maximum altitude of the sun that day. Sun altitude calculations may differ with minutes, depending on selected point of sun.

During the noon hours there was a 100% cloud cover and a haze; there was also a light rain (drizzle). According to the Finnish Meteorological Institute's historical data, the visibility at the Orrengrund observation station decreased from some 12 km to 3 km.

We estimate that the light and visibility conditions at the incident hours were poor.

7 VOYAGE RE-CONSTRUCTION



The thick yellow line represents the 6771 AIS track points for the Eagle S tanker. At certain locations near St Petersburg there was no GPS signal and, therefore, no AIS data [screenshot from simulation]

7.1 THE TRAFFIC SEPARATION SYSTEM AND SUBMERGED CABLES

From the available information, the Eagle S passed a total of 24 cables or pipelines while dragging its anchor. In addition, there may have been further undisclosed cables.

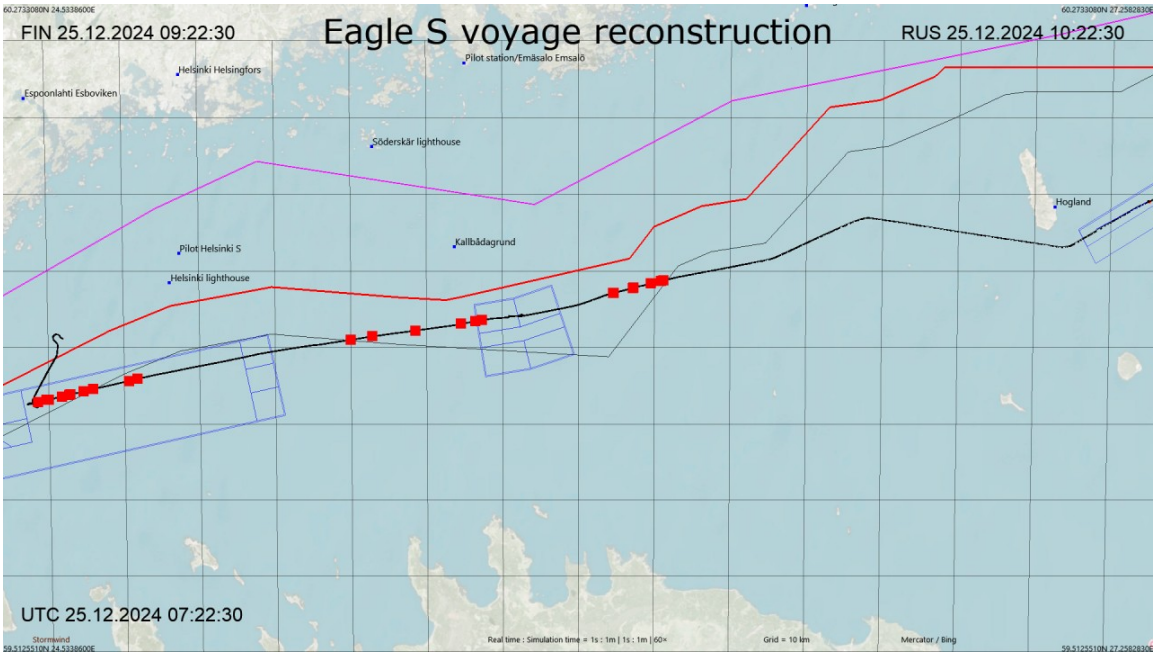
Initially, the Finnish power cable Estlink 2 was damaged. For the next few hours, Russian or Russian/German infrastructure was crossed and/or damaged. Eventually, in the evening hours, Russian, Russian/German and Finnish cables or pipelines were crossed and/or damaged.

All cable/pipeline crossings were outside Finnish territory, on international water, but inside the Finnish Economy Zone. The ship came into Finnish territorial water upon command from the coast guard.

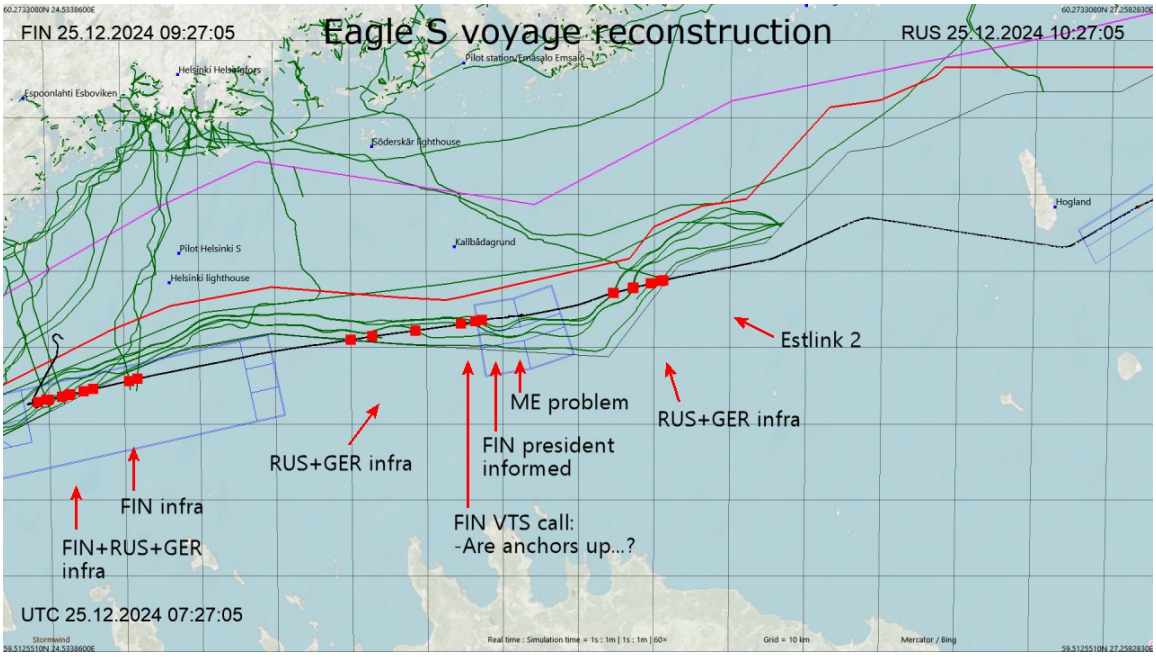
The ship came into Finnish inner territorial waters only after it had been detained, and moved to Svartbäcksfjärden, Porvoo, where it stayed for the next two months.

We have not investigated the cable damage, or even identified the individual cables; we only allocate them to an owner country.

The images below (from computer simulations) shows the primary parameters.



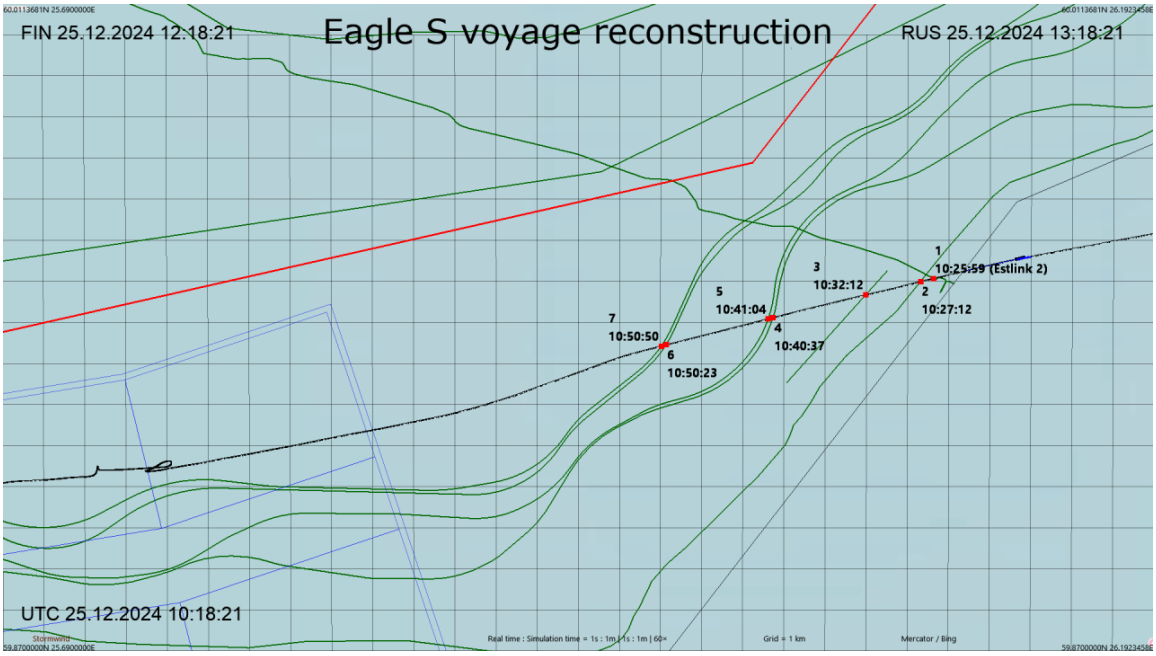
The Finnish economy zone (thin black line), territorial water border (red line), inner territorial water border (purple line), the TSS (thin blue lines) and the Eagle S route (thick black line) between Russian Hogland and Finnish Porkkala. The small red squares are 24 cable crossing locations. Grid = 10km.



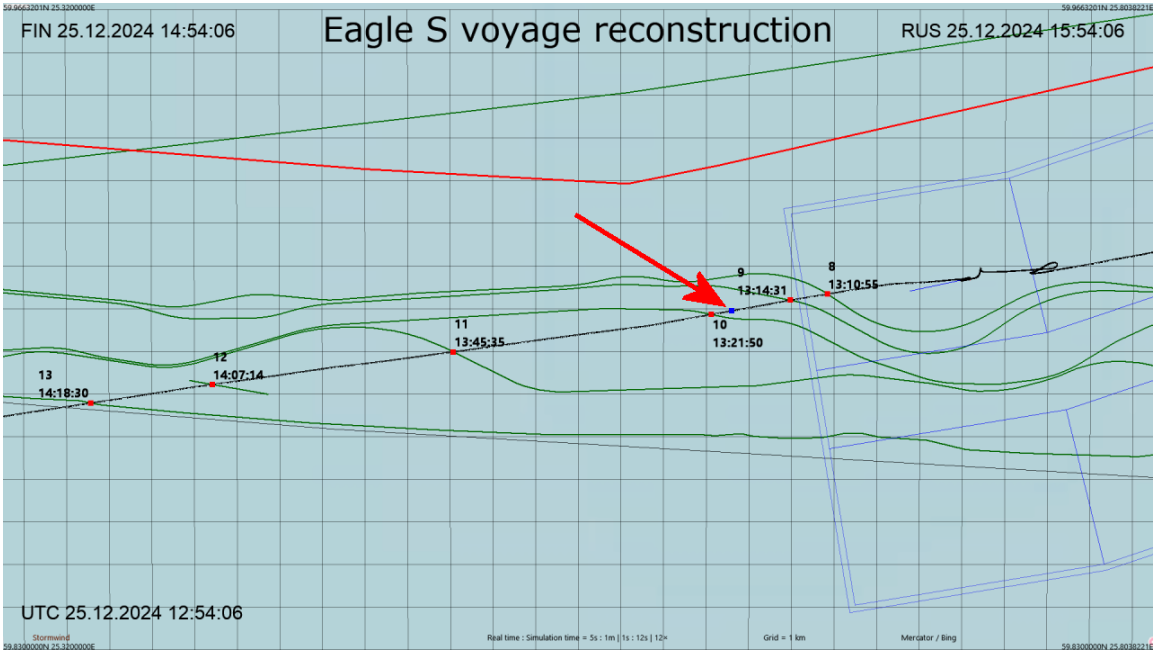
As the previous image, but with cables/pipelines (green) and metadata inserted. The "ME problem" is where the Eagle S stopped, in order to oversee the main engine. Grid = 10km.

We note that the cables and pipelines are, to a relevant extent, placed straight under the Traffic Separation System, which is the lane for ship traffic in both

directions. Thousands of large ships pass there annually. The water depth in this area is typically 40-60 metres.

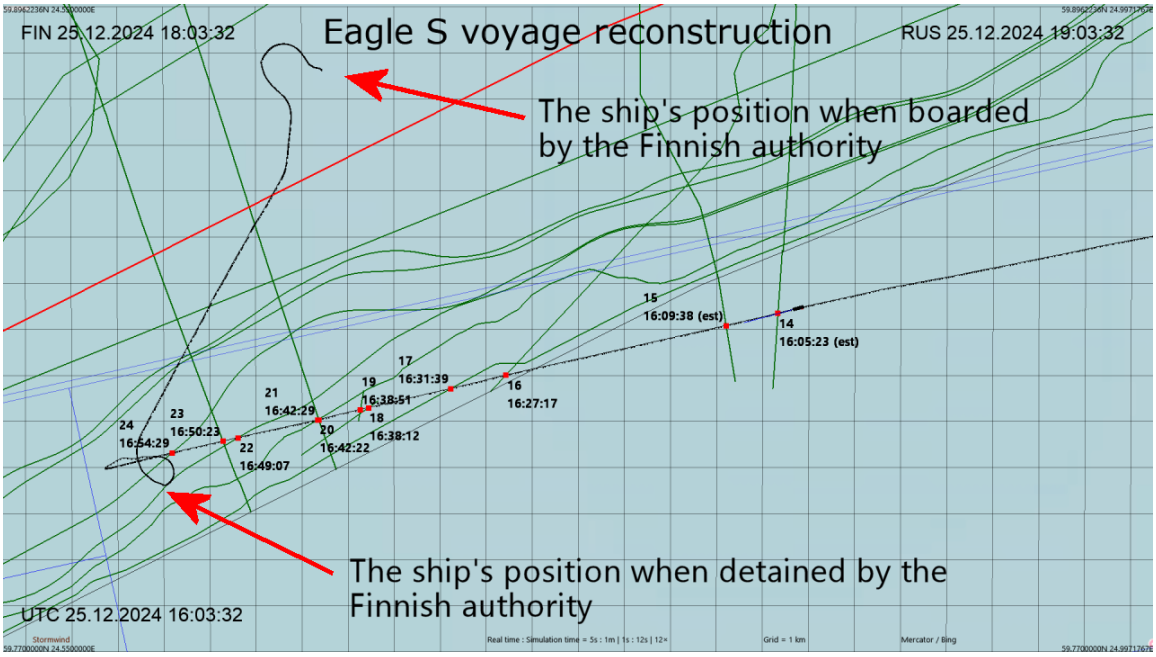


Cables/pipelines in the Estlink 2 area, from east to west: Estlink 2 (1), Russian cables (2,3), Nordstream 1 (4,5), Nordstream 2 (6,7). We do not have data for the Russian tele cable (3), hence only one short line segment represents it. Grid = 1km, times are UTC.



Cables/pipelines in the event's mid area: Nordstream 2 (8,9), Nordstream 1 (10,11), Russian cables (12,13). We do not have data for the Russian tele cable (12), hence only one short line segment represents it. The red arrow indicates the vessel's position when

asked by the Finnish VTS whether anchors are “up and secured”. Grid = 1km, times = UTC.



Cables/pipelines in the event’s west area: Finnish (14,15,16), Russian (17,18), Finnish (19,20,21), Nordstream 1 (22), Finnish (23), Nordstream 1 (24). We do not have data for cable 19, hence only one short line segment represents it. According to databases, the Finnish cables 21 and 23 have a “disuse” status. Grid = 1km, times = UTC.

Cable crossing times and positions, as well as cable owning country and cable purpose, are shown in the table below.

The crossing times and positions are calculated with a “side-of-line” algorithm (a point on either side of a line). When the side changes, the AIS transponder of the Eagle S has passed a cable (a segment of it) and the time stamp and position will be known. The actual crossing time for a cable may be 0-30 seconds later, because it is unknown how much anchor chain was out behind the vessel at different times during the voyage. In addition, the cable information is most likely not fully accurate, implying that the crossing times may have tolerances of seconds or minutes, and the crossing positions tolerances of metres.

Times are UTC.

#	Time	Latitude	Longitude	Country			Purpose
1	10:25:59	59.9516106570	26.0962851005	Finland			Power
2	10:27:12	59.9509377396	26.0906050975		Russia		Power
3	10:32:12	59.9480376815	26.0667281080		Russia		Tele
4	10:40:37	59.9430324170	26.0261314845			Rus / Ger	Gas
5	10:41:04	59.9427632032	26.0240230140			Rus / Ger	Gas
6	10:50:23	59.9370955316	25.9794395858			Rus / Ger	Gas

7	10:50:50	59.9368277413	25.9773181280			Rus / Ger	Gas
8	13:10:55	59.9050719871	25.6666073779			Rus / Ger	Gas
9	13:14:31	59.9037840824	25.6508772020			Rus / Ger	Gas
10	13:21:50	59.9007820476	25.6177333354			Rus / Ger	Gas
11	13:45:35	59.8929194710	25.5092421713			Rus / Ger	Gas
12	14:07:14	59.8860455716	25.4077978922		Russia		Tele
13	14:18:30	59.8821509831	25.3567104466		Russia		Power
14	16:05:23	59.8361229889	24.8511421300	Finland			n/a
15	16:09:38	59.8337356286	24.8309563086	Finland			Tele
16	16:27:17	59.8240657315	24.7453487281	Finland			n/a
17	16:31:39	59.8214522372	24.7239048193		Russia		Tele
18	16:38:12	59.8177151807	24.6918570283		Russia		Power
19	16:38:51	59.8173576122	24.6887562922	Finland			Tele
20	16:42:22	59.8153962231	24.6725590690	Finland			n/a
21	16:42:29	59.8153360676	24.6720598898	Finland			n/a
22	16:49:07	59.8118790318	24.6411957370			Rus / Ger	Gas
23	16:50:23	59.8111959112	24.6353375747	Finland			Tele
24	16:54:29	59.8089251175	24.6155190466			Rus / Ger	Gas
24				**8**	**6**	**10**	

Eagle S cable/pipeline crossings

7.2 SCHEMATIC RE-CONSTRUCTION 19.8 2024 – 25.12 2024

Listed on next pages are the main steps for the ship's travel from India, starting from the end of August, 2024, to the early morning of 25 December, 2024, when the ship commenced unmooring at the Ust-Luga oil terminal.

There are three specific points of note from this part of the collected data:

1. The raw AIS data is, at certain locations, somewhat unstable, possibly due to GPS signal scrambling. For this reason, we have performed a mathematical stabilisation of the spatial part of the data using a recursive method where each point is adjusted in time and space by the least square of adjacent points within plus/minus a few minutes. For all further calculations we use both the raw data and the stabilised data.

2. The raw AIS data has gaps, possibly due to GPS signal scrambling. There are twelve gaps longer than 10 minutes that happened when the ship was under way.

   The longest gap lasted for almost 4 hours (23.12.2024 00:54:42 – 04:47:23 UTC). This happened after the ship had left the St Petersburg terminal and the pilot had disembarked, and the ship was preparing to receive the Ust-Luga pilot.

   The last gap ends at 25.12.2024 04:37:21 UTC, and lasted for 13 minutes and 24 seconds. This happened when the Ust-Luga pilot has disembarked and the ship was still almost directly north of Ust-Luga.

   As these gaps appear several hours before the anchor incident begins, they

are not critical for this investigation.

All AIS data gaps greater than 10 minutes are listed below:

```
20.12.2024 12:30:28  -  20.12.2024 14:48:13  =   8265 s (02:17:45)
20.12.2024 15:19:43  -  20.12.2024 15:29:56  =    613 s (00:10:13)
21.12.2024 18:01:07  -  21.12.2024 18:16:35  =    928 s (00:15:28)
21.12.2024 18:35:56  -  21.12.2024 18:48:26  =    750 s (00:12:30)
21.12.2024 19:25:39  -  21.12.2024 22:33:16  =  11257 s (03:07:37)
22.12.2024 22:11:31  -  22.12.2024 23:47:07  =   5736 s (01:35:36)
23.12.2024 00:54:42  -  23.12.2024 04:47:23  =  13961 s (03:52:41)
23.12.2024 04:56:48  -  23.12.2024 05:45:00  =   2892 s (00:48:12)
23.12.2024 05:55:54  -  23.12.2024 07:18:48  =   4974 s (01:22:54)
25.12.2024 03:09:26  -  25.12.2024 03:30:09  =   1243 s (00:20:43)
25.12.2024 04:08:18  -  25.12.2024 04:18:50  =    632 s (00:10:32)
25.12.2024 04:23:57  -  25.12.2024 04:37:21  =    804 s (00:13:24)
```

The AIS data after the last gap is very dense, typically with 10 seconds between the AIS points, and hence very suitable for analysis.

3. The difference between Heading and COG while on straight course never exceeded 5 degrees, either during the time before crossing Estlink 2 or after it, and was, for the majority of the time throughout this part of the data set, typically a few degrees. We show this in the graph in section 7.5 The Autopilot's off-course and off-heading warnings (page 84).

   It can, therefore, be concluded that the alarm setting of 5 degrees on the autopilot is appropriate.

   A difference between ship heading and ship COG appears when a ship is drifting sideways while moving forwards. This happens to every vessel on water, due to weather conditions and current, and cannot be avoided. This drifting is independent of whether the ship is steered manually or with autopilot; the AIS apparatus collects both heading and COG independently of each other.

   On entering Finnish EEZ waters, when the ship was under way and dragging its anchor, the 5 degrees limit was still not exceeded, meaning that no warning (sound alarm) was triggered by the autopilot.

   Figures extracted from the Eagle S AIS data set provide a good understanding of what drifting is normal for this vessel.

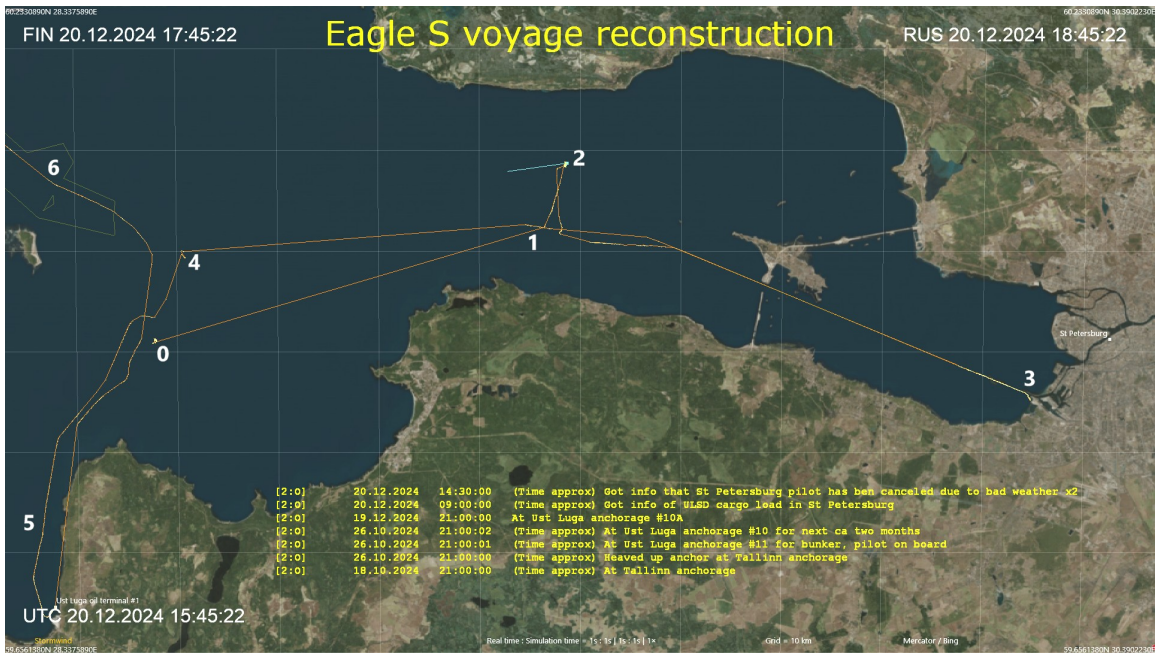
The following table shows a daily breakdown of the Eagle S's activities 26 August 2024 – 25 December 2024.

M	T	W	T	Fr	S	S	Action	Anchor
August 2024								
19	20						In transit to India	
		21					**Vessel at Gulf of Kutch, India**	

M	T	W	T	Fr	S	S	Action	Anchor
			22	23	24	25	At Port Mundra The Eagle S discharged her previous cargo at **Port Mundra**. While there, the process of changing Class from ABS (American Bureau of Shipping) to IRS (Indian Register of Shipping) was started. IRS raised a number of observations that the crew dealt with over the course of several days. According to the Second Officer, none of these observations related to the anchors, cables, or mooring machinery. When the vessel sailed in ballast from Port Mundra, the only outstanding Class issue was the requirement for an underwater hull survey. ***The Second Officer joined the vessel on 23 August*** American Bureau of Shipping: https://ww2.eagle.org/en.html https://en.wikipedia.org/wiki/American_Bureau_of_Shipping Indian Register of Shipping: https://www.irclass.org/ https://en.wikipedia.org/wiki/Indian_Register_of_Shipping	
26	27	28	29	30	31		At Port Mundra	
September 2024								
						1	Anchored at Kandla anchorage	↓(1)
2							Anchored	
	3						Left Kandla anchorage	↑(1)
		4	5	6	7	8	In transit to Denmark	
9	10	11	12	13	14	15	In transit to Denmark	
16	17	18	19	20	21		In transit to Denmark	
						22	Passed Cape of Good Hope	
23	24	25	26	27	28	29	In transit to Denmark	
30							In transit to Denmark	
October 2024								
	1	2	3	4	5	6	In transit to Denmark	
7	8	9	10	11	12	13	In transit to Denmark	
14							In transit to Denmark	
	15						Arrived at **OPL Skagen/Denmark anchorage on 15 October**. An IRS Class surveyor attended there, and divers carried out an underwater inspection of the hull (the outstanding Class issue from Port Mundra). Change	↓(2)

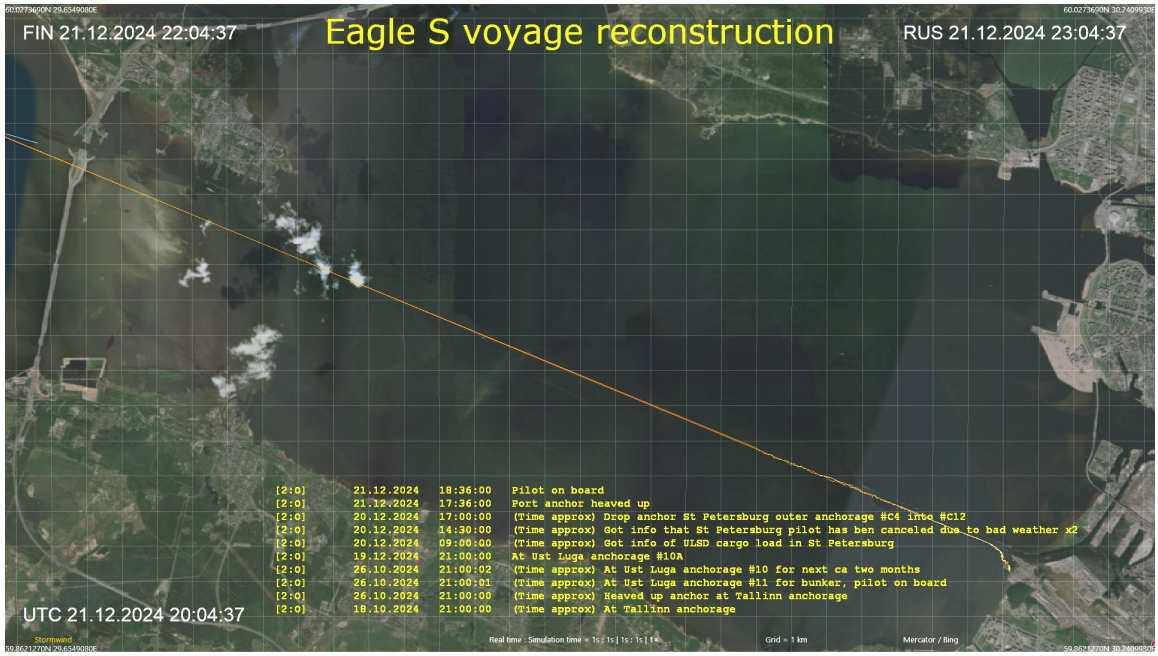
M	T	W	T	Fr	S	S	Action	Anchor
							of Class formalities were completed that day before the vessel sailed for Ust-Luga. The Master and 5 other crew members – Bosun, an Oiler, a Steward, and 2 OS – joined, and 6 crew members left the vessel. ***The Master joined the vessel.*** Sailed from **OPL Skagen/Denmark** anchorage at around 21:00	↑(2)
		16	17	18			In transit to Estonia	
					19		Anchored at **OPL Tallinn/Estonia anchorage** at 09:00	↓(3)
						20	Anchored	
21	22	23	24	25			Anchored	
					26		Left **OPL Tallinn/Estonia anchorage** at 09:00 Arrived at **Ust Luga/Russia** anchorage 11 at 21:00 for bunker, pilot on board Anchored at **Ust Luga/Russia** anchorage #10A	↑(3) ↓(4) ↑(4) ↓(5)
						27	Anchored	
28	29	30	31				Anchored	
November 2024								
				1	2	3	Anchored	
4	5	6	7	8	9	10	Anchored	
11	12	13	14	15	16	17	Anchored	
18	19	20	21				Anchored	
				22			Arrived at **Ust Luga/Russia** anchorage 11 at 21:00 for bunker, pilot on board	↑(5) ↓(6)
					23	24	Anchored	
25							Anchored at **Ust Luga/Russia** anchorage #10A	↑(6) ↓(7)
	26	27	28	29	30		Anchored	
December 2024								
						1	Anchored	
2	3	4	5	6	7	8	Anchored	
9	10	11	12				Anchored	

M	T	W	T	Fr	S	S	Action	Anchor
				13			Re-anchoring for crew change	↑(7) ↓(8)
					14		Anchored ***The First Officer joined the vessel.***	
						15	Anchored	
16							Anchored	
	17						The vessel underwent a TVS (Tanker Vetting Inspection) inspection on 13 December 2024 while at **Ust-Luga/Russia inner anchorage** for bunkers and provisions. Anchored at **Ust-Luga anchorage 11** SIRE inspection: ***https://www.ocimf.org/document-libary/71-programmes-sire/file***	
		18					Re-anchored at **Ust-Luga anchorage 10A**	↑(8) ↓(9)
			19				Anchored	
				20			In transit to **St Petersburg outer anchorage** at 09:00 Anchored at **St Petersburg outer anchorage** #C4/#C13 at 17:00	↑(9) ↓(10)
					21		Port anchor heaved up at 17:36 Pilot on board at 18:36 Moored at **St Petersburg oil terminal** at 23:30	↑(10)
						22	Commenced unmooring at 21:01	
23							Commenced drifting **near Ust-Luga outer anchorage** at 04:00 Proceed to **Pilot Stn** at 07:00 Vessel all made fast at **Ust-Luga KNG #1** at 11:30	
	24						Mooring Ust-Luga Loading op completed at 15:36	
		25					Commenced unmooring at 00:36 UTC In transit to **Port Said, Egypt** Pilot away at 03:00 Crossing **Estlink 2** at 10:26 UTC	

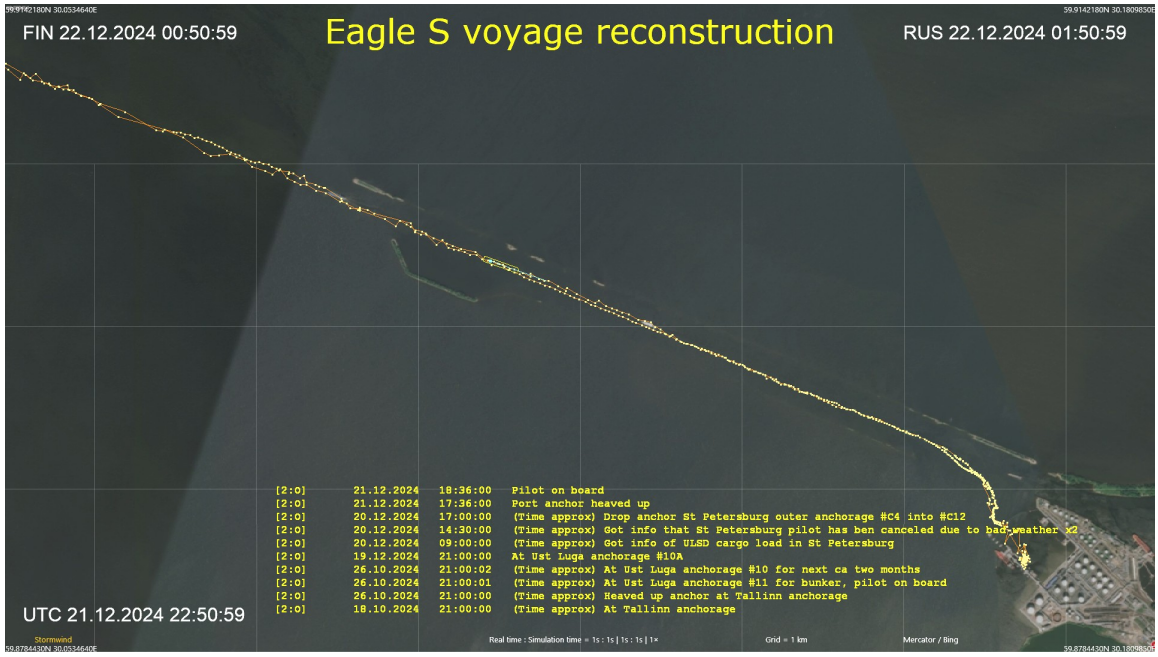


The St Petersburg and Ust-Luga areas

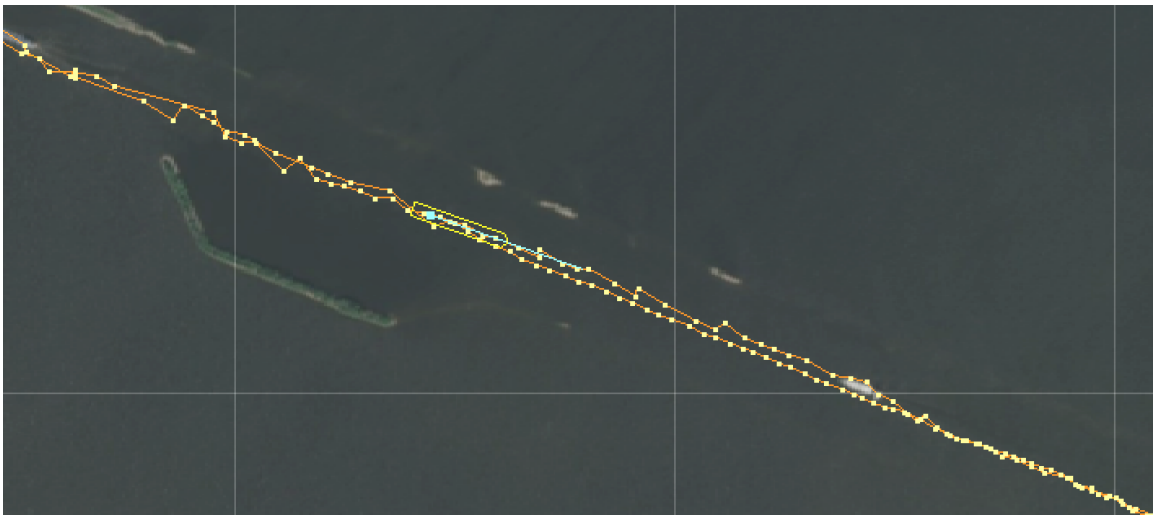
1. The ship anchored at **point 0** on 26 October, 2024, and spent 1.5 months there. On 13 December, 2024, it approached Ust-Luga (near point 5) for a TVS inspection, after which (5 days later) it returned to **point 0**.
2. On 20 December, 2024, the crew was directed to go to St Petersburg to load cargo and set course there. However, in the afternoon the Pilot was cancelled at **point 1** due to bad weather, and the ship went to St Petersburg outer anchorage at **point 2**.
3. On 21 December, 2024, a Pilot embarked near **point 1**, and the ship sailed to St Petersburg (**point 3**) where it arrived at 23:30 UTC+3.
4. On 22 December, 2024, the loading operation was completed in the evening and the ship commenced unmooring and transfer to **point 4**.
5. On 23 December, 2024, the ship arrived at point 4 at 04:00 UTC+3, and picked up the Pilot at 07:00 UTC+3. After this, the ship went to Ust-Luga (**point 5**) for another cargo load operation, which was completed in the afternoon of 24 December.
6. On 25 December, 2024, at 00:35 UTC+3 the ship left Ust-Luga. The Pilot disembarked near point 0 at 03:00 UTC+3, after which the ship took course towards the Baltic Sea via **point 6**.



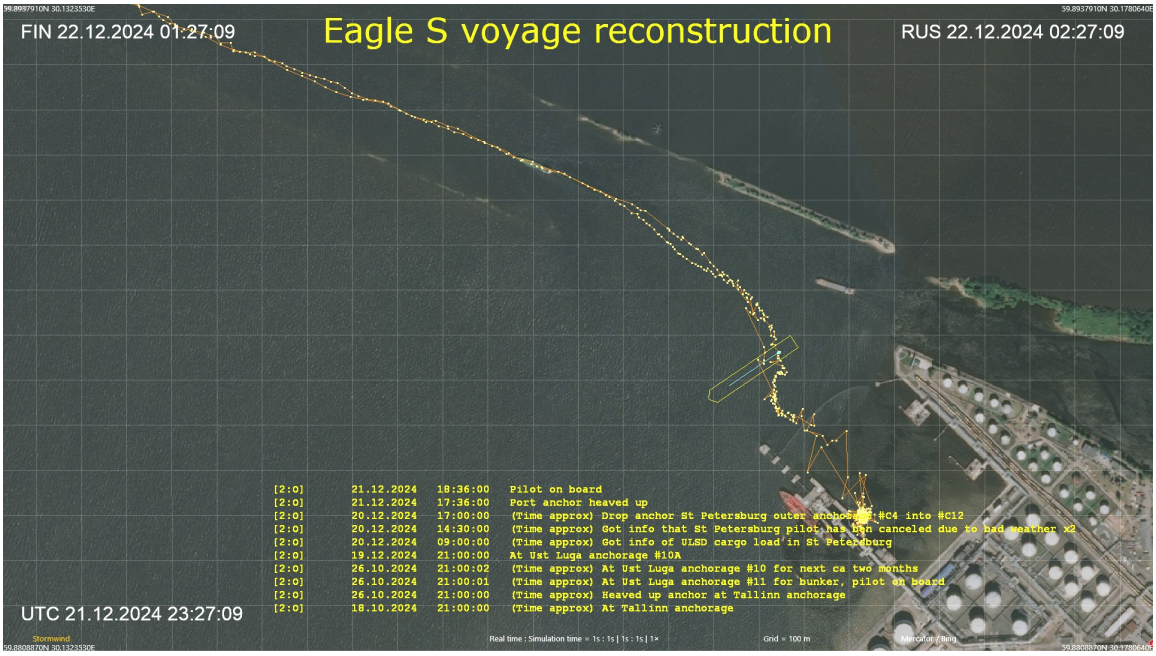
The inlet to St Petersburg. During this leg there is no AIS data, apparently due to weak GPS signal, hence there is a straight line for route. The ship had a Pilot on board.



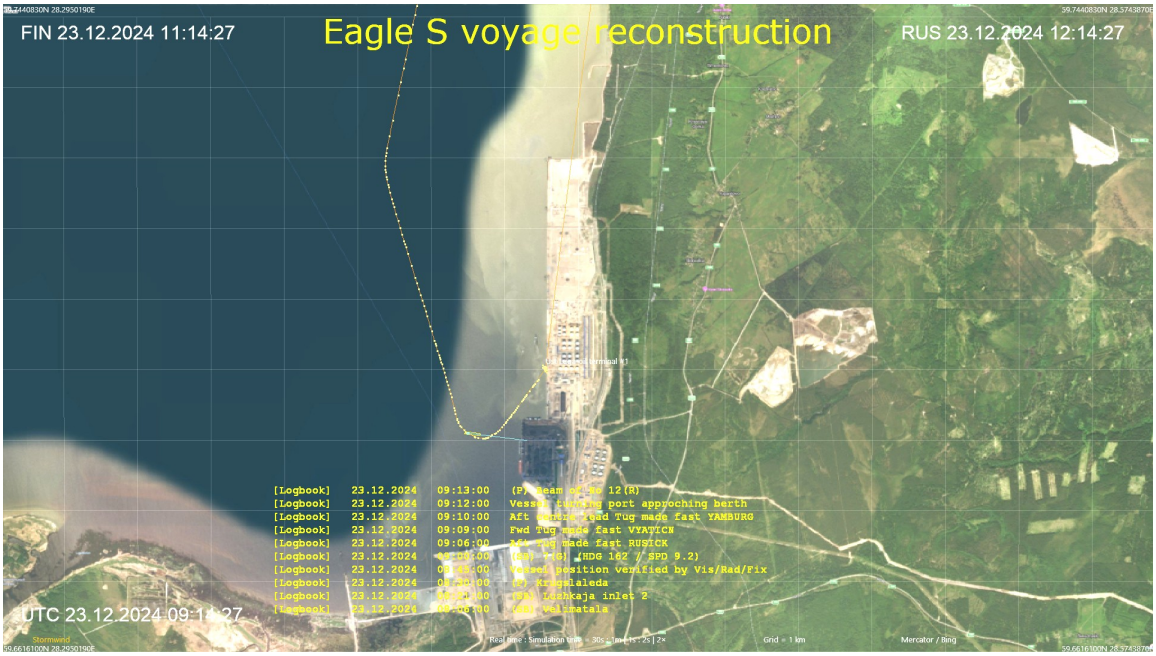
Approaching the St Petersburg oil terminal. The white dots are AIS points. The image reveals that the GPS has a tolerance of several metres.



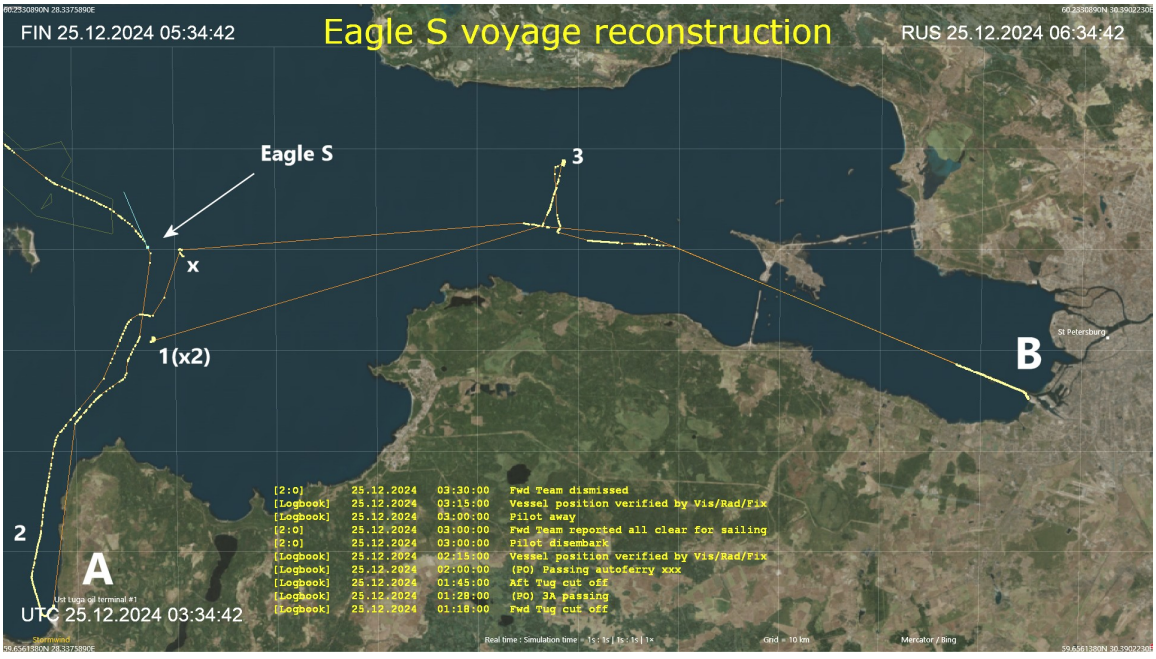
Part of previous image in greater detail. The accuracy of a GPS depends on several factors. ECDIS and other devices that use GPS perform mathematical stabilisations on the positions; the points above are not stabilised.



About to commence mooring in St Petersburg; two or three harbour tugs are already controlling the Eagle S dynamics. The ship will connect with its stern towards land.



About to commence mooring at Ust-Luga oil terminal #1; harbour tugs have connected to the ship.



Eagle S en route to Port Said.

7.2.1 Considerations regarding the Ust-Luga and St Petersburg stay

During the two-month time period of 26 October, 2024, 21:00 UTC to 25 December, 2024, 03:00 UTC (when the vessel arrived at the Ust-Luga outer anchorage and when the pilot disembarked after the vessel had left Ust-Luga respectively) the anchor was used 5 times.

During this time period, the vessel moored twice.

The deck crew has unanimously stated that anchoring or mooring during these operations raised no particular concern and the equipment worked as expected.

The ship's crew has unanimously stated that, during the port stays, nobody left the ship and no unauthorised personnel came on board the ship. The stairway was guarded during the port stays. Port Inspectors entered and left the vessel during harbour stays; these were recorded in the deck log books.

While anchored at the Ust-Luga anchorage, only the First Officer came on board. Pilots entered the ship at Pilot pick-up points for St Petersburg and for Ust-Luga.

We have encountered no details nor events during the aforementioned time period that point towards any unusual activity.

7.3 Chronological voyage log 18.10 2024 – 26.12 2024

Row colours in the table below and what they relate to

Red	Radio communication with authority or authority action
Yellow	Events at the vessel
Cyan	Cable or pipeline crossings
Strong yellow	Finnish president
Blue	Vessel on Finnish territorial water

Source	Date	Time UTC	Action / Event	Bridge command
2:O	19.10	09:00:00	(Time approx) At Tallinn anchorage	
2:O	26.10	09:00:00	(Time approx) Heaved up anchor at Tallinn anchorage	
2:O	26.10	23:00:00	(Time approx) At Ust Luga anchorage #11 for bunker, pilot on board	
2:O	27.10	11:00:00	(Time approx) Dep Ust Luga anchorage #11, pilot on board	
2:O	27.10	13:00:00	(Time approx) At Ust Luga anchorage #10 for next ca two months, in between 2 times shifting from outer anchorage 10A to inner anchorage 11 for bunkering , crew change, FW Vetting sinpection	
2:O	20.12	09:00:00	(Time approx) Got info of ULSD cargo load in St Petersburg	
2:O	20.12	11:00:00	(Time approx) Heaved up anchor and proceeding to St Petersburg	
2:O	20.12	15:00:00	(Time approx) Got info that St Petersburg pilot has ben canceled due to bad weather x2	

Source	Date	Time UTC	Action / Event	Bridge command
2:O	20.12	17:00:00	(Time approx) Drop anchor St Petersburg outer anchorage #C12	
2:O	21.12	17:36:00	Port anchor heaved up	
2:O	21.12	19:30:00	Pilot on board	
Logbook	22.12	18:29:00	Logbook entries start ----------	
Logbook	22.12	18:30:00	1 hr notice to E/R	
Logbook	22.12	18:36:00	Clocks synchronised, comm checked	
Logbook	22.12	19:00:00	Both steering motors on, tested SOLAS	
Logbook	22.12	19:06:00	Telegraph tested and in order	
Logbook	22.12	19:16:00	Off course + off heading alarms tested and in order	
Logbook	22.12	19:30:00	Two pilots on board BWL-04, conn with Master	
Logbook	22.12	19:30:00	ECDIS safety setting changed and checked	
Logbook	22.12	19:54:00	Gangway up	
Logbook	22.12	20:00:00	ME blown through	
Logbook	22.12	20:12:00	ME tried out ahd & astern found satisfactory	
Logbook	22.12	20:24:00	Master Pilot duty exchange	
Logbook	22.12	20:30:00	Tugs alongside	
Logbook	22.12	20:54:00	Aft Tug made fast EVGENY ISOCNSN	
Logbook	22.12	20:58:00	Fwd Tug made fast MKMREVOY	
Logbook	22.12	21:01:00	Commenced unmooring	
2:O	22.12	21:24:00	Depart from St Petersburg Jetty #3	
Logbook	22.12	21:24:00	All cut off Aft	
Logbook	22.12	21:24:00	Fwd & Aft Tug cut off	
Logbook	22.12	21:48:00	Vessel position verified by Vis/Rad/Fix	
Logbook	22.12	22:00:00	Vessel position verified	
Logbook	22.12	22:15:00	Vessel position verified by Vis/Rad/Fix	
Logbook	22.12	22:15:00	Verified (COG 291 SPD 10.2)	
Logbook	22.12	22:30:00	Vessel position verified by Vis/Rad/Fix	
Logbook	22.12	22:57:00	Passing military corner SB	
Logbook	22.12	23:00:00	Verified (HDG 315 / SPD 9)	
Logbook	22.12	23:15:00	Vessel position verified by Vis/Rad/PJ	
Logbook	22.12	23:30:00	Vessel position verified by Vis/Rad/PJ	
Logbook	23.12	00:00:00	Pilot away BWL-03	
Logbook	23.12	00:30:00	Verified (HDG 273 / SPD 6)	
Logbook	23.12	00:30:00	Conn with D:O BWL-02	
2:O	23.12	04:00:00	Arrived at Us Luga, started drifting	

Source	Date	Time UTC	Action / Event	Bridge command
Logbook	23.12	04:00:00	Com with Master, BLW-03	
Logbook	23.12	04:00:00	E.O.S.P	
Logbook	23.12	04:00:00	Commenced drifting	
Logbook	23.12	04:30:00	Conn handed over to D:O BWL-02	
2:O	23.12	07:00:00	Received instruction to go to Pilot pickup station	
Logbook	23.12	07:00:00	Stop drifting, proceeding Pilot stn	
2:O	23.12	07:36:00	Pilot on board, proceeding to Ust Luga KNG #1	
Logbook	23.12	07:36:00	P.O.B	
Logbook	23.12	07:36:00	(P) Kolgoyoja	
Logbook	23.12	08:06:00	(SB) Velimatala	
Logbook	23.12	08:21:00	(SB) Luzhkaja inlet 2	
Logbook	23.12	08:30:00	(P) Krugslaleda	
Logbook	23.12	08:45:00	Vessel position verified by Vis/Rad/Fix	
Logbook	23.12	09:00:00	(SB) 7(G) (HDG 162 / SPD 9.2)	
Logbook	23.12	09:06:00	Aft Tug made fast RUSICK	
Logbook	23.12	09:09:00	Fwd Tug made fast VYATICN	
Logbook	23.12	09:10:00	Aft centre lead Tug made fast YAMBURG	
Logbook	23.12	09:12:00	Vessel turning port approching berth	
Logbook	23.12	09:13:00	(P) Beam of No 12(R)	
Logbook	23.12	09:48:00	F.L.A	
Logbook	23.12	10:00:00	Aft centre lead Tug cut off	
2:O	23.12	11:30:00	Alongside Ust Luga KNG #1	
Logbook	23.12	11:30:00	Vessel all made fast, Fwd & Aft Tug cut off	
Logbook	23.12	11:30:00	Pilot away	
Logbook	23.12	11:36:00	P.W.E BANL off	
	23.12		(Comment: Låg i Ust Luga resten av dagen, inga anteckningar)	
2:O	24.12	15:36:00	Loading op completed	
Logbook	24.12	23:30:00	30 min notice to E/R	
Logbook	24.12	23:32:00	Clocks synchronised, comm checked	
Logbook	24.12	23:42:00	Both steering motors on, tested SOLAS	
Logbook	24.12	23:48:00	Telegraph tested, all found satisfactory	
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Logbook	25.12	00:12:00	Pilot on board BWL-04, Conn with Master	**Master**
Logbook	25.12	00:18:00	ME blown through	
Logbook	25.12	00:20:00	Fwd Tug made fast VYATICR	
Logbook	25.12	00:24:00	Aft Tug made fast ASKOLD	
Logbook	25.12	00:36:00	Commenced unmooring	

Source	Date	Time UTC	Action / Event	Bridge command
2:O	25.12	01:00:00	Pilot on board, departed from UST Luga	**Pilot**
Logbook	25.12	01:00:00	All cast off	
Logbook	25.12	01:18:00	Fwd Tug cast off	
Logbook	25.12	01:28:00	(PO) 3A passing	
Logbook	25.12	01:45:00	Aft Tug cut off	
Logbook	25.12	02:00:00	(PO) Passing autoferry terminal	
Logbook	25.12	02:15:00	Vessel position verified by Vis/Rad/Fix	
2:O	25.12	03:00:00	Pilot disembark	**Master**
Logbook	25.12	03:00:00	Pilot away	
Logbook	25.12	03:15:00	Vessel position verified by Vis/Rad/Fix	
2:O	25.12	03:29:00	Fwd Team reported all clear for sailing	
2:O	25.12	03:30:00	Fwd Team dismissed	
2:O	25.12	04:00:00	Sea passage (RPM 85 / SOG 12)	
2:O	25.12	04:00:00	Watch handover Master -> 3:O (plus 1 AB on bridge), Master and 2:O to own cabins	**3:O**
2:O	25.12	04:00:00	Autopilot ON	
Logbook	25.12	04:00:00	C.O.S.P Conn handed over to 3:O	
Logbook	25.12	04:00:00	Vessel on Autopilot	
2:O	25.12	06:00:00	(Approx time) GPS working	
2:O	25.12	09:00:00	Watch handover 3:O -> 2:O (COG 278 / SOG 12.0 / SIGNW 2.0 SW)	**2:O**
2:O	25.12	09:15:00	Called St Petersburg Traffic (leaving territorial) and Helsinki VTS (entering traffic area)	
2:O	25.12	09:30:00	Three vessels in vicinity: Two Fwd and one FWD/SB	
2:O	25.12	10:00:00	Check (COG 258 / SOG 11.0)	
Other	25.12	10:13:04	First indication of speed decrease	
Other	25.12	10:15:32	2:O reacts on speed being 10.8 knots	
Other	25.12	10:24:00	Speed goes under 10 knots	
Other	25.12	10:25:00	2:O calls Chief Engineer to bridge because of speed decrease	
Cables	25.12	10:25:59	Crossing cable #1	
Other	25.12	10:26:00	Estlink 2 offline	
2:O	25.12	10:26:00	Check (COG 258 / SOG 10.0)	
2:O	25.12	10:26:00	Check (COG 250 / SOG 8.5)	
Cables	25.12	10:27:12	Crossing cable/pipeline #2	
Cables	25.12	10:32:12	Crossing cable/pipeline #3	
Cables	25.12	10:40:37	Crossing cable/pipeline #4	
Cables	25.12	10:41:04	Crossing cable/pipeline #5	
Cables	25.12	10:50:23	Crossing cable/pipeline #6	

Source	Date	Time UTC	Action / Event	Bridge command
Cables	25.12	10:50:50	Crossing cable/pipeline #7	
Other	25.12	10:59:00	GPS for VDR working	
2:O	25.12	11:02:00	2:O reacting on RPM instability	
2:O	25.12	11:04:59	RPM 84 -> RPM 75 (anomaly), 2:O informed Master, Master on bridge, resolving	**Master**
Logbook/2	25.12	11:05:00	RPM reduced to 75, E/R informed bridge will stop the engine and give E/R control	
Engine	25.12	11:05:37	RPM 75 BRIDGE CONTROL	
2:O	25.12	11:10:00	(Approx) Autopilot -> Manual	
Logbook/2	25.12	11:12:00	RPM 69	
Engine	25.12	11:12:03	RPM 69 BRIDGE CONTROL	
2:O	25.12	11:15:00	(Approx) Helsinki VTS calls and asks reason for stopping, ME problem, ask to report when fixed	
Logbook/2	25.12	11:16:00	RPM 61	
Logbook/2	25.12	11:16:00	VTS and Coast Guard asked reason for stopping, replied ME problem	
2:O	25.12	11:30:00	Situation has been reported to Tech Dept accordingly	
Engine	25.12	11:40:23	RPM 61 BRIDGE CONTROL	
Engine	25.12	11:44:23	RPM 54 BRIDGE CONTROL	
Engine	25.12	11:44:48	RPM 51 BRIDGE CONTROL HALF AHEAD	
Engine	25.12	11:45:04	RPM 51 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	11:48:12	RPM 51 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	11:48:39	RPM 41 BRIDGE CONTROL	
2:O	25.12	11:49:00	Ship -> VTS: Reported ME problem, commenced drifting	
Logbook/2	25.12	11:49:00	RPM 0	
Engine	25.12	11:49:02	RPM 21 BRIDGE CONTROL STOP	
Engine	25.12	11:49:21	RPM 0 CONTROL ROOM CONTROL	
Engine	25.12	11:49:23	RPM Control loc: CONTROL ROOM CONTROL	
2:O	25.12	12:00:00	Drifting (COG 068 / SOG 0.8)	
2:O	25.12	12:15:00	Control at bridge (to ECR) but ME unable to go above critical RPM 52	
Logbook/2	25.12	12:15:00	Call from E/R, control given to bridge but RPM not passing critical	
Engine	25.12	12:15:19	RPM Control loc: BRIDGE CONTROL	
Engine	25.12	12:15:42	RPM 0 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:15:58	RPM 0 BRIDGE CONTROL STOP	
Engine	25.12	12:16:02	RPM 1 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:16:30	RPM 0 BRIDGE CONTROL STOP	
Engine	25.12	12:16:36	RPM 12 BRIDGE CONTROL DEAD SLOW AHEAD	

Source	Date	Time UTC	Action / Event	Bridge command
Engine	25.12	12:16:43	RPM 11 BRIDGE CONTROL	
Engine	25.12	12:16:48	RPM 0 CONTROL ROOM CONTROL STOP	
Engine	25.12	12:16:49	RPM Control loc: CONTROL ROOM CONTROL	
Engine	25.12	12:16:53	RPM 0 CONTROL ROOM CONTROL	
Logbook/2	25.12	12:17:00	E/R takes ME control	
Engine	25.12	12:17:19	RPM 35 CONTROL ROOM CONTROL	
Engine	25.12	12:17:26	RPM 35 CONTROL ROOM CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:17:28	RPM 35 CONTROL ROOM CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:17:59	RPM Control loc: BRIDGE CONTROL	
2:O	25.12	12:17:59	Control at bridge, ME seem normal, RPM 40 (dead slow ahead)	
Logbook/2	25.12	12:18:00	C:E called Bridge, gives control to bridge and advises dead slow ahead	
Engine	25.12	12:18:06	RPM 38 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	12:18:25	RPM 40 BRIDGE CONTROL	
Engine	25.12	12:21:42	RPM 43 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:22:42	RPM 42 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	12:23:51	RPM 47 BRIDGE CONTROL	
Engine	25.12	12:24:55	RPM 52 BRIDGE CONTROL	
Engine	25.12	12:24:57	RPM A SLD CANCELED	
Engine	25.12	12:26:18	RPM 49 BRIDGE CONTROL HALF AHEAD	
Engine	25.12	12:26:26	RPM 49 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	12:28:33	RPM N SLD CANCELED	
Engine	25.12	12:29:22	RPM 58 BRIDGE CONTROL HALF AHEAD	
Engine	25.12	12:29:35	RPM 60 BRIDGE CONTROL	
2:O	25.12	12:30:00	Vessel under way (COG 266 / SOG 2.0)	
2:O	25.12	12:30:00	Ship -> VTS: Reported ME Ok, returning to TSS	
Logbook/2	25.12	12:30:00	Vsl on RPM 67, informed VTS & Coast Guard proceeding on westerly course	
Engine	25.12	12:30:33	RPM 67 BRIDGE CONTROL	
Engine	25.12	12:31:41	RPM A SLD CANCELED	
Engine	25.12	12:31:43	RPM 51 BRIDGE CONTROL	
Engine	25.12	12:32:52	RPM 50 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	12:33:00	RPM 51 BRIDGE CONTROL DEAD SLOW AHEAD	
2:O	25.12	12:33:00	ME sudden drop to RPM 40, control to ECR	
Logbook/2	25.12	12:33:00	RPM again down to 40, E/R called to give E/R control	
Engine	25.12	12:33:33	RPM 41 BRIDGE CONTROL	
Engine	25.12	12:34:58	RPM 40 BRIDGE CONTROL SLOW AHEAD	

Source	Date	Time UTC	Action / Event	Bridge command
Engine	25.12	12:35:15	RPM 46 BRIDGE CONTROL	
Engine	25.12	12:41:56	RPM 45 BRIDGE CONTROL DEAD SLOW AHEAD	
2:O	25.12	12:42:00	Vessel stopped	
Logbook/2	25.12	12:42:00	RPM 0	
Engine	25.12	12:42:12	RPM 21 BRIDGE CONTROL STOP	
Engine	25.12	12:42:29	RPM 0 BRIDGE CONTROL	
2:O	25.12	12:45:00	Control to bridge, command Dead Slow Ahead	
Logbook/2	25.12	12:45:00	Call from E/R, giving control to Bridge, Dead Slow Ahead from Bridge	
Engine	25.12	12:45:26	RPM 15 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	12:45:37	RPM 41 BRIDGE CONTROL	
Engine	25.12	12:46:01	RPM 46 BRIDGE CONTROL	
Engine	25.12	12:47:16	RPM 48 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	12:47:49	RPM 52 BRIDGE CONTROL	
2:O	25.12	12:47:59	ME passed critical RPM 52	
Logbook/2	25.12	12:47:59	RPM 58, Slow Ahead	
Engine	25.12	12:48:27	RPM 58 BRIDGE CONTROL	
Engine	25.12	12:49:07	RPM 64 BRIDGE CONTROL	
Engine	25.12	12:51:23	RPM N SLD CANCELED	
Engine	25.12	12:53:28	RPM 66 BRIDGE CONTROL HALF AHEAD	
Logbook/2	25.12	12:55:00	RPM 70, Half Ahead	
Engine	25.12	12:55:17	RPM 70 BRIDGE CONTROL	
2:O	25.12	13:00:00	Watch handover: 2:0 -> 1:O (COG 264 / SOG 5.9)	
2:O	25.12	13:00:00	Conn handover: Master -> 1:O	**1:O**
Engine	25.12	13:01:31	RPM 76 BRIDGE CONTROL	
Other	25.12	13:02:00	Finnish president informed (2:36 after Estlink 2 crossing, 3:03:07 before next Finnish cable crossing)	
Engine	25.12	13:03:48	RPM 78 BRIDGE CONTROL FULL AHEAD	
Cables	25.12	13:10:55	Crossing cable/pipeline #8	
Cables	25.12	13:14:31	Crossing cable/pipeline #9	
2:O	25.12	13:15:00	(Approx time) Master left bridge	
2:O	25.12	13:15:00	(Approx time) Manual steering -> Autopilot	
2:O	25.12	13:20:00	VHF/Coast Guard #16->#80: Asked "Your both anchors are lift off and secured?" to which reply "Yes"	
Cables	25.12	13:21:50	Crossing cable/pipeline #10	
2:O	25.12	13:30:00	Vessel under way (COG 262 / SOG 8.5 / RPM 82)	
2:O	25.12	13:30:00	(Approx time) 2:O left bridge	
Engine	25.12	13:37:17	RPM 82 BRIDGE CONTROL	

Source	Date	Time UTC	Action / Event	Bridge command
Cables	25.12	13:45:35	Crossing cable/pipeline #11	
2:O	25.12	14:00:00	Vessel under way, Master left bridge (COG 261 / SOG 8.7 / RPM 82)	
Cables	25.12	14:07:14	Crossing cable/pipeline #12	
Cables	25.12	14:18:30	Crossing cable/pipeline #13	
2:O	25.12	15:00:00	Vessel under way (COG 259 / SOG 8.6 / RPM 82)	
Cables	25.12	16:05:23	Crossing cable/pipeline #14	
Cables	25.12	16:09:38	Crossing cable/pipeline #15	
Cables	25.12	16:27:17	Crossing cable/pipeline #16	
Cables	25.12	16:31:39	Crossing cable/pipeline #17	
Cables	25.12	16:38:12	Crossing cable/pipeline #18	
Cables	25.12	16:38:51	Crossing cable/pipeline #19	
Cables	25.12	16:42:22	Crossing cable/pipeline #20	
Cables	25.12	16:42:29	Crossing cable/pipeline #21	
2:O	25.12	16:45:00	(Unclear timestamp) VHF / Coast Guard: We are dragging something. Master informed.	
Logbook	25.12	16:45:00	Finland Coast Guard called vessel on CH16, informed possibility of dragging anchor	
Cables	25.12	16:49:07	Crossing cable/pipeline #22	
Cables	25.12	16:50:23	Crossing cable/pipeline #23	
Logbook	25.12	16:51:00	Engines stopped and commenced heaving of port anchor	
Engine	25.12	16:51:57	RPM 82 BRIDGE CONTROL HALF AHEAD	
2:O	25.12	16:52:00	Watch handover: 1:0 -> Master. C:O and Bosun ordered forward to check anchor	**Master**
Engine	25.12	16:52:49	RPM 82 BRIDGE CONTROL SLOW AHEAD	
Engine	25.12	16:53:19	RPM 82 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	16:54:08	RPM 42 BRIDGE CONTROL	
Cables	25.12	16:54:29	Crossing cable/pipeline #24	
Engine	25.12	16:54:30	RPM 35 BRIDGE CONTROL	
Engine	25.12	16:54:48	RPM 42 BRIDGE CONTROL	
Engine	25.12	16:55:16	RPM 34 BRIDGE CONTROL	
Engine	25.12	16:59:37	RPM 21 BRIDGE CONTROL STOP	
Engine	25.12	16:59:54	RPM 0 BRIDGE CONTROL	
Engine	25.12	17:03:25	RPM 0 BRIDGE CONTROL DEAD SLOW ASTERN	
Engine	25.12	17:03:53	RPM 0 BRIDGE CONTROL STOP	
Engine	25.12	17:05:37	RPM ¯14 BRIDGE CONTROL DEAD SLOW ASTERN	
Engine	25.12	17:05:56	RPM ¯50 BRIDGE CONTROL	
Engine	25.12	17:06:52	RPM ¯44 BRIDGE CONTROL	

Source	Date	Time UTC	Action / Event	Bridge command
Engine	25.12	17:06:57	RPM ¯21 BRIDGE CONTROL STOP	
Engine	25.12	17:07:10	RPM 0 BRIDGE CONTROL	
Engine	25.12	17:25:47	RPM 0 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	17:26:14	RPM 38 BRIDGE CONTROL	
Engine	25.12	17:26:49	RPM 15 BRIDGE CONTROL STOP	
Engine	25.12	17:27:00	RPM 0 BRIDGE CONTROL	
Logbook	25.12	17:48:00	Anchor chain lifted without anchor	
Logbook	25.12	17:50:00	Vessel informed Coast Guard about the anchor, asked permission to continue sailing	
Vessel detained and in international water				
Logbook	25.12	17:52:00	Coat Guard orders to veer hard to SB wheel and maintain HDG 025	
Logbook	25.12	17:52:00	VSL informed CG intended true course 257, CG refused and instructed 028 and follow them	
Engine	25.12	17:56:03	RPM 16 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	17:56:18	RPM 40 BRIDGE CONTROL	
Engine	25.12	17:59:59	RPM 17 BRIDGE CONTROL STOP	
2:O	25.12	18:00:00	Chain lifted without anchor, reported to Coast Guard	
Engine	25.12	18:00:10	RPM 0 BRIDGE CONTROL	
Engine	25.12	18:01:01	RPM 0 BRIDGE CONTROL DEAD SLOW AHEAD	
Engine	25.12	18:01:18	RPM 38 BRIDGE CONTROL	
2:O	25.12	18:10:00	VHF / Coast Guard: Instructed vessel to do 025 deg	
2:O	25.12	18:15:00	VHF / Coast Guard: Vessel asked permission to return to original course, denined	
2:O	25.12	18:20:00	VHF / Coast Guard: Vessel asked for intentions, ordered to follow	
Engine	25.12	18:27:28	RPM 44 BRIDGE CONTROL	
2:O	25.12	18:45:00	VHF / Coast Guard: Instruction to drop anchor 5 M to north	
2:O	25.12	18:50:00	VHF / Coast Guard: Vessel informs that designated anhoring area is unsafe	
2:O	25.12	19:00:00	VHF / Coast Guard: CG gives position 59 53N 24 40.4E for anchoring	
Vessel detained and in Finnish territorial water				
Other	25.12	19:00:29	Ship enters Finnish territorial water	
Logbook	25.12	19:12:00	CG called CH16->CH06 and instructed to drop anchor at posn xN xE	
Logbook	25.12	19:22:59	Vessel commenced anchoring	
2:O	25.12	19:30:00	Vessel anchored at 59 52.99N 24 40.41E with 4 schackles in water	
Logbook	25.12	19:45:00	Vessel achored and infored Coat Guard	

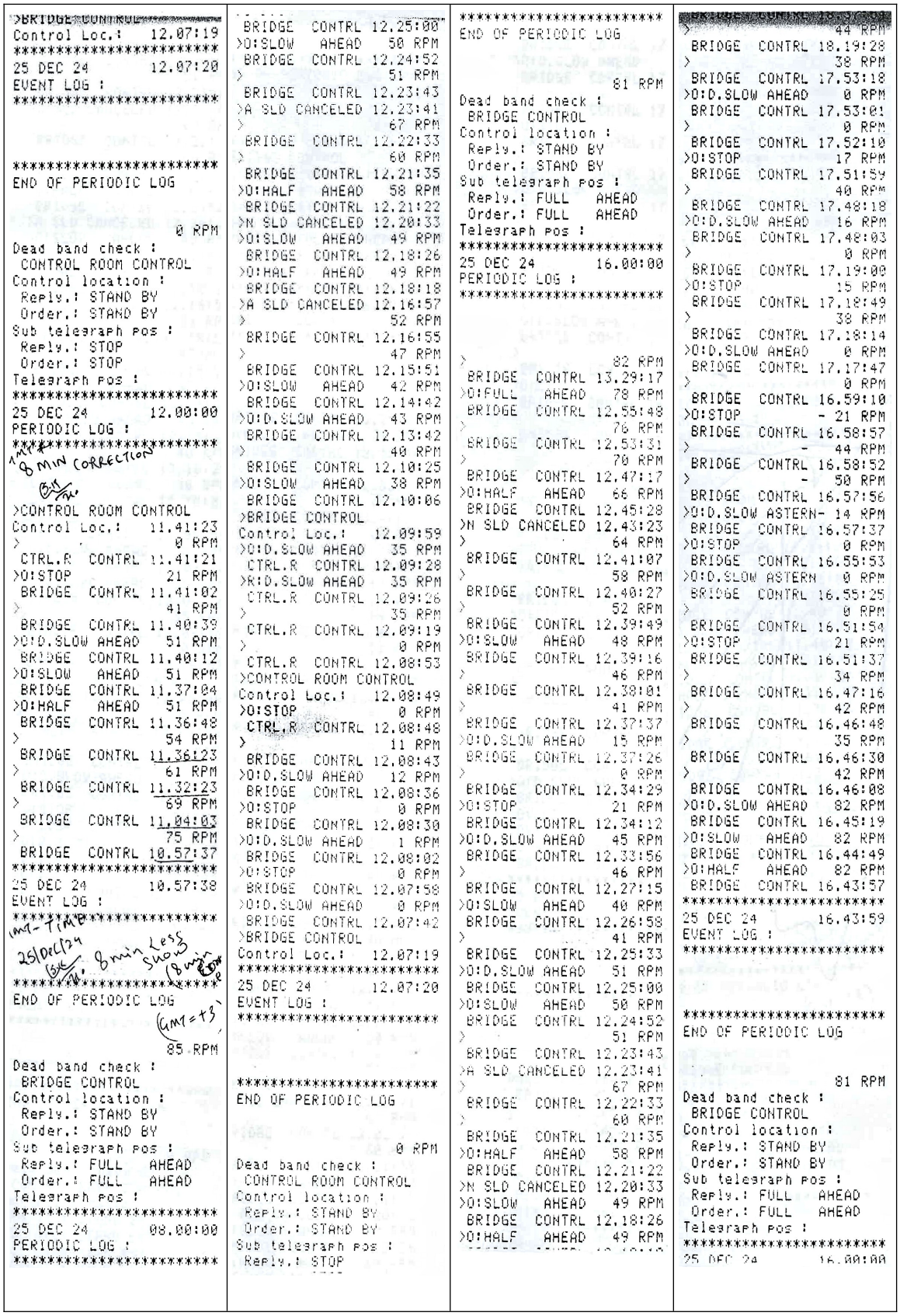
Source	Date	Time UTC	Action / Event	Bridge command
Logbook	25.12	19:45:00	VTS called vessel CH16->CH60 enq vsl anchor holding/not, vsl informed holding	
Logbook	25.12	19:45:00	Vessel asked Coast Guard any information why vsl at anchor, they said be at anchor	
2:O	25.12	20:06:00	VHF / Coast Guard: Anchor position given by Coast Guard	
2:O	25.12	21:20:00	VHF / Coast Guard: Boarding in 1 hour, Master+C:E+Bosun to bridge others to Messroom	
Logbook	25.12	21:30:00	Coast Guard ordered all crew in messroom and Master+Ch Eng+Boatswain on bridge, vsl ACK	
2:O	25.12	22:00:00	Boarding: 1 helicopter arrived, 12-15 armed polices board the vessel	
2:O	25.12	22:40:00	Boarding: +1 helocopter arrived, more teams	
2:O	25.12	23:00:00	Boarding: All passports captured, investigation commencing	
2:O	25.12	23:00:00	Boarding: All crew instructed to sleep in messroom, ship equipment captured	

7.4 Incident day 25 December 2024

7.4.1 Engine commands and rpm

At the time of writing this report, we only have data from the Kongsberg Engine Command Printer for engine rpm at hands. Times in the printouts are in UTC. According to a hand-written note (removed in image) on printout #1, the time stamps are 8 minutes behind.

The list begins when the rpm has decreased to 75 (at 11:05 UTC), having passed Estlink 2 slightly over half an hour earlier.



"Receipts" from the Kongsberg Engine Command Printer. In each column, the oldest event is at the bottom of the list.

The table is re-written into a more readable format below, but still with the 8-minute time offset; times in the list are UTC–8 minutes. Prior to the first time stamp, the engine rpm had, according to statements by the ship's crew, been 85 rpm.

Date	Time	Rpm	Control	Telegraph command
25.12.2024	10:57:37	75	BRIDGE CONTROL	
25.12.2024	11:04:03	69	BRIDGE CONTROL	
25.12.2024	11:32:23	61	BRIDGE CONTROL	
25.12.2024	11:36:23	54	BRIDGE CONTROL	
25.12.2024	11:36:48	51	BRIDGE CONTROL	HALF AHEAD
25.12.2024	11:37:04	51	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	11:40:12	51	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	11:40:39	41	BRIDGE CONTROL	
25.12.2024	11:41:02	21	BRIDGE CONTROL	STOP
25.12.2024	11:41:21	0	CONTROL ROOM CONTROL	
25.12.2024	11:41:23			Control loc: CONTROL ROOM CONTROL
25.12.2024	12:07:19			Control loc: BRIDGE CONTROL
25.12.2024	12:07:42	0	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:07:58	0	BRIDGE CONTROL	STOP
25.12.2024	12:08:02	1	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:08:30	0	BRIDGE CONTROL	STOP
25.12.2024	12:08:36	12	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:08:43	11	BRIDGE CONTROL	
25.12.2024	12:08:48	0	CONTROL ROOM CONTROL	STOP
25.12.2024	12:08:49			Control loc: CONTROL ROOM CONTROL
25.12.2024	12:08:53	0	CONTROL ROOM CONTROL	
25.12.2024	12:09:19	35	CONTROL ROOM CONTROL	
25.12.2024	12:09:26	35	CONTROL ROOM CONTROL	DEAD SLOW AHEAD
25.12.2024	12:09:28	35	CONTROL ROOM CONTROL	DEAD SLOW AHEAD
25.12.2024	12:09:59			Control loc: BRIDGE CONTROL
25.12.2024	12:10:06	38	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:10:25	40	BRIDGE CONTROL	
25.12.2024	12:13:42	43	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:14:42	42	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:15:51	47	BRIDGE CONTROL	
25.12.2024	12:16:55	52	BRIDGE CONTROL	
25.12.2024	12:16:57			A SLD CANCELED
25.12.2024	12:18:18	49	BRIDGE CONTROL	HALF AHEAD
25.12.2024	12:18:26	49	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:20:33			N SLD CANCELED
25.12.2024	12:21:22	58	BRIDGE CONTROL	HALF AHEAD
25.12.2024	12:21:35	60	BRIDGE CONTROL	
25.12.2024	12:22:33	67	BRIDGE CONTROL	
25.12.2024	12:23:41			A SLD CANCELED
25.12.2024	12:23:43	51	BRIDGE CONTROL	
25.12.2024	12:24:52	50	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:25:00	51	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:25:33	41	BRIDGE CONTROL	
25.12.2024	12:26:58	40	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:27:15	46	BRIDGE CONTROL	
25.12.2024	12:33:56	45	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:34:12	21	BRIDGE CONTROL	STOP
25.12.2024	12:34:29	0	BRIDGE CONTROL	
25.12.2024	12:37:26	15	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	12:37:37	41	BRIDGE CONTROL	
25.12.2024	12:38:01	46	BRIDGE CONTROL	

Date	Time	Rpm	Control	Telegraph command
25.12.2024	12:39:16	48	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	12:39:49	52	BRIDGE CONTROL	
25.12.2024	12:40:27	58	BRIDGE CONTROL	
25.12.2024	12:41:07	64	BRIDGE CONTROL	
25.12.2024	12:43:23			N SLD CANCELED
25.12.2024	12:45:28	66	BRIDGE CONTROL	HALF AHEAD
25.12.2024	12:47:17	70	BRIDGE CONTROL	
25.12.2024	12:53:31	76	BRIDGE CONTROL	
25.12.2024	12:55:48	78	BRIDGE CONTROL	FULL AHEAD
25.12.2024	13:29:17	82	BRIDGE CONTROL	
25.12.2024	16:43:57	82	BRIDGE CONTROL	HALF AHEAD
25.12.2024	16:44:49	82	BRIDGE CONTROL	SLOW AHEAD
25.12.2024	16:45:19	82	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	16:46:08	42	BRIDGE CONTROL	
25.12.2024	16:46:30	35	BRIDGE CONTROL	
25.12.2024	16:46:48	42	BRIDGE CONTROL	
25.12.2024	16:47:16	34	BRIDGE CONTROL	
25.12.2024	16:51:37	21	BRIDGE CONTROL	STOP
25.12.2024	16:51:54	0	BRIDGE CONTROL	
25.12.2024	16:55:25	0	BRIDGE CONTROL	DEAD SLOW ASTERN
25.12.2024	16:55:53	0	BRIDGE CONTROL	STOP
25.12.2024	16:57:37	-14	BRIDGE CONTROL	DEAD SLOW ASTERN
25.12.2024	16:57:56	-50	BRIDGE CONTROL	
25.12.2024	16:58:52	-44	BRIDGE CONTROL	
25.12.2024	16:58:57	-21	BRIDGE CONTROL	STOP
25.12.2024	16:59:10	0	BRIDGE CONTROL	
25.12.2024	17:17:47	0	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	17:18:14	38	BRIDGE CONTROL	
25.12.2024	17:18:49	15	BRIDGE CONTROL	STOP
25.12.2024	17:19:00	0	BRIDGE CONTROL	
25.12.2024	17:48:03	16	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	17:48:18	40	BRIDGE CONTROL	
25.12.2024	17:51:59	17	BRIDGE CONTROL	STOP
25.12.2024	17:52:10	0	BRIDGE CONTROL	
25.12.2024	17:53:01	0	BRIDGE CONTROL	DEAD SLOW AHEAD
25.12.2024	17:53:18	38	BRIDGE CONTROL	
25.12.2024	18:19:28	44	BRIDGE CONTROL	

7.4.2 Day overview

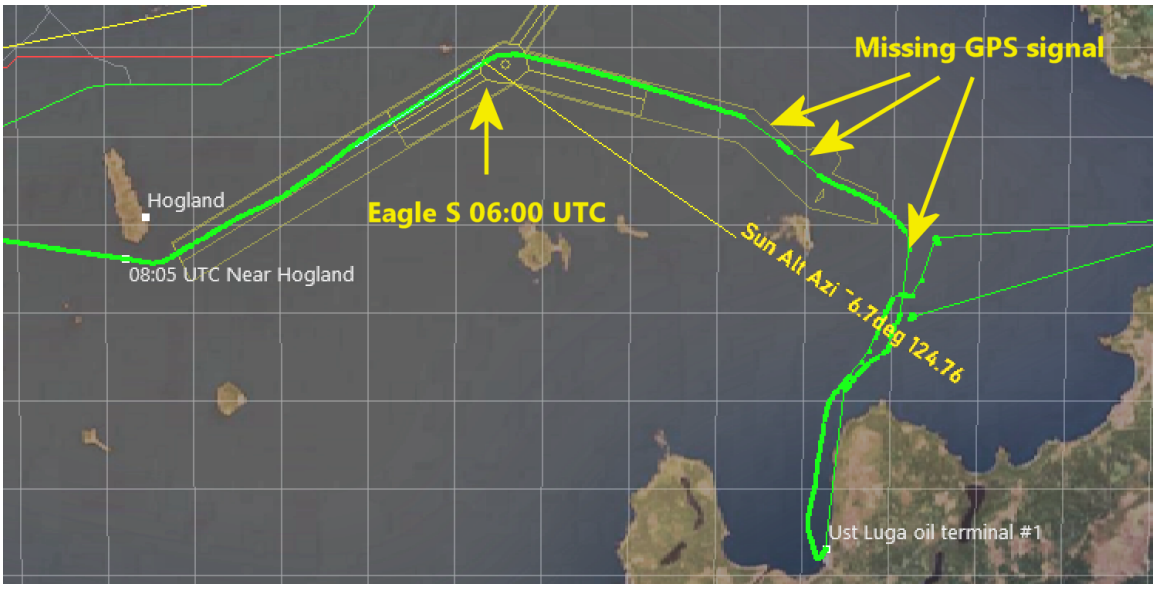
The Eagle S left the Ust-Luga oil terminal at around 01:00 UTC. Within an hour, all tugs were disconnected. At 03:00 UTC the pilot left the ship at the pilot pick-up area.

At 03:30 UTC, the Forward Team, responsible for mooring, was dismissed. This team consisted of three people, of which the First Officer was one.

At 04:00 UTC the Master handed over the command to the Third Officer. The autopilot was turned on, and the ship followed the TSS on the Russian side. Until then, the ship had been under manual steering by calculation based on magnetic and gyro compasses plus speed log; in addition, the ship performed regular position fixes using fix points like beacons. This is also the normal convention when driving on autopilot.

At approximately 06:00 UTC, while executing the turn towards southwest, the GPS signal, which had until then been weak and unstable, was again functional for navigation with ECDIS. During the hours before, there are gaps in the AIS data due to lack of positional info.

It was still dark as the sun was slightly below the horizon.



The position of the Eagle S at 06:00 UTC, when the GPS signal became functional

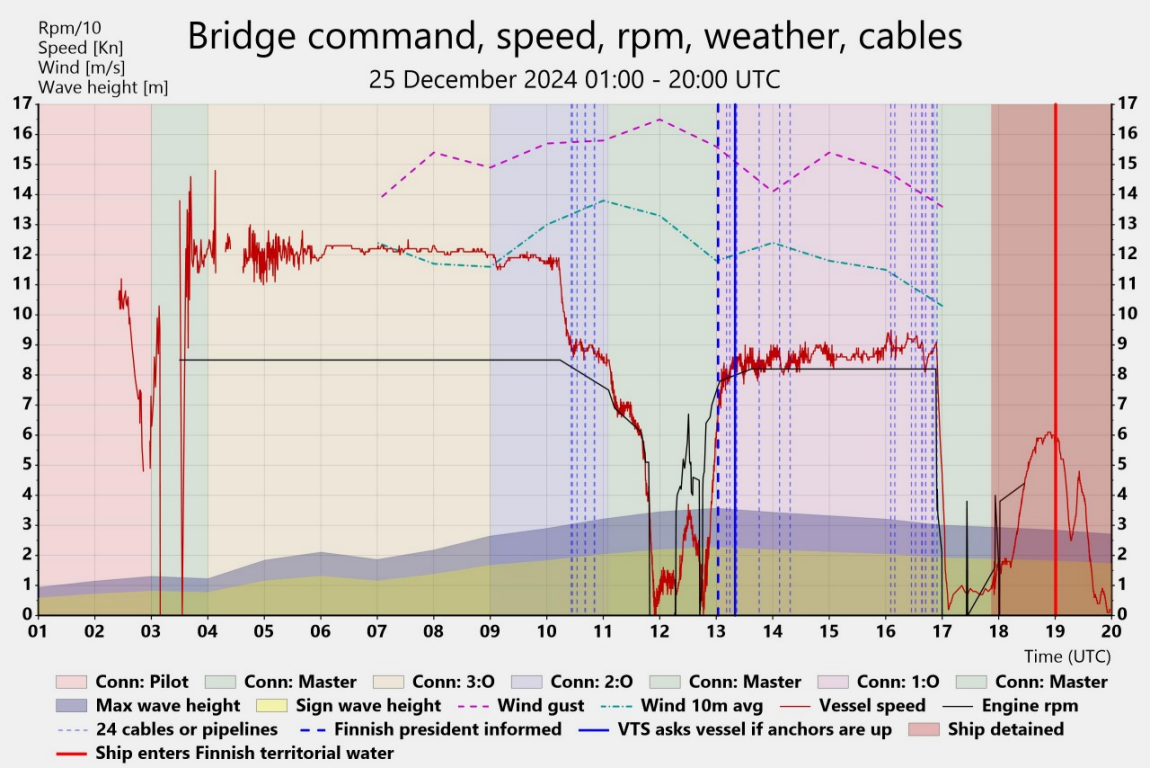
At 07:17 UTC (10:17 Russian time, which was still in effect on board), when approximately 10M from Hogland, the ship saw the sunrise.

At 08:00 UTC the ship passed Hogland and the sea state quickly deteriorated; the ship had (for the past two hours) been in "shelter" from the waves. The ship speed had until then been 12.1 knots on average.

At 09:00 UTC, after a 5-hour watch, the Third Officer handed over the bridge command to the Second Officer, who then made radio calls to the Russian and Finnish VTS, informing them of leaving and entering their traffic systems respectively.

There were two people on the bridge, the Second Officer and an AB/OS.

An overview of the ship's bridge command, travel speed, engine rpm, sea state, and passed cables is shown in the graph below.



The conditions in effect on the cable incident day. The background colours indicate which crew member had the bridge command. The rpm decrease from 85 to 75 rpm is drawn as a diagonal line connecting two data points. It is unknown exactly how and when the rpm fluctuated between these points.

7.4.3 Cable incident day from the Second Officer's point of view

The next graph shows the same data as the previous one, but only for the time slot that represented the Second Officer's bridge watch.

As he came to the bridge at 09:00, he noted an increasingly deteriorating sea state and limited visibility.

According to interviews with the Second Officer, he noticed three slightly slower vessels in front/starboard of him. During the first hour of his watch, he followed these vessels on radar, then he made a small course adjustment to pass them on their port side. This would, however, take some hours to occur.

7.4.3.1 ADDITIONAL INFORMATION BY THE SECOND OFFICER ON 24 AUGUST, 2025

On Friday 22 August, 2025, the Second Officer was interrogated during his weekly (and mandatory) visit to the Finnish Police. During the event, a bridge recording from the VDR was presented to him. In the recording, discussions between him, the Chief Engineer and the Master could be heard. Hearing these discussions again, 8 months after the incident, served to make the Second Officer remember exactly what was said on the bridge, and when this took place. The Second Officer made notes of the interrogation event.

This new VDR information reveals that the Second Officer reacted on a speed decrease at no later than 10:25, which is 11 minutes and 56 seconds after the very first speed decrease indication at 10:13:04, as shown by the AIS data. 10:13:04 is however the theoretical "last time stamp" for his knowledge regarding the ship's keeping of a normal speed. It is more likely that he, at this moment, had a general impression about the speed, based on what he had seen on the consoles during the first hour of his watch.

The following table shows the relevant AIS data records, 3381-3544. Before the table begins, the ship's speed had steadily been slightly below 12 knots.

Date and time [UTC]	Latitude	Longitude	SOG	Remarks
25.12.2024 10:10:24	59,96	26,18	11,8	
25.12.2024 10:10:44	59,96	26,18	11,6	
25.12.2024 10:10:53	59,96	26,18	11,6	
25.12.2024 10:11:04	59,96	26,18	11,8	
25.12.2024 10:11:13	59,96	26,18	11,8	
25.12.2024 10:11:33	59,96	26,18	11,8	
25.12.2024 10:12:04	59,96	26,17	11,8	
25.12.2024 10:12:13	59,96	26,17	11,8	
25.12.2024 10:12:44	59,96	26,17	11,9	
25.12.2024 10:13:04	59,96	26,17	11,5	First indication of a speed decrease, speed drops below the recent average of 11.8 Kn
25.12.2024 10:13:13	59,96	26,17	11,6	
25.12.2024 10:13:44	59,96	26,16	11,5	
25.12.2024 10:14:04	59,96	26,16	11,3	
25.12.2024 10:14:13	59,96	26,16	11,3	
25.12.2024 10:14:44	59,96	26,16	11	
25.12.2024 10:14:53	59,96	26,16	11	
25.12.2024 10:15:00	59,96	26,15	11	
25.12.2024 10:15:22	59,96	26,15	10,9	
25.12.2024 10:15:32	59,96	26,15	10,8	Last time the speed was 10.8 Kn, before dropping further. The yellow, consecutive cells below indicate the time window during which the Second Officer realised that there was a speed decrease. The time window is from **10:15:32** (speed = 10.8 Kn) to **10:25** (called the Chief Engineer).
25.12.2024 10:15:53	59,96	26,15	10,6	
25.12.2024 10:16:04	59,96	26,15	10,4	
25.12.2024 10:16:12	59,96	26,15	10,6	
25.12.2024 10:16:32	59,96	26,15	10,4	
25.12.2024 10:16:53	59,96	26,14	10,4	
25.12.2024 10:17:12	59,96	26,14	10,3	
25.12.2024 10:17:22	59,96	26,14	10,2	
25.12.2024 10:17:44	59,96	26,14	10,1	
25.12.2024 10:18:02	59,96	26,14	10,1	
25.12.2024 10:18:08	59,96	26,14	10,1	
25.12.2024 10:18:22	59,96	26,14	10,1	
25.12.2024 10:18:32	59,96	26,13	10,1	
25.12.2024 10:18:44	59,96	26,13	10	
25.12.2024 10:18:44	59,96	26,13	10	
25.12.2024 10:19:02	59,96	26,13	9,9	
25.12.2024 10:19:12	59,96	26,13	9,9	
25.12.2024 10:19:22	59,96	26,13	9,8	
25.12.2024 10:19:32	59,96	26,13	9,8	
25.12.2024 10:19:41	59,96	26,13	9,7	
25.12.2024 10:20:02	59,96	26,13	9,7	
25.12.2024 10:20:12	59,96	26,13	9,7	
25.12.2024 10:20:22	59,95	26,12	9,7	

Date and time [UTC]	Latitude	Longitude	SOG	Remarks
25.12.2024 10:20:32	59,95	26,12	9,9	
25.12.2024 10:20:44	59,95	26,12	9,3	
25.12.2024 10:20:53	59,95	26,12	9,5	
25.12.2024 10:21:14	59,95	26,12	9,5	
25.12.2024 10:21:32	59,95	26,12	9,5	
25.12.2024 10:21:44	59,95	26,12	9,5	
25.12.2024 10:22:02	59,95	26,12	9,4	
25.12.2024 10:22:14	59,95	26,12	9,4	
25.12.2024 10:22:22	59,95	26,11	9,4	
25.12.2024 10:22:32	59,95	26,11	9,3	
25.12.2024 10:22:44	59,95	26,11	9,4	
25.12.2024 10:22:53	59,95	26,11	9,3	
25.12.2024 10:23:04	59,95	26,11	9,2	
25.12.2024 10:23:24	59,95	26,11	9,2	
25.12.2024 10:23:44	59,95	26,11	9	
25.12.2024 10:23:53	59,95	26,11	9	
25.12.2024 10:24:02	59,95	26,11	9,2	
25.12.2024 10:24:14	59,95	26,1	9,1	
25.12.2024 10:24:42	59,95	26,1	9,3	
25.12.2024 10:24:53	59,95	26,1	9,2	
25.12.2024 10:25:02	59,95	26,1	9,3	The Second Officer called the Chief Engineer to bridge, because of a speed decrease
25.12.2024 10:25:14	59,95	26,1	9	
25.12.2024 10:25:24	59,95	26,1	9,1	
25.12.2024 10:25:32	59,95	26,1	9	
25.12.2024 10:25:42	59,95	26,1	9	
25.12.2024 10:25:53	59,95	26,1	9	
25.12.2024 10:26:02	59,95	26,1	8,8	Ship crossed Estlink 2
25.12.2024 10:26:14	59,95	26,09	8,9	
25.12.2024 10:26:24	59,95	26,09	9	
25.12.2024 10:26:32	59,95	26,09	8,9	
25.12.2024 10:26:42	59,95	26,09	8,9	
25.12.2024 10:26:53	59,95	26,09	8,9	
25.12.2024 10:27:02	59,95	26,09	8,9	
25.12.2024 10:27:14	59,95	26,09	8,8	
25.12.2024 10:27:24	59,95	26,09	8,8	
25.12.2024 10:27:32	59,95	26,09	8,8	
25.12.2024 10:27:42	59,95	26,09	8,8	
25.12.2024 10:27:53	59,95	26,09	8,7	
25.12.2024 10:28:02	59,95	26,09	8,8	
25.12.2024 10:28:22	59,95	26,08	8,6	
25.12.2024 10:28:33	59,95	26,08	9	
25.12.2024 10:28:53	59,95	26,08	8,7	
25.12.2024 10:29:02	59,95	26,08	8,9	
25.12.2024 10:29:13	59,95	26,08	8,7	
25.12.2024 10:29:33	59,95	26,08	8,7	
25.12.2024 10:29:43	59,95	26,08	9	
25.12.2024 10:29:53	59,95	26,08	8,8	
25.12.2024 10:30:02	59,95	26,08	8,9	
25.12.2024 10:30:13	59,95	26,08	8,9	
25.12.2024 10:30:33	59,95	26,07	9,1	
25.12.2024 10:30:44	59,95	26,07	8,8	
25.12.2024 10:31:02	59,95	26,07	9,2	
25.12.2024 10:31:13	59,95	26,07	8,9	
25.12.2024 10:31:33	59,95	26,07	8,9	

Date and time [UTC]	Latitude	Longitude	SOG	Remarks
25.12.2024 10:31:43	59,95	26,07	8,9	
25.12.2024 10:31:53	59,95	26,07	8,9	
25.12.2024 10:32:02	59,95	26,07	9	
25.12.2024 10:32:13	59,95	26,07	9	
25.12.2024 10:32:22	59,95	26,07	9	
25.12.2024 10:32:33	59,95	26,07	9	
25.12.2024 10:32:53	59,95	26,06	9	
25.12.2024 10:33:02	59,95	26,06	9	
25.12.2024 10:33:13	59,95	26,06	9	
25.12.2024 10:33:33	59,95	26,06	9	
25.12.2024 10:33:43	59,95	26,06	9	
25.12.2024 10:33:53	59,95	26,06	9	
25.12.2024 10:34:03	59,95	26,06	9	
25.12.2024 10:34:13	59,95	26,06	9	
25.12.2024 10:34:22	59,95	26,06	9	
25.12.2024 10:34:33	59,95	26,06	9	
25.12.2024 10:34:43	59,95	26,05	9	
25.12.2024 10:34:49	59,95	26,05	9,1	
25.12.2024 10:35:03	59,95	26,05	9,1	
25.12.2024 10:35:13	59,95	26,05	9,1	
25.12.2024 10:35:33	59,95	26,05	9,1	
25.12.2024 10:35:43	59,95	26,05	9,1	
25.12.2024 10:35:53	59,95	26,05	9,2	
25.12.2024 10:36:03	59,95	26,05	9,1	
25.12.2024 10:36:13	59,95	26,05	9,1	
25.12.2024 10:36:23	59,95	26,05	9	
25.12.2024 10:36:43	59,95	26,04	8,8	
25.12.2024 10:36:54	59,95	26,04	9,1	
25.12.2024 10:37:03	59,95	26,04	9,1	
25.12.2024 10:37:13	59,95	26,04	9	
25.12.2024 10:37:44	59,94	26,04	9	
25.12.2024 10:37:54	59,94	26,04	8,9	
25.12.2024 10:38:13	59,94	26,04	8,8	
25.12.2024 10:38:33	59,94	26,04	8,8	
25.12.2024 10:38:44	59,94	26,04	8,8	
25.12.2024 10:38:54	59,94	26,03	8,8	
25.12.2024 10:39:03	59,94	26,03	8,9	
25.12.2024 10:39:13	59,94	26,03	8,9	
25.12.2024 10:39:23	59,94	26,03	8,5	
25.12.2024 10:39:33	59,94	26,03	8,7	
25.12.2024 10:39:44	59,94	26,03	8,8	
25.12.2024 10:39:54	59,94	26,03	8,8	
25.12.2024 10:40:13	59,94	26,03	8,8	
25.12.2024 10:40:23	59,94	26,03	8,8	
25.12.2024 10:40:33	59,94	26,03	8,8	
25.12.2024 10:40:44	59,94	26,03	8,8	
25.12.2024 10:40:54	59,94	26,02	8,8	
25.12.2024 10:41:03	59,94	26,02	8,8	
25.12.2024 10:41:13	59,94	26,02	8,8	
25.12.2024 10:41:23	59,94	26,02	8,8	
25.12.2024 10:41:44	59,94	26,02	8,8	
25.12.2024 10:41:54	59,94	26,02	8,8	
25.12.2024 10:42:02	59,94	26,02	8,8	
25.12.2024 10:42:13	59,94	26,02	8,8	
25.12.2024 10:42:32	59,94	26,02	8,9	

Date and time [UTC]	Latitude	Longitude	SOG	Remarks
25.12.2024 10:42:42	59,94	26,02	8,8	
25.12.2024 10:42:53	59,94	26,02	8,9	
25.12.2024 10:43:02	59,94	26,01	8,9	
25.12.2024 10:43:13	59,94	26,01	8,9	
25.12.2024 10:43:32	59,94	26,01	8,8	
25.12.2024 10:43:42	59,94	26,01	8,8	
25.12.2024 10:44:02	59,94	26,01	8,9	
25.12.2024 10:44:13	59,94	26,01	8,9	
25.12.2024 10:44:23	59,94	26,01	8,9	
25.12.2024 10:44:42	59,94	26,01	9	
25.12.2024 10:44:53	59,94	26,01	8,9	
25.12.2024 10:45:02	59,94	26,01	8,9	
25.12.2024 10:45:13	59,94	26	9	
25.12.2024 10:45:22	59,94	26	9	
25.12.2024 10:45:30	59,94	26	9	

As the Chief Engineer entered the bridge, this ship's speed had decreased further. When the Chief Engineer heard about this, he went to Engine Room to investigate the situation, and returned to the bridge approximately 20 minutes later.

Statement from the Second Officer on 23 August, 2025, regarding the actions taken at bridge:

> I called Ch eng around 1025 UTC when vessel dropped her speed that time speed was 10.8 knots approx and this recording has police when ch eng came on bridge same time i informed him again
>
> 1. " speed is very slow when i called you at that time speed was 10.8 and now speed 8 -8.8 knots and RPM also dropped 72 and same time he left the bridge going to engine room for investigating" same time i informed Capt and within a minute capt on bridge (Recorded in VDR)
>
> 2. Capt asked me about ETA for pilot boarding point and i ws calculating ETA and dist to go 483Nmiles. And i informed capt i already informed chief engineer he is investigating, waiting for the reply from engine room ,after this conversation capt told me show this actual rough weather, sea condition 5 and taking photo to identify weather to send with the noon report.(Recorded in VDR)
>
> 3. Call from engine room Capt rcvd and they told capt to stop main engine and capt denied that we cannot stop our vessel because we are in TSS and other vessel are in vicinity and after 2 min Capt discussed ok in this position we can stop our vessel(Recorded in VDR) because chief enginner instructed.
>
> 4. when we are stoppind our vessel at that time finn coast guard calling us why u are dropping your speed, Capt replied due tomain engine problem we are stopping our vessel once problem get resolved will continue on our passage copied by coast guard and told us inform once problem rectified.(Recorded in VDR)

5. Same time capt calling ECR told ch engineer everyone calling us please do fast give back engines.(Recorded in VDR)

6. Same time i called Helsinki VTS due to main engine problem vessel stopped once problem get resolved will inform you.(Recorded in VDR)

7. Capt and me waiting for the engines chf engineer told us to wait for the further instructions and we are talking about some normal ship board normal activities. (Normal talks Recorded in VDR)

8. Rcvd call from engine room and got control on bridge we started 1st time and RPM doesnot go up stucked in critical RPM range. Vibration recorded in VDR.

9. Rcvd call again from engine room and main engine stopped and control given to Engine room.following engine room instructions.(Recorded in VDR)

10. Capt called engine room, 2nd engineer rcvd and capt said Super is asking what is the problem, some replied from engineer capt repeat his words again Governor problem(Recorded in VDR)

11. Rcvd call from engine room Capt rcvd engine room told will start local control and capt replied ok dead slow ahead and i followed his instruction and then we got bridge control slowly slowly increasing our Teegraph (Recorded in VDR) 2nd time engines started.

12. Same time Capt called Capt Ankit on speaker abot governor problem and engines are on local control , in Denmark 24 hrs pilotage how we can manage then reply from Capt Ankit no problem that will be ok local control.(Recorded in VDR)

13. chf officer came on bridge and capt handover to the chf officer about the main engine problem to the chf officer in their local language.(Recorded in VDR)

14. At 1300 UTC i handed over to chf officer and going to my bridge PC for Noon report.

Conclusion from the statement

The statement reveals that

- The Second Officer called the Chief Engineer for help regarding a speed decrease at **10:25**.
- When the Second Officer called the Chief Engineer to bridge, his most recent information regarding the ship's speed was 10.8 knots. This speed had occurred, according to the AIS data, at **10:15:32**.

The AIS data reveals that

- The speed decrease begun at **10:13:04**.

We conclude that the Second Officers "reaction time" was between

- **10:15:32 – 10:13:04 = 2 minutes and 28 seconds, and**
- **10:25:00 – 10:13:04 = 11 minutes and 56 seconds**

The Finnish Police has not included this information regarding the VDR recording of the bridge actions in the Pre-Trial Investigation Protocol.

According to AIS data, the nearby vessels also had decreases in speed; these speed decreases were however not as big as that experienced by the Eagle S one, but only up to 1 knot.

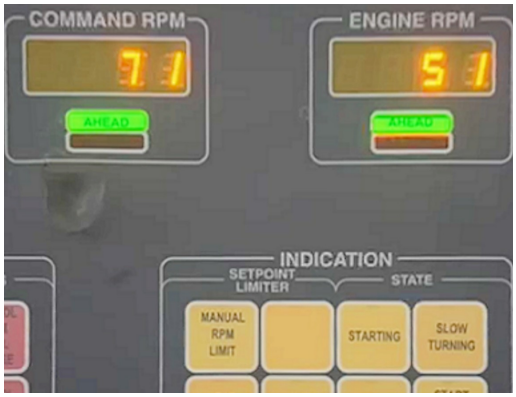
The Second Officer has stated that he initially believed that the worsening weather and water current conditions were a reason for the change in speed, however he noticed some time later that the engine rpm had decreased to 75, and immediately called the Master to the bridge. According to logbook entries, the Master was on bridge within one minute, and officially took over the bridge command at 11:05.

7.4.3.2 NOTE REGARDING THE RPM DISPLAY

The primary rpm indicator is on the engine control panel next to the telegraph (see image below). According to the crew, the engine rpm reading may **fluctuate**.

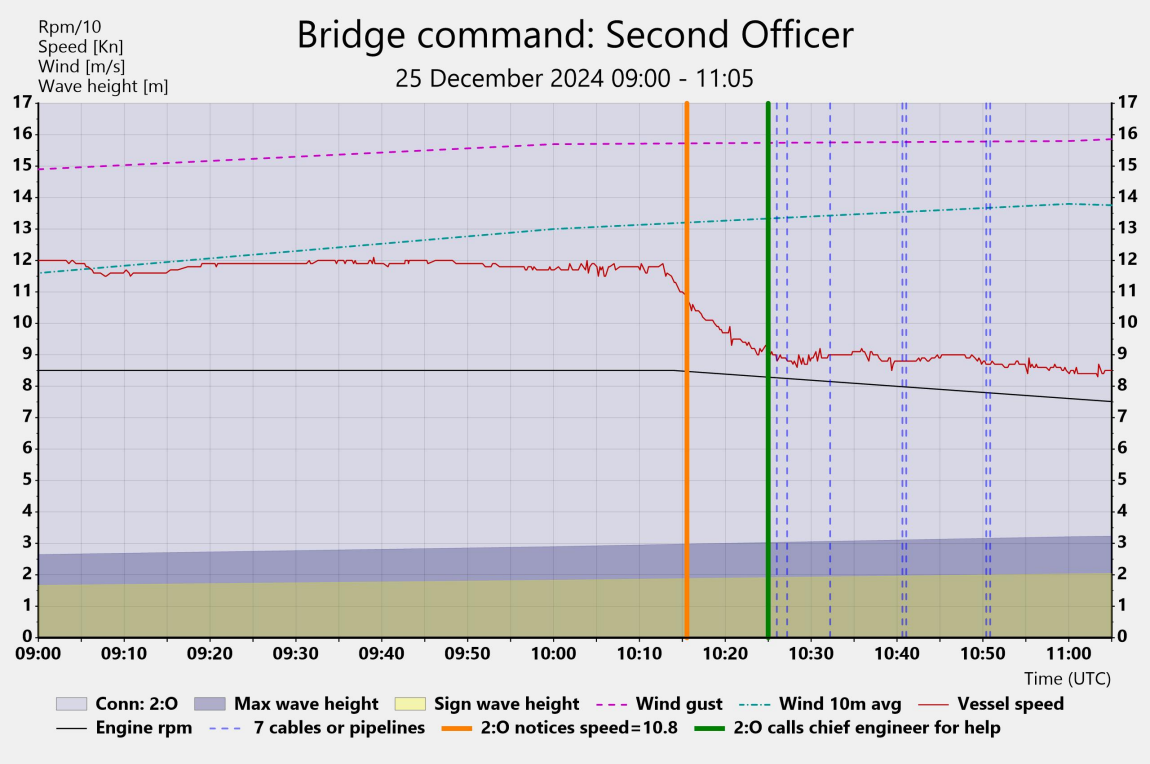
If the accurate rpm, as detected by the engine computer software, is 80.6, the display shows 81. But if the rpm is, for some reason (for example a wave) decreased by 0.2, the display will show 80. If rpm is decreased by 1.2, the display will show 79.

We do not know the exact behaviour of the system, so this is a generic description. The fluctuation can happen in both directions.



The rpm display [Master's and crew's image portfolio]

1 img36



The situation as experienced by the Second Officer. The rpm decrease from 85 to 75 rpm is drawn as a diagonal line connecting two data points. It is unknown exactly how and when the rpm fluctuated between these points.

2 During the Second Officer's watch, a total of 7 cables or pipelines were crossed:

3 • Estlink 2

4 • A Russian power cable

5 • A Russian telecom cable

6 • Russian/German Nordstream 2A and 2B

7 • Russian/German Nordstream 1A and 1B

8 At 11:05 the bridge command was taken over by the Master.

9 **Additional notes**

10 • **There is no information about the rate of rpm decrease. It may have**
11 **happened early, or late, and it may have happened linearly or irregularly.**

12 • **We have no engine information prior to the speed decrease, other than that**
13 **it was, according to the crew, 85 rpm.**

According to the Master's standing orders, ship crew members had an obligation to inform the Master without delay if they encountered anything abnormal. To our understanding, the Second Officer fulfilled this obligation when he realised that there was a problem.

7.4.4 Cable incident day from the Master's point of view (2)

As the Master took over the bridge command at 11:05 (the second time this day, the first being when exiting from Ust-Luga), the only information he got about the situation was that the engine rpm had decreased to 75.

According to interviews with the Master, there had recently been a similar situation where the Kongsberg engine governor had shown issues. Hence, the Master immediately connected the current situation to such an issue.

7.4.4.1 Master's statement regarding the earlier governor problem

Master's Clarification Statement – Main Engine Governor Incident (21 December 2024, St. Petersburg Approach)

On 21 December 2024, while approaching St. Petersburg, the vessel transited through fully ice-free waters. There were no navigational ice conditions or restrictions on the planned route, and no icebreaker assistance or external support was requested or required at any stage of the inbound voyage.

While under pilotage, the St. Petersburg port pilot informed us of a delay in tugboat availability. Based on this, a joint decision was made to stop the vessel in a safe area to wait until terminal readiness was confirmed.

During this brief standby phase, some thin ice was observed drifting around the hull. However, this did not present a navigational hazard or impede safe control of the vessel. Once tug availability and port clearance were confirmed, the vessel proceeded under pilot command.

At this point, the pilot requested a propulsion increase from "Dead Slow Ahead" to higher orders ("Slow" and then "Half Ahead") faster than usual. However, the engine RPM failed to increase beyond 52, which is a known vibration resonance zone on certain older engines. To avoid potential mechanical stress, I ordered a temporary stop to reassess the propulsion response.

In consultation with the Chief Engineer (CE), I was informed that:

- *The governor's response was delayed, likely due to the engine age and operational condition.*
- *On some older vessels, it is normal for RPM transitions from a full stop to be*

gradual, requiring time and careful handling. As the vessel's speed begins to increase slowly, revolutions can then be raised progressively in a controlled manner.

- *This was not considered a technical failure, but rather a manageable condition requiring controlled handling.*

The pilot accepted the explanation and requested a test of astern propulsion before proceeding. After confirming astern movement was fully functional, we began slow forward movement. Once the vessel reached approximately 1–2 knots, the next RPM increase attempt was successful, and the vessel passed through the critical RPM range without further issue.

During this manoeuvre, the Chief Engineer verbally mentioned a minor irregularity with the governor, noting it was under control and being monitored closely. He gave no indication that it posed a serious risk or required shore-based intervention.

Importantly:

- *No formal defect report, engine alarm, or request for urgent support was submitted.*
- *I assessed this as non-critical feedback, based on the CE's professional judgement.*
- *At no point was I informed that engine reliability was compromised or navigation was at risk.*

As per the ISM Code (Sections 5 and 10) and the company Safety Management System (SMS):

"Any failure of critical systems must be recorded in the engine room logbook, reported to the Master, and communicated to technical management using formal defect reports."

In this case:

- *No such records exist.*
- *The governor issue was not listed in the engine logbook, the defect report list, or the PMS (Planned Maintenance System).*
- *There was no notification to classification society, flag state, or technical management regarding any malfunction.*

Therefore, based on the Chief Engineer's verbal comments, lack of formal escalation, and absence of supporting documentation, I made a reasonable operational decision that the situation did not require emergency measures or shore-based support. As per standard practice and based on his senior technical judgement, I accepted the matter as non-critical. I received no further reports or warnings prior to the 25th December event that would indicate ongoing or worsening governor malfunction.

Cable incident day from the Master's point of view (2) (continued)

As an initial action, the engine telegraph was re-set to match the current rpm, that is, 75.

Within moments, the bridge communicated with the engine room, from where the Chief Engineer requested that the ship start drifting, and for engine control to be shifted from the bridge to the engine room. This is an action that must specifically be permitted from the bridge. The shifting of engine control creates an entry on the Engine Control Printer printout.

The Master gave this permission; the ship's engine was shut down at 11:49:21, and the ship went into drifting mode.

From the printer's "receipt" we can read the following:

- 12:16:02 UTC (26:41 [min:sec] after the engine shutdown) there is an entry "1 rpm". This seems to be an engine start.
- 12:16:36 UTC (27:15 after the shutdown) there is an entry "12 rpm".
- 12:17:19 UTC (27:58 after the shutdown) there is an entry "35 rpm". Here, the engine room informs the bridge that the engine is ready for normal rating. The engine control was given back to the bridge.

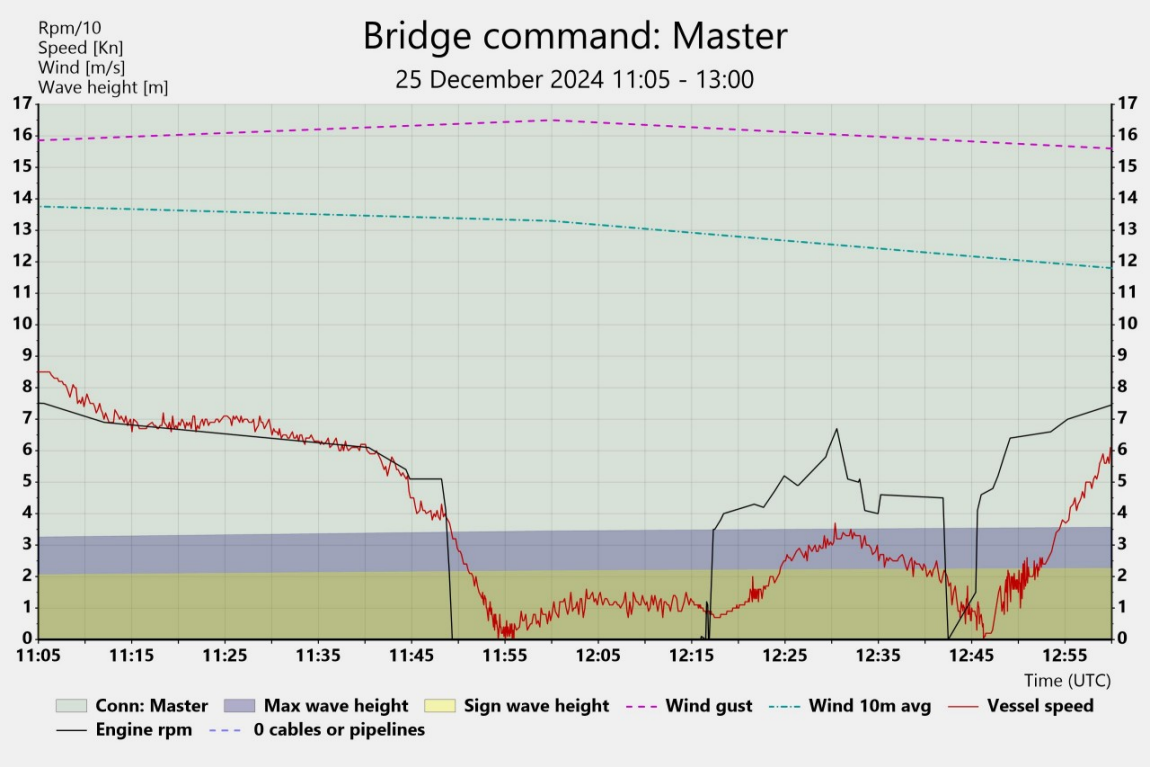
In total, the ship drifted for approximately half an hour. The drifting happened sideways, and the drifting speed was mostly 1-1.5 knots.

Even though the crew believed that the engine governor problem had been fixed, the engine again began to lose rpm, and at 12:42:29 it was shut down. The ship again went into drifting mode, but only for a short while, during which the Chief Engineer took necessary action.

- At 12:45:26, which is 2:57 after this shutdown, the engine was started again, the bridge was given control and was informed that the engine was ready for normal rating.

A ship's Master does not, and is not supposed to, have knowledge of the main engine's technicalities; this is the Chief Engineer's responsibility. We have not been able to interview the Chief Engineer.

The image below shows the data for this section's time period (1 hour and 55 minutes).



Situation during the Master's bridge command. Note that the ship moved sideways from 11:55 to 12:15. No submerged cables were passed during the graph's time period.

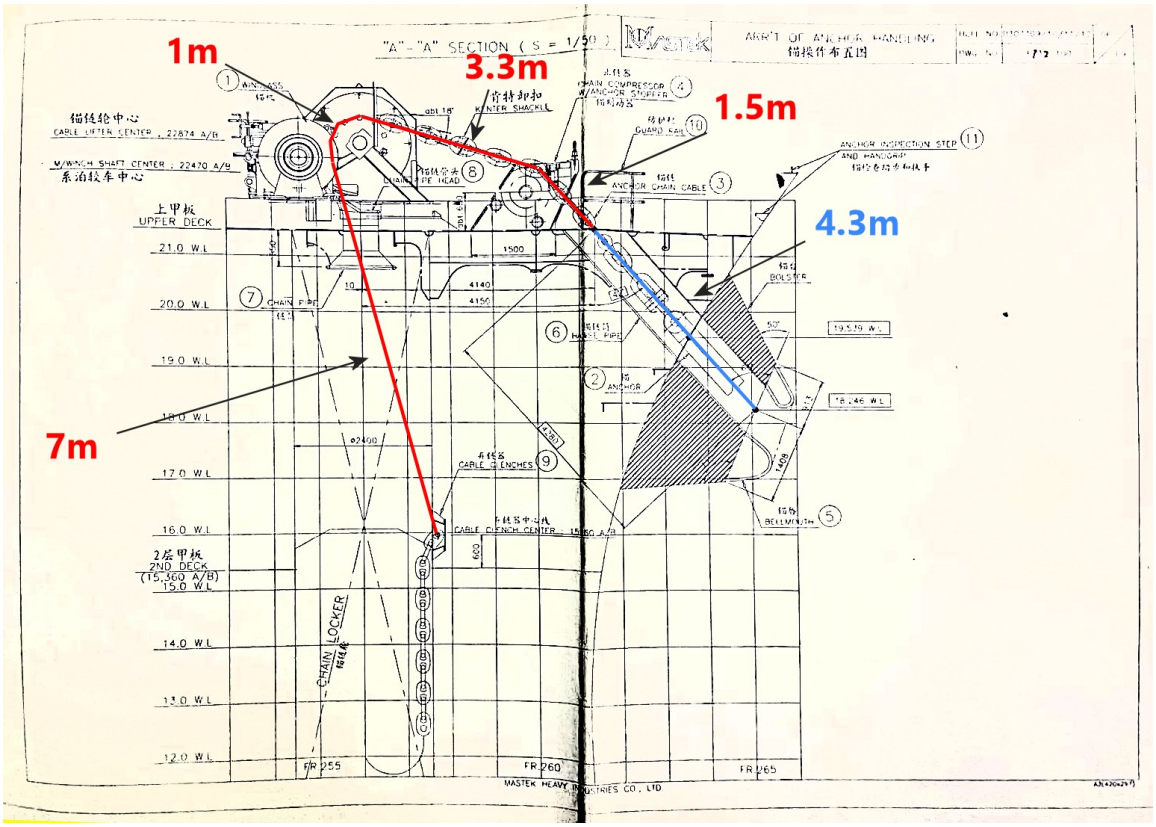
7.4.4.2 The ship's behaviour while drifting

It has been suggested that the anchor, on the seabed during the first drifting event, would have affected the ship's movement. A computer simulation shows the anchor chain's tension in relation to the ship.

In addition to the AIS data, the following anchor chain parameters have been used for the simulation:

356.616m	Port side anchor chain length 13 shots [shipyard drawings say 357.5m]
12.8m	Chain consumed on board [by drawing below, 7+1+3.3+1.5=12.8m]
4.3m	Length of anchor endpoint to centre point, added to chain length [by drawing below]
5m	Estimation, distance between water surface and anchor centre point
40m	Water depth at manoeuvre location

The image below shows how the chain consumption on board is determined.

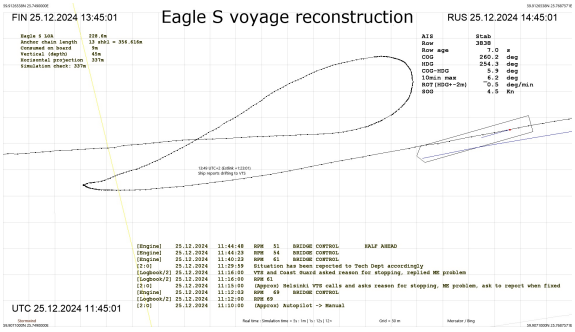


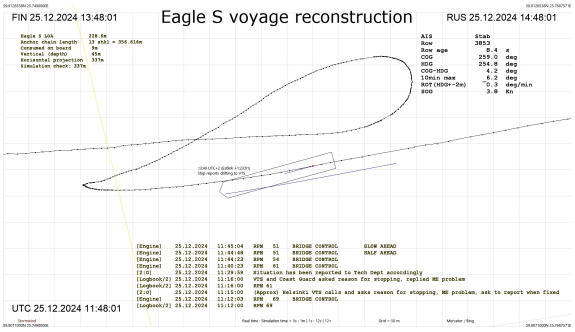
Anchor chain consumed on board, from the bitter end to the end of the anchor arm (red); length of the anchor itself (blue)

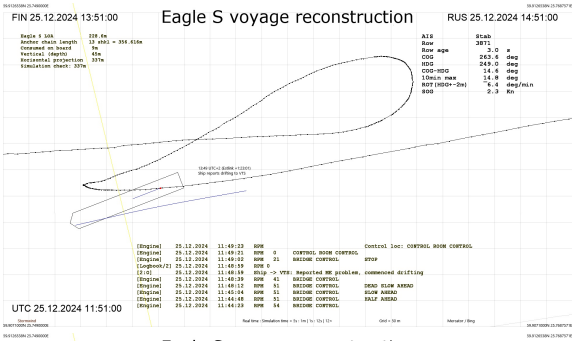
In total, 12.8 metres of chain is consumed on board the ship when the chain is under full tension. 4.3 metres is added to the chain length because of the anchor's arm.

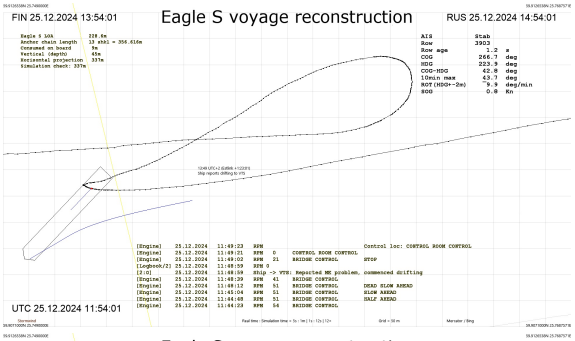
The simulation is performed using a recursive chain-link algorithm, where the chain is divided into 1-metre segments. The first approximately 100 metres of the chain is "unbendable", expressing the part of the chain that hangs freely in the water without touching the sea bed – this is always straight when seen from above. We have estimated its projection onto the seabed to be twice the height between the seabed and hawse pipe end, that is, 2*45 = 90 m. The hypotenuse of a triangle with sides 45 and 90 is 100.62, hence this amount of chain is consumed to form the projection of a first "long" 90-metre chain link in the simulation. The rest of the chain is assumed to lie horizontally on the seabed, at 40 metres depth; this part of the chain is divided into 1-metre, bendable, segments.

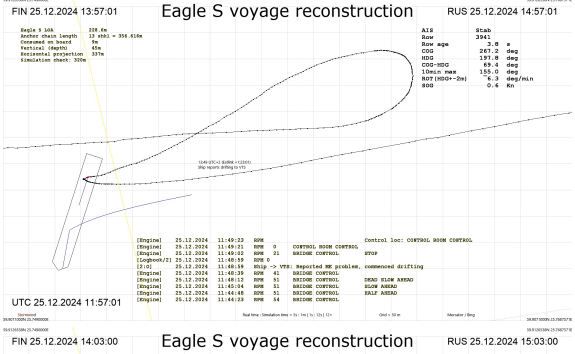
The images below show the ship's position and the geometry of the anchor chain with three minutes intervals.

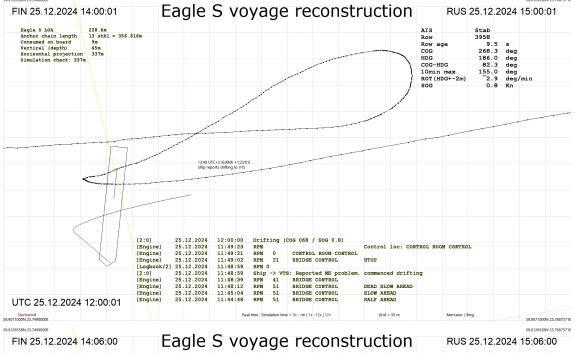

FIN 25.12.2024 13:45:01
Eagle S voyage reconstruction
RUS 25.12.2024 14:45:01
UTC 25.12.2024 11:45:01

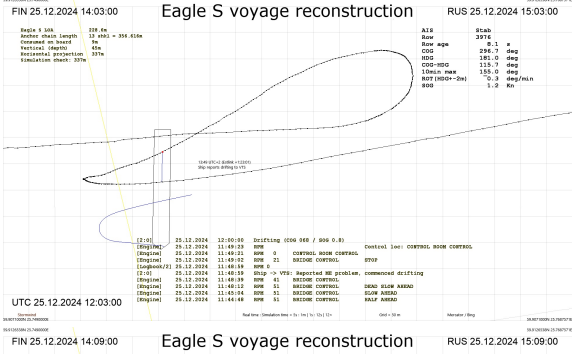

FIN 25.12.2024 13:48:01
Eagle S voyage reconstruction
RUS 25.12.2024 14:48:01
UTC 25.12.2024 11:48:01

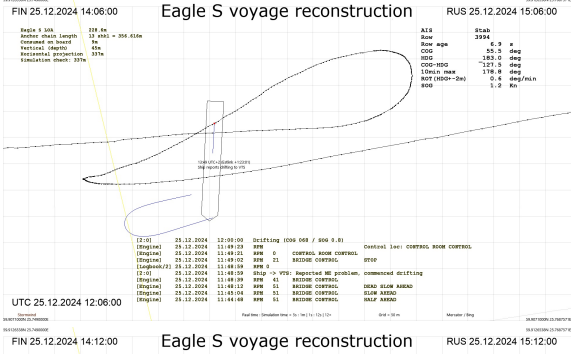

FIN 25.12.2024 13:51:00
Eagle S voyage reconstruction
RUS 25.12.2024 14:51:00
UTC 25.12.2024 11:51:00

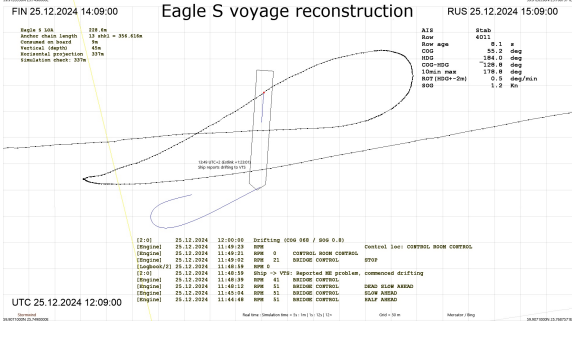

FIN 25.12.2024 13:54:01
Eagle S voyage reconstruction
RUS 25.12.2024 14:54:01
UTC 25.12.2024 11:54:01

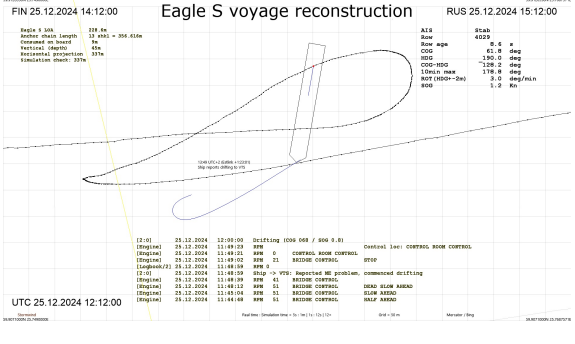

FIN 25.12.2024 13:57:01
Eagle S voyage reconstruction
RUS 25.12.2024 14:57:01
UTC 25.12.2024 11:57:01

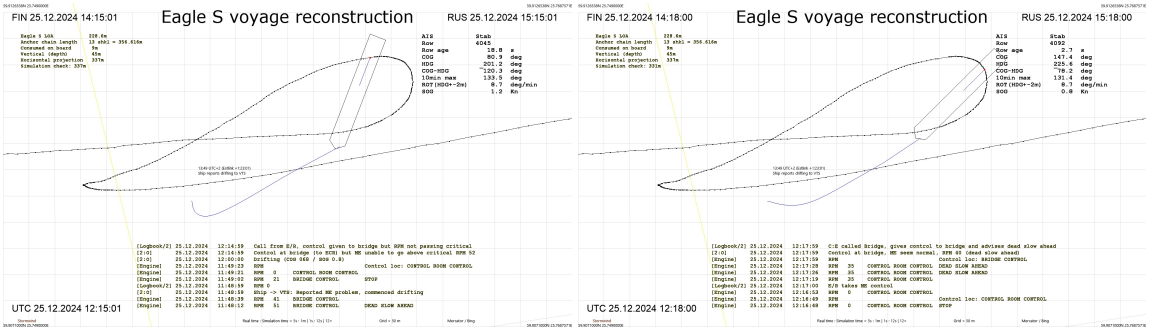

FIN 25.12.2024 14:00:01
Eagle S voyage reconstruction
RUS 25.12.2024 15:00:01
UTC 25.12.2024 12:00:01


FIN 25.12.2024 14:03:00
Eagle S voyage reconstruction
RUS 25.12.2024 15:03:00
UTC 25.12.2024 12:03:00

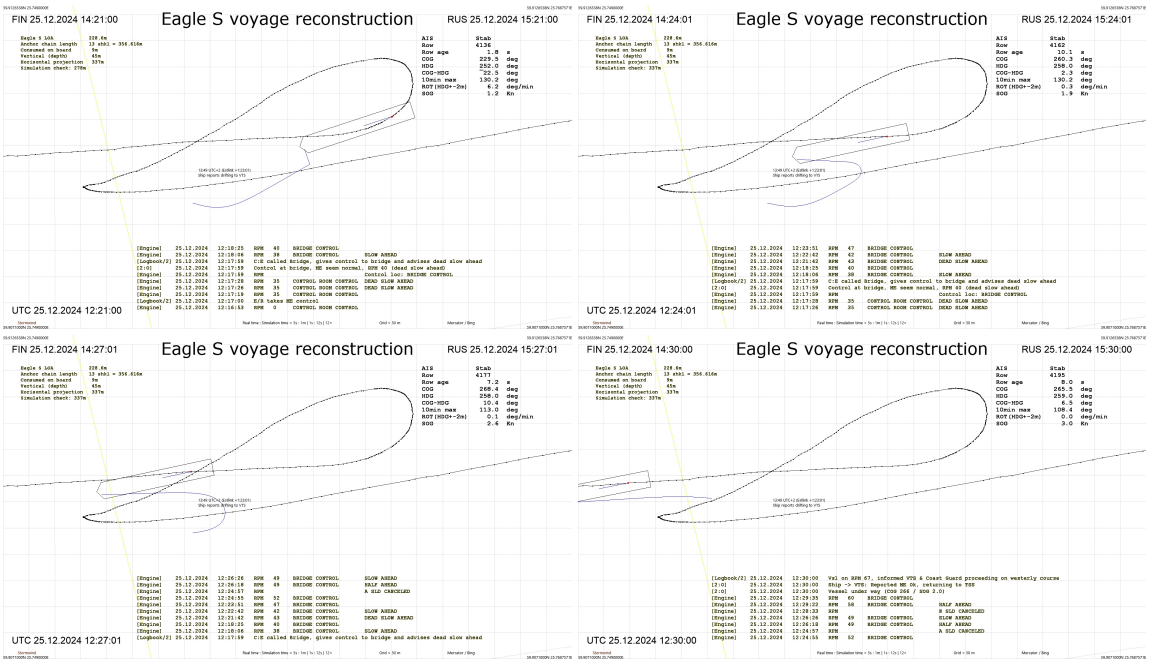

FIN 25.12.2024 14:06:00
Eagle S voyage reconstruction
RUS 25.12.2024 15:06:00
UTC 25.12.2024 12:06:00


FIN 25.12.2024 14:09:00
Eagle S voyage reconstruction
RUS 25.12.2024 15:09:00
UTC 25.12.2024 12:09:00


FIN 25.12.2024 14:12:00
Eagle S voyage reconstruction
RUS 25.12.2024 15:12:00
UTC 25.12.2024 12:12:00



Above: Main engine started and running



Simulation of the anchor chain (blue) behaviour during the drifting and solving of the main engine problem (grid = 50m)

We have concluded from the simulation that the anchor chain was never fully straightened during the drifting manoeuvre, and hence it did not interfere with the ship's drifting pattern. This, in turn, implies that the drifting did not give the ship's crew a reason to suspect that an anchor was down.

7.4.5 Cable incident day from the First Officer's point of view

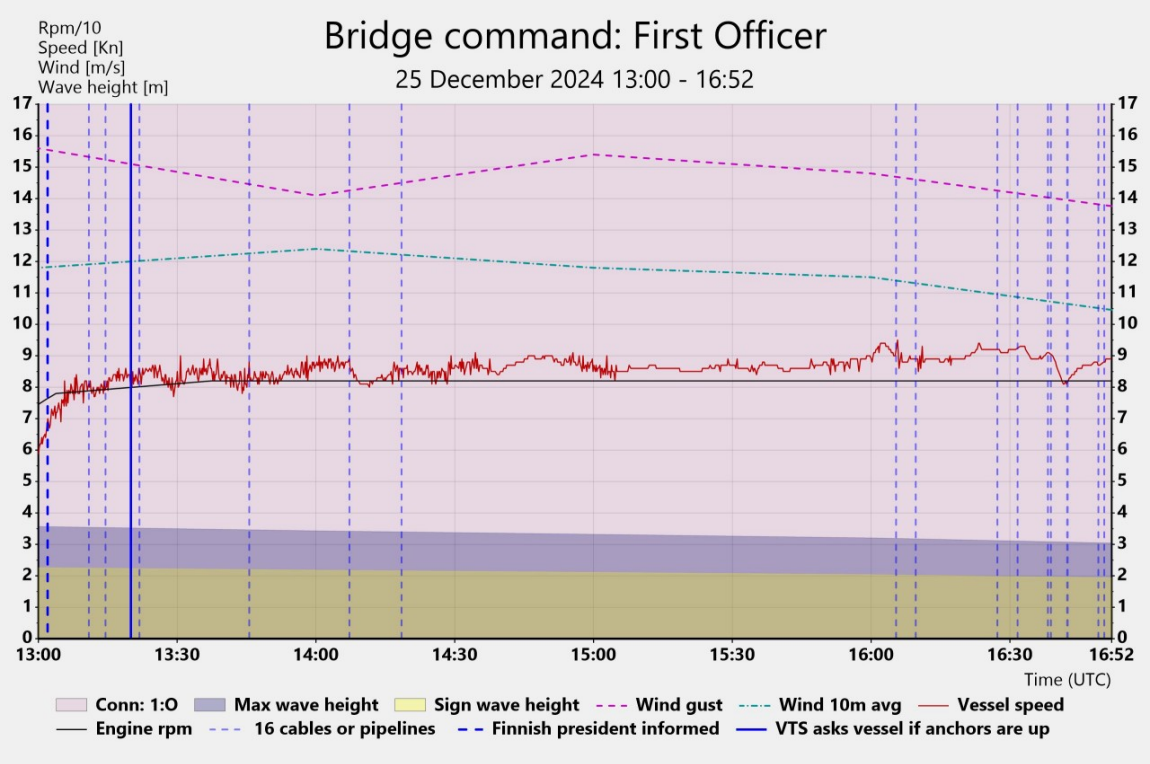
When the First Officer entered the bridge at 13:00, he was told that there had been a main engine problem that was now resolved. The subject was not discussed any further, and the First Officer went into normal duty.

It is worth noting that this was his first bridge open sea navigation watch on this vessel. The First Officer entered the ship in Ust-Luga, 11 days earlier. During the transfers to St Petersburg and Ust-Luga harbour area (for re-supplies) there had always been a Pilot on board, and/or the Master responsible for safe navigation.

At 13:20 UTC [log book], the Finnish VTS/Coast Guard contacted the vessel over VHF and asked "Your both anchors are lift off and secured?" to which the vessel replied "Yes", believing the question was part of a standard VTS Helsinki procedure, and knowing that the anchors had been lifted off and secured at the start of the voyage ½ day earlier.

During the First Officer's watch a total of 16 cables or pipelines were passed, including Finnish telecom cables.

At 16:45 the Finnish Coast Guard informed the vessel about a dragging anchor, causing the Master to take over bridge control at 16:52.



Situation during the First Officer's bridge command. 16 cables or pipelines were passed during this time period, initially Russian ones and Nordstream. At 13:20 the Finnish VTS asked the vessel if its anchors are up. At 16:45 the Coast Guard informed the vessel about a dragging anchor.

7.4.6 Cable incident day from the Master's point of view (3)

At 16:45, the Finnish Coast Guard informed the vessel about the possibility that they were dragging something. The First Officer immediately called the Master to the bridge; the Master took bridge control 2 minutes later, at 16:47 (his third bridge command of the day). Note that the graph shows a 5-minutes later bridge command handover time, 16:52. This is the handover timestamp for entry in the logbook.

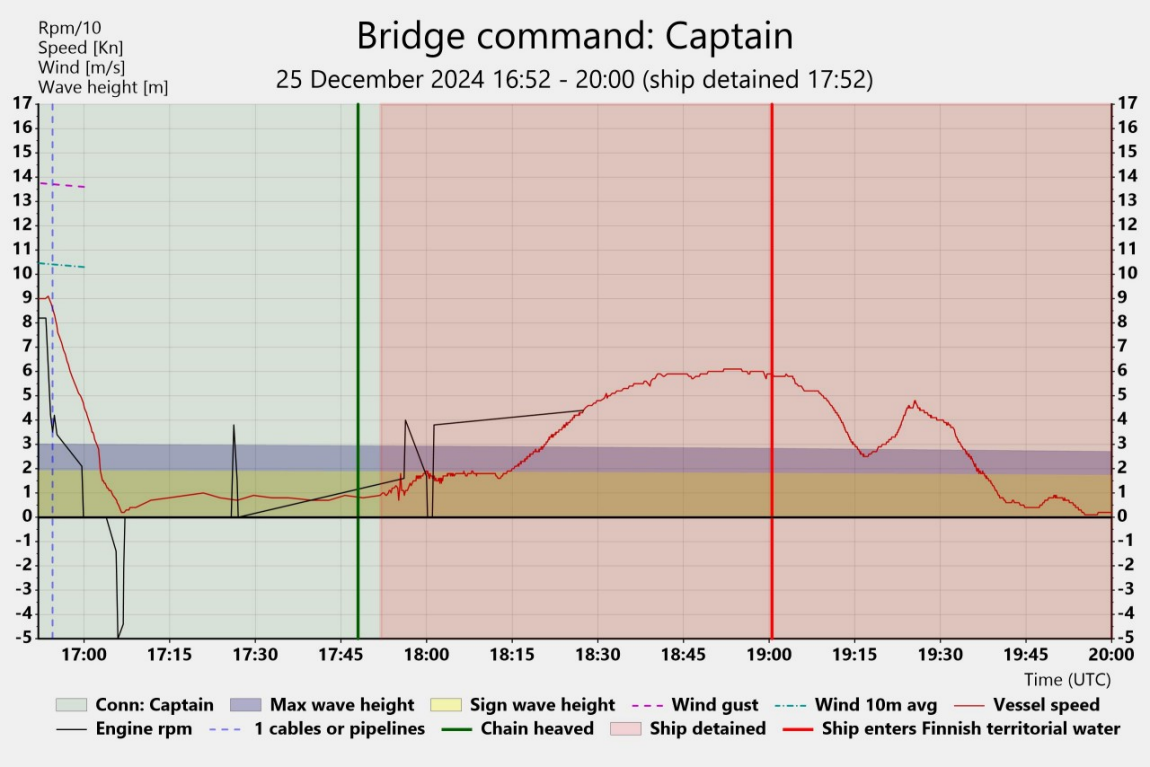
The ship began to slow down, and a team was sent to forward deck to check the situation. It was noted that the port anchor chain was out to its full length. This will be described in more detail in the next sections of this report.

By 17:15 the ship had slowed down, shut down the main engine, and commenced drifting.

At 17:48 the anchor chain was heaved up, without anchor.

At 17:52 the ship was ordered into Finnish waters by the Coast Guard and detained.

At 19:00 the ship crossed the Finnish territorial water border.



Situation during the Master's third bridge command. 1 cable was passed during this time period. At 17:45 the Finnish Coast Guard informed the vessel that its anchor chain was hanging out. At 17:52 the Coast Guard took command over the ship (red area) and at 19:00 the ship crossed the Finnish border.

7.5 The Autopilot's off-course and off-heading warnings

It has been suggested that a dragging anchor would have changed the Eagle S's heading and course significantly, and that this change could not have been undiscovered by the ship's crew.

We have investigated this by examining the AIS data.

According to the table presented in section 5.8 Onboard navigation equipment at page 22, the vessel has two Yokogawa/CMZ700D gyro compasses and an L&G Sestrel SR4 magnetic compass. The autopilot is a Yokogawa PM-208, which is an adaptive autopilot.

The equipment was, according to the table, tested monthly and daily and had “good condition” markings. The gyro spheres were changed in May 2021 and February 2023. Shore-based maintenance on them was performed in April 2024.

The off-heading alarm was set to 5°, according to the Second Officer.

The AIS data provides information about COG (Course Over Ground). COG-values are always calculated from the GPS signal.

The AIS data provides information about heading, the HDG. This is taken from a gyro compass, which is the most accurate compass on board. The HDG equals the direction of the ship’s hull.

Due to drifting, COG and HDG are rarely identical.

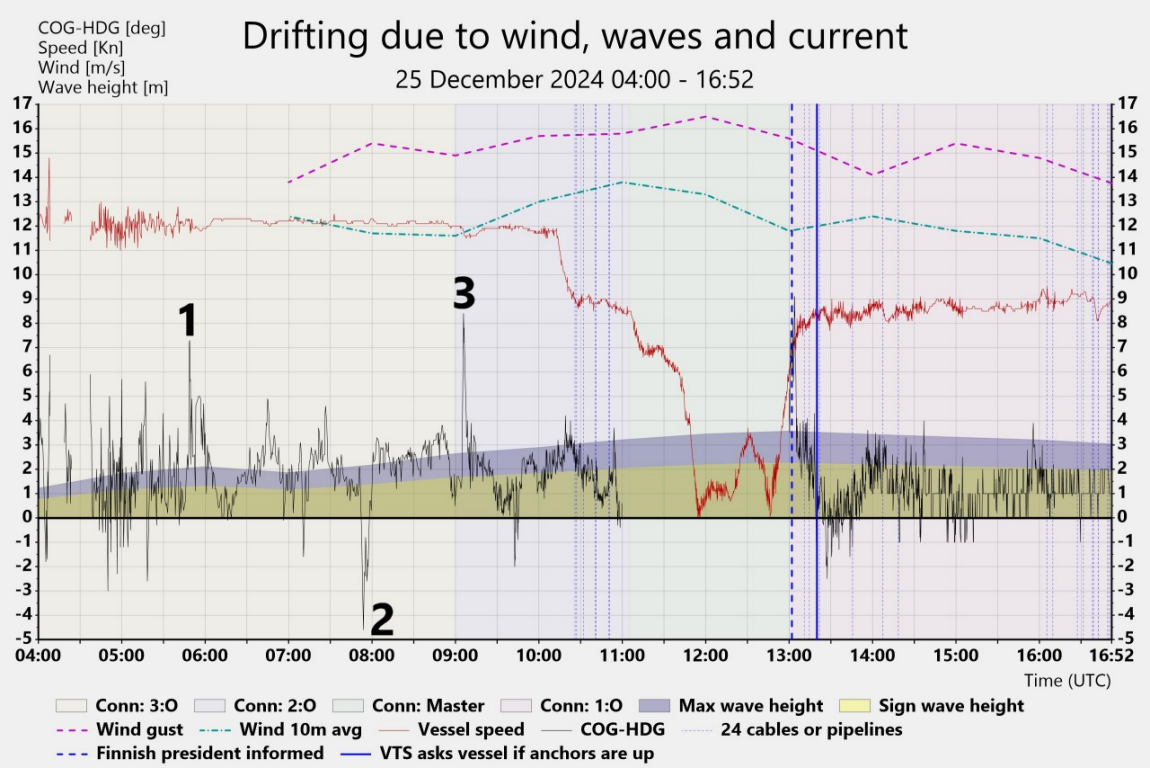
When reading the manual for the autopilot (see the web address below), we notice that the autopilot has two alarms, an off-course alarm and an off-heading alarm.

https://www.scribd.com/document/468160909/PM208-adaptive-autopilot-PT500A-series-19th-Editio111111111

- The **off-course alarm** compares the magnetic and gyro compasses, and raises an alarm if these diverge from each other too much. This would indicate a compass problem.
- The **off-heading alarm** compares the gyro heading with the calculated GPS course and raises an alarm if these diverge from each other too much. This would indicate that the vessel is drifting sideways too much.

The Second Officer has repeatedly stated that the off-heading alarm in the Autopilot was set to 5°. A value exceeding this would activate a sound alarm on the ship’s bridge. This alarm never activated, meaning that the 5° threshold was never exceeded.

The analysis is done by plotting the difference between COG and HDG in the chart below.



The source data for the Autopilot's off-heading alarm, COG-HDG is in black. The gap in the middle is when the vessel stopped to fix the main engine problem; during that time the vessel turned almost 90° and hence the line plot would go outside the chart

It can be seen from the above image that the 5° threshold was not exceeded, either before the vessel begun to drag its anchor or after the ME problem had been resolved and the vessel continued its voyage, still with a dragging anchor.

Points 1, 2, and 3 in the image occur where the vessel altered its course. Obviously, these caused a sideways drifting for a short while (some minutes) during and after. These occasions are:

1) At 05:52, 5 hours after leaving Ust-Luga, when the ship changed course from NW to SW.
2) At 07:53, immediately south of Hogland, when the ship changed course from SW to WNW.
3) At 09:05, when the vessel was approximately 10M west of Hogland and changed course from WNW to WSW.

The temporarily slightly smaller sideways drifting immediately after course alterations 1 and 3 is most likely due to the autopilot making adaptions.

Other than those, COG appears to have been some degrees higher than HDG persistently, but always less than 5 degrees higher. This matches well with the sea and wind states, which the vessel met with its port side bow. Hence, the ship's bow was at all time a few degrees more towards the wind and waves than the actual course over ground, and the HDG always a few degrees less than the COG.

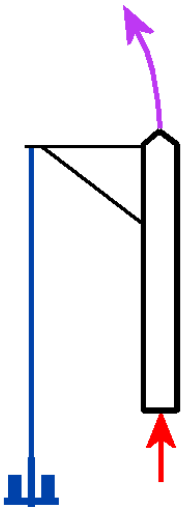
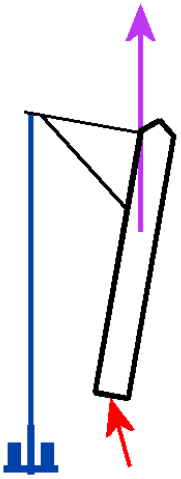
The vessel's sideways drifting was the same both without and with anchor dragging. Hence, our conclusion is that the dragging of the anchor did not have any impact on the vessel's course, and did not change its sideways drifting behaviour.

From this, it follows that the vessel's sideways drifting behaviour did not give the crew a reason to suspect that an anchor was down.

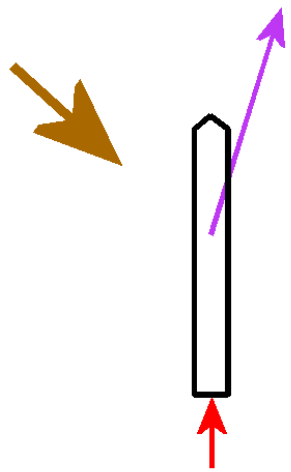
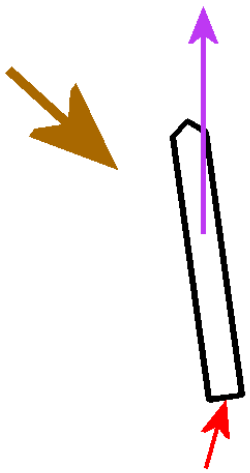
7.6 Discussion about anchor dragging vs. rudder

We want to emphasise the following.

The pictures below show a set of scenarios. Note that the drawings are exaggerated to better express the logic.

	
If a ship is dragging its port side anchor and the rudder is kept midships, <u>the ship will turn towards port</u> (shown by the purple arrow).	**By compensating with the rudder, the ship/anchor are kept in balance and the ship will advance along the desired course over ground (straight up in the picture).** **<u>Note that the rudder is turned to starboard!</u>**

Conclusion 1: A dragging port side anchor <u>demands a rudder correction to starboard</u>.

	
If there is wind and waves incoming from the port side (brown arrow), the ship will drift to starboard while advancing forward.	**By compensating with the rudder, the ship vs. drifting are kept in balance and the ship will advance with the desired course over ground.** **Note that the rudder is turned to port!**

Conclusion 2: Wind & waves from the port side demand a rudder correction to port.

By examining the AIS data, we have seen that the Eagle S had its bow, during the event hours, persistently turned a few degrees towards the wind, which demanded a rudder turn to port. The anchor drag, however, demanded a rudder turn to starboard.

This implies that the dragging anchor compensated for needed rudder angles, not the opposite. The autopilot likely achieved its course demand with smaller rudder angles.

Had the ship instead lost its starboard side anchor, the situation would have been different and the off-heading alarm **may** have triggered.

7.7 Discussion about physics and scales

It is important to understand the orders of magnitude:

- The displacement (mass) of the Eagle S vessel is 89,381 tonnes.
- The mass of the anchor is 11.1 tonnes.

The Eagle S vessel is `8,052` times heavier than its anchor.

According to the ship's chain certificate, the whole chain (both sides) weights approximately 99 tonnes. To our knowledge, the ship has 13 shots of chain on the port side and 12 shots on the starboard side, that is, 25 shots in total. One shot equals 90 feet, which is 90*0.3048 = 27.432 metres. Hence, the ship has 356.616 metres of chain on the port side, and 329.184 metres on the starboard side, 685.8 metres in total.

The chain has a weight of 144.36 kg/metre, or 3.96 tonnes/shot, meaning that there are 51.48 tonnes of chain on the port side. Together with the anchor, this makes 62.58 tonnes.

The Eagle S vessel is 1,428 times heavier than its port side anchor + chain.

For scale, if the Eagle S displaces 8.9 litres of water (approximately one bucket's worth), then proportionally:

- The weight of the Eagle S anchor would displace one millilitre of water (1*1*1 centimetre).
- The weight of the Eagle S anchor + chain would displace a cube of water with sides of approximately 1.84 centimetres.

(By same proportions, a 700 kg pleasure craft would have a 75 gramme anchor, and 109 grammes of anchor + a suggested 35 metres of chain)

7.7.1.1 How can an anchor stop a tanker?

An anchor can not stop a tanker that is under way.

The only purpose of an anchor is to make a vessel stay in its position when it is already stationary.

It is sometimes stated that "it is not the anchor but the chain that holds a vessel stationary". This is a simplified truth. **It is Earth's gravitation acting on the anchor chain that holds a vessel stationary**.

The system of anchoring has two major features:

- The chain works as a damper, or a spring; it provides elasticity between the ship and the anchor. It uses a long period of worktime to re-set the ship's position, using a small force.
- The chain geometry makes the pull on the anchor happen horizontally along the seabed, not upwards.

If a vessel is dragging its anchor, the aforementioned damping feature of the chain is already fully consumed and any further forces from the ship will act directly on the anchor. The system has lost its key functionality (the time and force transformation) and the anchor can easily be moved.

If the Eagle S anchor + chain, with a combined mass of 62.58 tonnes, had a friction coefficient of 1 against the sea bottom, it would act with an equal force on the moving vessel. To stop the vessel from a speed of 10 knots (5.144 m/s), ignoring the vessel's resistance against the water, it would imply an acceleration (retardation) of 62.58/89381 = 0.0007 m/s^2. Slowing the vessel to a complete stop would require 7,348 seconds, which is 2 hours, 2 minutes, and 28 seconds.

Although a dragging anchor does have an impact on a ship's speed, it is **imperative to understand the scaling difference between an 89,381 tonne floating object and an 11 tonne anchor / 63 tonne anchor + chain.**

8 THE ANCHORING AND MOORING ARRANGEMENT

During our inspection of the ship, the reason for the failure of the anchoring mechanics was immediately visible.

8.1 ORIGIN OF APPARATUS

From onboard documentation, the Eagle S was built by Chinese "New Century Shipyard" and her build number is 0307310.

According to a list provided by New Times Shipbuilding Co., Ltd, build number 0307310 is #196 of a long series of Panamax 73,400 DWT/85,000 CBM crude and product oil tankers: http://www.ntship.com.cn/images/file/REFERENCELIST20220110.pdf

Newbuild #222 (hull number 0307336) from the same shipyard is a tanker in the same series, built for Greece Hellespont and delivered the same year:

ITEM	SUB-ITEM	TYPE OF VESSEL	HULL NO	OWNER	OWNER'S NATIONALITY	CLASS	DELIVERY DATE	DEADWEIGHT
196	10	73,400 DWT/85,000CBM CRUDE & PRODCUT OIL TANKER	0307310	STC TANKER	GERMANY	ABS	16 March 2006	73,400
222	36	73,400 DWT/85,000CBM CRUDE &PRODCUT OIL TANKER	0307336	HELLESPONT	GREECE	ABS	18 December 2006	73,400

We have anchoring and mooring arrangement manufacturer's manual for the #222 build project, and make the assumption that an identical installation was made on the #196 build project (Eagle S) a few months earlier, as the drawings appear to match the Eagle S installation.

Several brands appear in the manual – Rolls-Royce, Rolls-Royce Marine AS, Ulstein Deck Machinery-Brattvaag, Ulstein-Brattvaag, Rauma Winches, Rauma Brattvaag.

Our impression from studying the manual is that the anchoring windlass and brake system was originally designed by Rauma-Repola. The plate mounted on the chain stopper says "Rauma-Brattvaag Deck Machinery", 2006, see section 5.10 The anchoring and mooring arrangement at page 27.

From the manual about the windlass and brake:

Cable lifter nominal load	31.8 tonnes
Hoisting speed (nominal load)	10m/min
Lowering of anchor (dynamic)	31 m/min

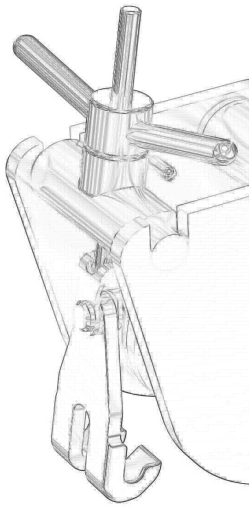
Anchor break-out(max) pull	47.7 tonnes
Chain stopper type	NP8 drawing 195-050-08
Roller type	Chain stopper with lashing device, suitable for 81mm U3 grade chain cable
Brake holding load	221 tonnes

According to drawings in the manual, it appears that the third anchor brake on the Eagle S, the devil's claw, has been replaced with a lashing wire.

We do not know the reason for this replacement, but assume it might have been because of problems in getting spare parts, or related to operability, working safety, or similar.

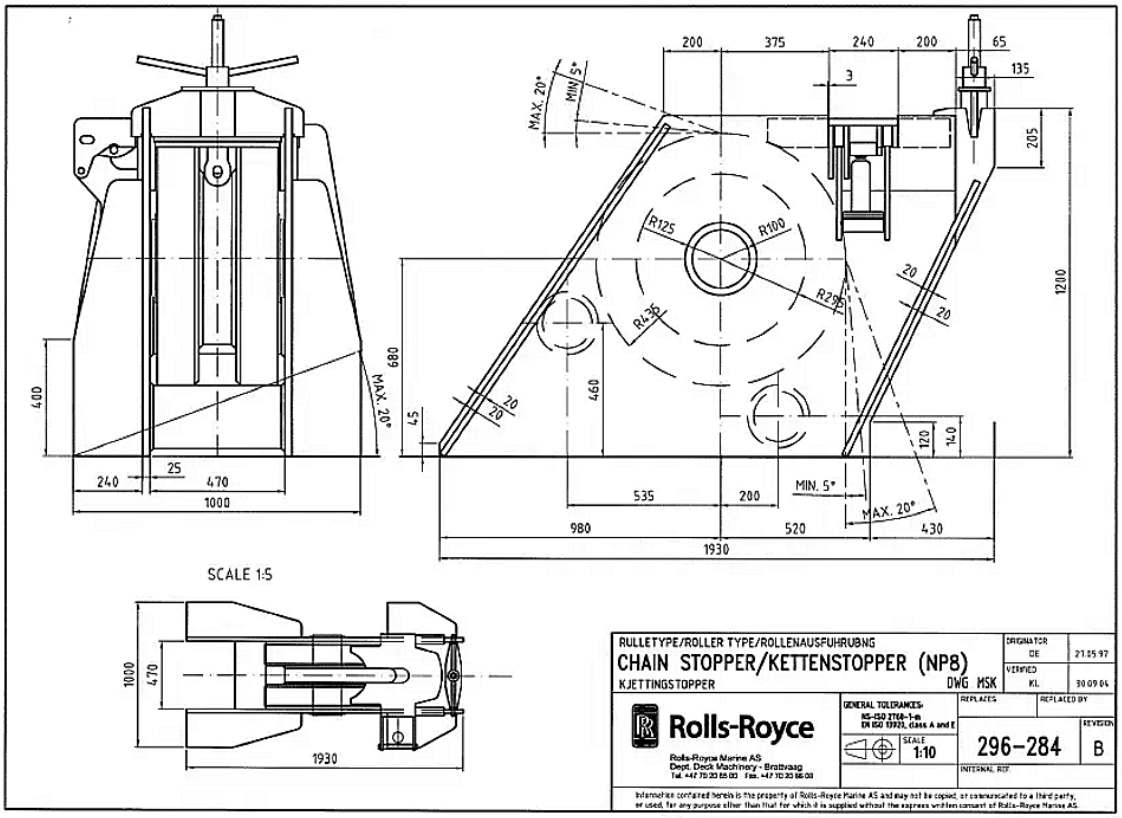
A devil's claw is a hook than hangs free in front of the main chain stopper; it hooks on to one of the anchor chain links.

A devil's claw is, in most cases, stronger than a lashing wire. However, a lashing wire is also accepted in class inspections.



Schematic picture of a devil's claw

Kongsberg, the current owner of Rauma-Brattvaag, has suggested that the locking mechanism for the Eagle S chain stopper's guillotine bar is not original. We cannot verify this, as the drawing in the manual gives no indication of a different kind of mechanism – there is none in the drawings.



Drawing of the chain stopper, taken from the aforementioned manual

8.2 REGULATIONS REGARDING THE ANCHORING AND MOORING ARRANGEMENT

1. The highest authority for ships' anchoring and mooring arrangements is the **International Maritime Organisation, IMO**: https://www.imo.org/

   IMO – the International Maritime Organization – is the United Nations specialised agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. IMO's work supports the UN sustainable development goals.

2. In 1914, in response to the Titanic accident, IMO set up the **Safety of Life at Sea convention, SOLAS**: https://www.imo.org/en/knowledgecentre/conferencesmeetings/pages/solas.aspx

   The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are

received from an agreed number of Parties.

As a result the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.

3. In 1993, IMO introduced its **ISM Code** (International Safety Management Code).

4. Since 1970, the **Oil Companies International Marine Forum, OCIMF**, has had a major role in defining industrial security standards for merchant ships, especially for tankers: https://www.ocimf.org/

   Our mission is to lead the global marine industry in the promotion of safe and environmentally responsible transportation of crude oil, oil products, petrochemicals and gas, and to drive the same values in the management of related offshore marine operations. We do this by developing best practices in the design, construction and safe operation of tankers, barges and offshore vessels and their interfaces with terminals and considering human factors in everything we do.

   Alongside an extensive publications' library, OCIMF provides a portfolio of tools and inspection programmes used by vessel owners, operators, managers and charterers worldwide to enhance the safety of their operations. This includes the Ship Inspection Report (SIRE) Programme, Offshore Vessel Inspection Database (OVID) and the Marine Terminal Information System (MTIS).

   The OCIMF holds a consultancy status at the IMO.

5. Prior to 2018, the IMO/SOLAS regulations, and, to some extent, the OCIMF standards, used to be to partially unclear and/or easily misunderstood by ship owners.

6. In June 2018 the OCIMF released the 4th edition of its **Mooring Equipment Guidelines, MEG4**: https://www.ocimf.org/publications/books/mooring-equipment-guidelines-meg4 and https://safety4sea.com/cm-ocimf-mooring-equipment-guidelines-meg4-an-update/

8.2.1 IMO regulations regarding the windlass brake capacity

General information:

https://www.classnk.or.jp/hp/pdf/tech_info/tech_img/T1304e.pdf
https://www.imo.org/en/ourwork/safety/pages/safemooring.aspx
https://puc.overheid.nl/nsi/doc/PUC_1875_14/
https://wwwcdn.imo.org/localresources/en/Documents/MSC.1-Circ.1175-Rev.1.pdf
https://www.classnk.or.jp/hp/pdf/tech_info/tech_img/T1304e.pdf

IMO states in its "*Classifications Register Rules and Regulations - Rules and Regulations for the Classification of Special Service Craft, July 2022 - Part 3 General Requirements and Constructional Arrangements - Chapter 5 Anchoring and Mooring Equipment - Section 8 Anchor windlass design and testing*" document about the windlass brake as follows.

Above document, section 8.4 Windlass design, 8.4.1, paragraph f:

Brake Capacity: The capacity of the windlass brake is to be sufficient to stop the anchor and chain cable when paying out the chain cable in a controlled manner. ***Where a chain cable stopper is not fitted, the brake is to produce a torque capable of withstanding a pull equal to 80 per cent of the specified minimum breaking strength of the chain cable without any permanent deformation of strength members and without brake slip. Where a chain cable stopper is fitted, 45 per cent of the breaking strength may instead be applied.***

https://www.imorules.com/SSC_PT3_CH5_8.html

The same document specifies the security factor as follows (section 8.4 Windlass design, paragraph c):

The anchor masses are assumed to be the masses as given in Table 5.6.1 Chain cable. The value of Zcont is based on the hoisting of one anchor at a time, assumes that the effects of buoyancy and hawse pipe efficiency (assumed to be 70 per cent) have been accounted for. ***In general, stresses in each torque-transmitting component are not to exceed 40 per cent of yield strength*** *(or 0,2 per cent proof stress)* ***of the material under these loading conditions****.*

More content can be found at, for example, Scribd:
https://www.scribd.com/document/410733205/Windlass-Brake-Capacity

8.2.2 OCIMF standard regarding the windlass brake capacity

Safety4Sea discusses these matters in its "Mooring operations in the spotlight: SDMBL vs MBL article by The Editorial Team August 17, 2023 in Maritime Knowledge, Safety":

https://safety4sea.com/mooring-operations-in-the-spotlight-sdmbl-vs-mbl/

The Ship Design MBL (as per OCIMF MEG-4 and IMO Circ. 1175 rev.1) has brought the structure base for all fittings and lines used on board. Additionally, the LDBF (Line Design Break Force) means the minimum force that a new, dry, spliced, mooring line will break at, has set the upper limit to the strength of a line used on board.

Winches have to be set to have Operational brake holding load at 60% of Ship Design MBL. ***However, if the operator sets the operational brake holding load to 60 % of MBL of the lines used on board and the lines have significant higher MBL than required by SDMBL, then serious hazards may occur****.*

8.2.3 Conflict within the regulations

There is a level of confusion among the regulations. Rightship.com makes a fair statement in its "Lessons Learned: What is render testing? (14 September 2020)" article at https://rightship.com/insights/what-is-render-testing

"It is imperative therefore, that Brake Holding Capacity test calculations must be based on the SDMBL and not the Line MBL."

and

"The tanker industry recommends that the Brake Holding Load (ie render setting) be set at 60% of the SDBML ..."

The Finnish insurance company Alandia states in its "Safe Anchoring Published: 2020-10-26" article at https://alandia.com/article/safe-anchoring/

Windlass brake design loads:

45% of chain breaking load when a chain stopper is installed.

80% of chain breaking load when no chain stopper is installed

8.2.4 IMO demands for anchor windlass brake's BRC repeated

According to IMO information, it is stated for the anchor brake system that:

- **if the system is equipped with a guillotine bar brake (a "chain stopper"), the brake's rendering limit shall be 45% of the anchor chain strength.**
- **if the system is not equipped with a guillotine bar brake, the brake's rendering limit shall be 80% of the anchor chain strength.**

8.2.4.1 *DISCUSSION ABOUT THE GUILLOTINE BAR LOGIC*

*A guillotine bar brake is "absolute" – **it cannot, by definition, render**. Hence, its strength equals the total mechanical strength of the device itself. In terms of logic, it has no connection to a band brake (which does allow rendering). A guillotine bar either brakes or does not brake, but **there is nothing in between**.*

8.2.5 Calculation: Solve band brake's braking capability

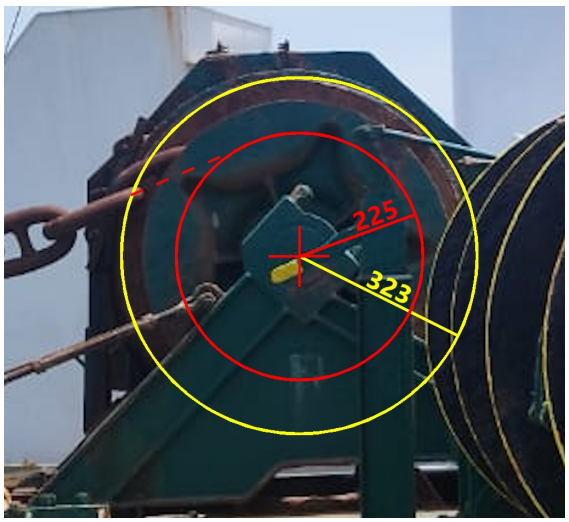
The Eagle S has an 81mm stud-linked U3 grade anchor chain. According to the ABS certificate supplied in 2021, this chain has a breaking strength of 492 tonnes:

- 80% of 492 tonnes is 393.6 tonnes
- 45% of 492 tonnes is 221.4 tonnes

As we do not have exact measurements for the individual components of the windlass band brake, we must make approximations from drawings and pictures. These will be sufficiently accurate.

The image to right shows the radiuses of the band brake (yellow, 323px) and the assumed alignment of the chain along inner wheel's pockets and whelps (red, 225px).

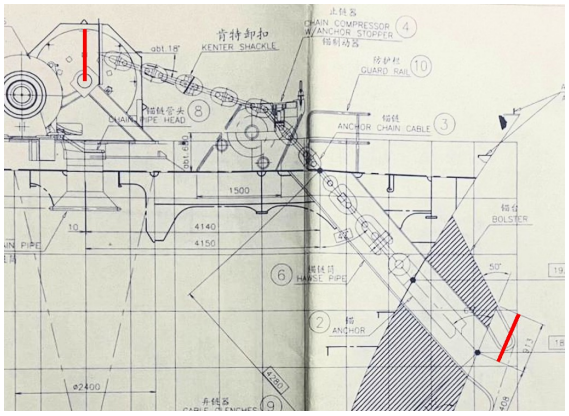
If we know either of the radiuses in metric units, we can solve the other one.



From the image to right, we get the radius for the band brake - the top red line - as a copy of this line exactly matches a given measurement of 91.3 cm, at bottom/right.

From this follows that the inner part of the gypsy wheel has a radius of 91.3*225/323 = 63.6 cm.

A 221.45 tonne chain pull would then create 0.636*221.45 = 140.8 tonnemetres rotational torque in the gypsy wheel.



Continuing the calculation, we can solve the circumference of the band brake drum, this will be 3.14*91.3*2 = 573.6 cm. Using an estimated band width of 15 cm, we get a surface area of 573.6*15 = 8604.8 cm^2. This is the area that is supposed to hold (with friction and pressure) a force of 221.45 tonnes, this equals **25.8 kg/cm^2**.

We compare this to a drum brake with a known render capacity, found at web pages of BMA Mitsubishi Alliance, at https://www.bhp.com/-/media/project/bhp1ip/bhp-com-en/documents/about/our-business/minerals-australia/hpct/2024-hpct-brake-render-testing-guidelines.pdf

From there, we find a model case, where a band brake with a diameter of 50.8 cm is set to render at 36.4 tonnes.

Calculating as above, and using an estimated band width of 10 cm, we get a load force of **22.8 kg/cm^2** for this model case.

As the values 25.8 and 22.8 are near each other, we conclude that the Eagle S windlass band brake's ability to hold a chain pull force of 221.45 tonnes **is realistic.**

8.2.6 Calculation: Solve the strength of the windlass' attachment to the deck

The windlass, with its band brake, is attached to the deck with 8 bolts which appear to be M24. There are two bolts in each corner of the windlass base.

From https://www.imorules.com/LRSHIP_PT3_CH13_8.html about attaching the windlass to deck with bolts:

> *8.13.6 Tensile axial stresses in the individual bolts in each bolt group i are to be calculated. The horizontal forces F xi and F yi are normally to be reacted by shear chocks. Where 'fitted' bolts are designed to support these shear forces in one or both directions, the von Mises equivalent stresses in the individual bolts are to be calculated, and compared to the stress under proof load. Where pourable resins are incorporated in the holding down arrangements, due account is to be taken in the calculations.*
>
> *8.13.7* ***The safety factor against bolt proof strength is to be not less than 2.0.***
>
> *8.13.8 Bolts are to be of ISO 898/1 material* ***Grade 8.8, 10.9 or 12.9*** *or equivalent and are to be* ***pretensioned by controlled means to 70 to 90 per cent of their yield stress****. Pretensioning is to be in accordance with the manufacturer's instructions and, in general, pretensioning by bolt torqueing up to bolt size M30 may be used. Beyond this, pretensioning is to be carried out by an hydraulic tensioning device and the elongation of the bolts measured to determine pre-load. Where resin chocks are proposed plans and calculations are to be submitted for consideration.*

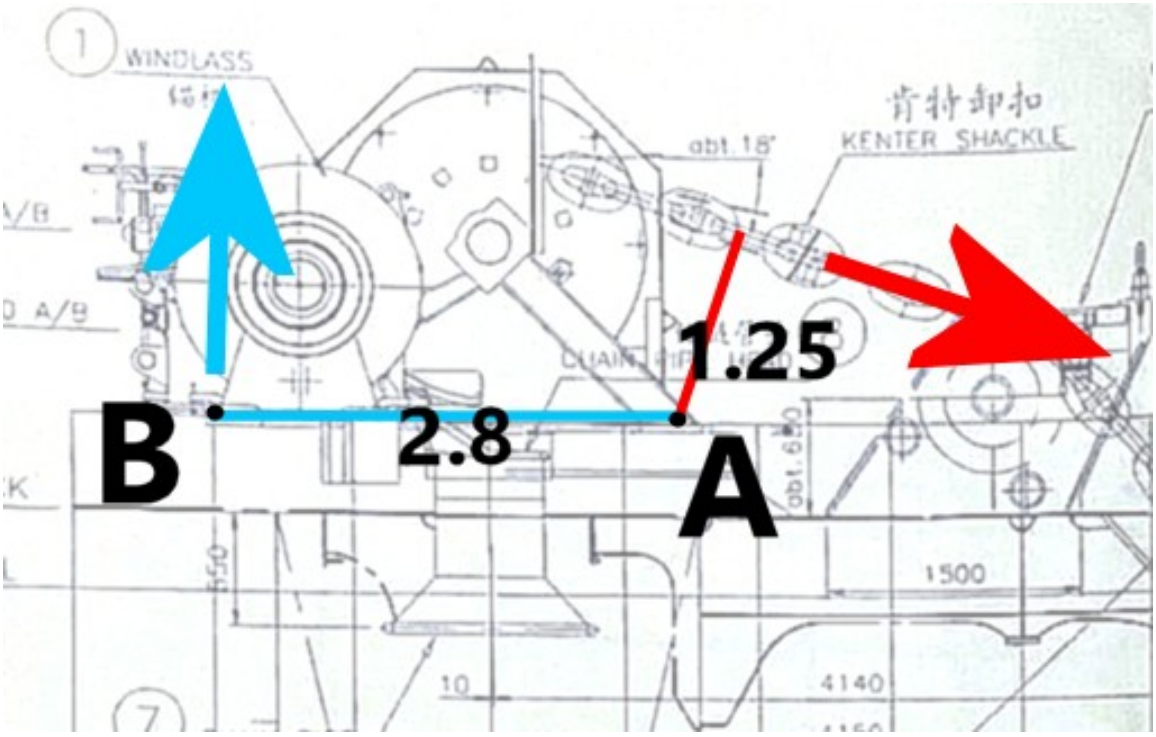
According to https://www.nfgab.se/teknik-och-kvalitet/tekniska-sidor/hallfasthet/metriska-grovgangor, their M24 bolt of grade 10.9 has a **proof strength of 32.4 tonnes**, which makes a total of **130 tonnes for 4 bolts**.

The chain (red arrow in the image below) aims at rotating the windlass frame around the frame's front attachment point to deck, point A. This causes a torque arm which aims at lifting point B, and thus burden its attachment to deck. A 221.4 tonne chain pull (45% of the chain breaking strength) would cause a 221.4*1.25/2.8 = **99 tonnes** lifting force on point B (the blue arrow).

Disregarding the pre-tension demand for the bolts, and disregarding shear stress onto the bolts, the IMO rules require a safety factor of no less than 2.0 against proof strength. This implies that the 4 bolts should be able to withstand a **198 tonne** pull force. This clearly exceeds their combined proof strength of **130 tonnes**, hence it seems that a chain pull force of 221.45 tonnes on the windlass band brake is **not realistic**.

We make a note that

- **The windlass band brake itself can withstand a chain pull force of 45% of the anchor chain strength.**
- **It is uncertain whether the windlass' attachment to the deck could withstand a chain pull force of 45% of the anchor chain strength.**



The chain pulls with a force F. This creates a torque 1.25*F around point A, which causes a lift force 1.25*F/2.8 on point B. The frame's own weight is negligible in the calculation.



Two of the four 24-mm bolts that attach the rear end of the windlass frame to the deck

8.2.7 The logic of the SDMBL standard

1. In case of an unintended, extreme physical (over)load acting on a ship (for example, in a harbour during a storm) there will be an "intentionally first failing component" – the weakest component.
2. This component should not be part of the harbour itself, as
    1. Standards cannot be set by a single vessel type, because the harbour serves multiple different vessel types.
    2. It is more relevant that the harbour remains intact than that the vessel remains intact.
3. Hence, the first failing component must be a mooring line, an anchor chain or a brake or bollard on board a vessel.
4. The selection between line/chain and brake happens as follows:
    1. If a mooring line or anchor chain is allowed to fail first, the failure is definite – **a line or a chain can only fail once (it breaks), after that it is redundant and can no longer serve the whole.**
    2. If a brake fails, it can still happen intentionally, that is. by allowing it to render (slip). In this case, the brake works as a damper **but still remains intact**. It is likely that the condition of extreme physical (over)load is only temporary, hence no persistent damage incurs to any parts of the total constellation, and **the brake can perform again**.

Reasoning

1. The above considerations imply that the IMO and OCIMF demands may **raise questions or misunderstandings**.
2. The band brake **did render too early** once the chain stopper had failed.
3. The IMO regulation if connecting the band brake's BRC to the presence of a chain stopper is **illogical**. From the band brake's point of view, it does not matter if there is a chain stopper present or not:
    - If there **is** a chain stopper, the band brake **never encounters any chain pull force**.
    - If there **is not** a chain stopper, **100% of the chain pull force is put on the band brake**.

    Yet, IMO rules bind the demanded BRC of the band brake (either 80% or 45% of the chain strength) **to the presence of a chain stopper**.
4. The band brake as such **would** withstand a load force of 45% of the chain strength, but it is **unlikely** that the brake's attachment to the deck withstands such a force.
5. We have no information about **possible changes** to, or **retrofittings** on, the windlass brake. Nothing implies that there would have been any such.
6. The ship was in dry dock between 5 April and 1 June, 2024. According to Dry Dock reports, the brake bands on both windlass brakes **were renewed**, and the brakes **were calibrated**.
7. IMO defines that the anchoring brakes shall be thoroughly serviced with **4-5 year intevals**.
8. Since 19 August, 2024, the anchor had been used **10 times**.
9. During the dry docking, an ABS (American Bureau of Shipping) surveyor **inspected the anchoring and mooring arrangement**.
10. There is a text on the cover of the windlass band brake:
    BRC -38.4T
    SDMBL -64T
    Tested on -
    07 JUN 2024
11. The band brake **did render too early**, at an estimated chain force of 17 tonnes.
    - If it was calibrated to render at 221.45 tonnes, it rendered 13 times too early. This seems **unrealistic**.
    - If it was calibrated to render at 38.4 tonnes, it rendered 2.3 times too early. This seems **realistic**.

Conclusion

We suggest that the windlass band brake may have been erratically calibrated during the most recent dry dock visit in the summer 2024, possibly due to a

misunderstanding of IMO/OCIMF regulations. Otherwise it would not have rendered.

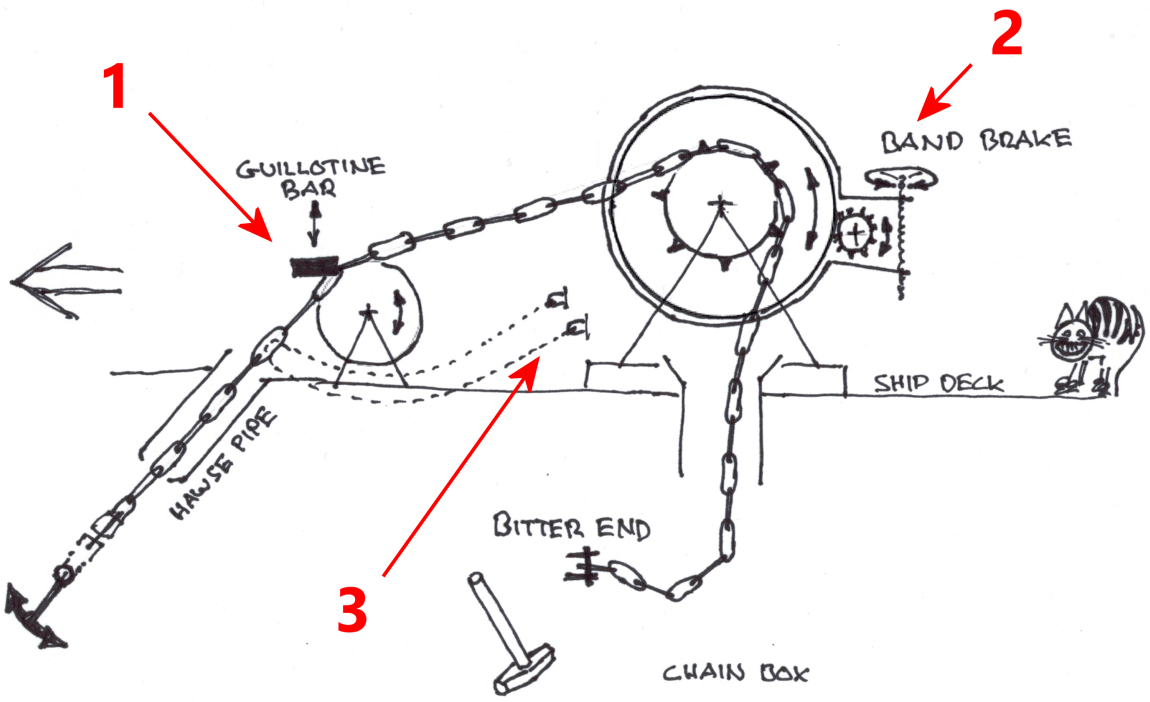
We bring in this parameter as a possibility, not an assumption.

We have investigated the dry dock reports and found no further information. These reports contain person data and will not be published with this report.



Texts on the port side of the post windlass/anchor band brake

8.3 THE WINDLASS AND ANCHOR BRAKE SET



Schematic drawing of the anchoring arrangement. The Eagle S has two identical (mirrored) arrangements, port and starboard. The three brakes are marked with numbers.

The image above describes a typical anchoring arrangement logically. To our knowledge, numerous big merchant ships use a logically similar construction.

The wheel to the left can rotate freely. The larger wheel to the right is driven by a hydraulic engine via the small cogwheel next to (outside) it; the small wheel is rotated by a hydraulic engine via a dog clutch.

Inside the big wheel is a smaller one (gypsy wheel) with a surface shape that matches the chain links. These shapes grip on every other chain link, hence the chain cannot slip against this wheel. This inner wheel is welded to the big wheel, so they are synchronised.

The system has three brakes:

1) The guillotine bar, acting mechanically on the chain, blocking it.
2) The band brake, which tightens around the big wheel and acts on it by friction.
3) A lashing wire that goes through a chain link; the wire ends are fastened to the windlass frame. The implementations of this brake vary, but they are based on having a wire or a shackle going through a chain link.



The port side anchoring arrangement



The port side anchoring arrangement

1 ***8.3.1 Pictures of brake 1: The guillotine bar (“chain cable stopper”)***



The guillotine bar with its counterweight to left (yellow)



The guillotine bar with its counterweight to left (yellow)



The turnbuckle holding down the guillotine bar being opened. A tool is required, because of the turnbuckle's rotational resistance.



Turnbuckle partially lose; the anchor chain has been pulled back approximately 10cm to release the guillotine bar



The guillotine bar being lifted up. Notice the deformed corners.



The contact point between the guillotine bar and a chain link



The guillotine bar closed again. We find the design to be inherently dangerous, for reasons discussed in section 9.1.2 Problematic design of the chain stopper at page 122.

8.3.2 Pictures of brake 2: The band brake



The brake band, inside the green metal frame vertically in the middle of the picture



The band brake, front (ship bow) side



The tightening mechanism of the band brake (the smaller cogwheel that provides rotation from the hydraulic engine seen up/right)



Opening the band brake requires strength and is preferably a two-man job, although one person could open it alone



Band brake in semi-open position



Band brake in fully open position



Starboard side band brake mechanic in fully closed position. The Brake Rendering Capacity, BRC, is adjusted at the shipyard (the last time this was done was in summer 2024); the deck crew always tightens the brake to maximum.

8.3.3 Pictures of brake 3: The anchor lashing



Anchor lashing ends, attached with turnbuckles to the windlass frame. The other end of the lashing is behind the larger cog wheel's cover.



Anchor lashing; the wire goes through a chain link in front of the guillotine brake's frame

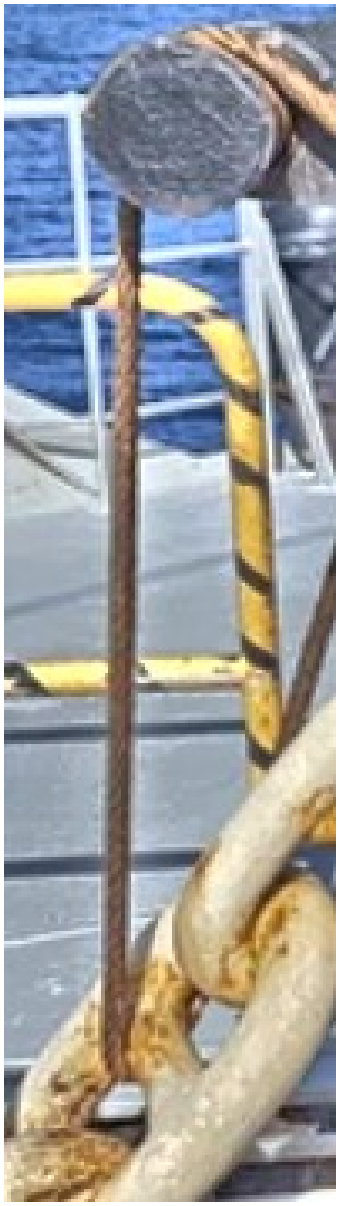


The anchor lashing seen from the front

The four pictures below, copied from the internet, show lashing wire implementations on some other ships.









Lashing wire implementations on some other ships [copied from the internet]

8.4 ANCHOR HANDLING

8.4.1 Lifting the anchor

The process of securing an anchor for sea from anchor down is as follows:

1. Ask permission from bridge to power up the windlass hydraulic motor; the bridge must confirm that there is enough power available.
2. Power up the anchor windlass hydraulic motor, wait approximately 5 minutes to let the hydraulic oil warm up.
3. Rotate and engage the dog clutch, take weight onto clutch.

4. Release band brake.
5. Heave up cable slightly to remove any weight on guillotine and raise guillotine.
6. Start heaving up anchor.
7. Bring anchor fully home, hard-up against ship's side.
8. Apply and tighten band brake.
9. Apply guillotine bar and secure it in closed position by applying turnbuckle and tighten with a steel bar (that is, bar-tight not hand-tight).
10. Give slack between the chain lifter and the guillotine bar brake to avoid having tension on the band brake, tighten the band brake again.
11. Take weight off the dog clutch and de-clutch so that the cable-lifter is out of gear.
12. Apply and secure wire lashing through chain link above hawse pipe.
13. Apply and secure spurling pipe covers.

We have sought confirmation on point 10 and found it on several places, for example the earlier mentioned Finnish insurance company Alandia's "Safe Anchoring Published: 2020-10-26" article at https://alandia.com/article/safe-anchoring/:

Anchoring Best Practices

Consider the following for safe and successful anchoring operations:

- ***Once the anchor is confirmed, and holding, give slack between the chain lifter and the chain stopper (if fitted) to avoid direct jolts to the windlass brake.***

According to the Eagle S crew, this technique was used.

9 EVENT DESCRIPTION OF INCIDENT TIME

The description below is written by maritime investigators in the United Kingdom, and quoted upon agreement with them.

Notes to the text:

- "Captain" and "Master" are synonyms. We have used "Master" elsewhere in this report.
- The text was written on 14 April, 2025. Since then, additional information has become available.
- The text uses UTC+3 (Russian time).

After clearing the berth after 0400 on 25 December 2024, the Master called the forward mooring party aft to stand by in the messroom as the pilotage was expected to take about 2 hours. Around 0530 the Captain told the Chief Officer that the pilot would be disembarking around 0600 and to prepare the pilot ladder on the starboard side. The Chief Officer went out on deck with the Bosun and 3 OS. While the 3 OS started bringing out and rigging the pilot ladder the Chief Officer and Bosun went forward to the bow. It was still dark at this time.

The Chief Officer and Bosun started applying the wire lashings to the anchor chains. In all other respects, the anchors were secure for sea. As they were doing this, the Captain advised the pilot would be leaving soon so the Chief Officer sent the Bosun aft to supervise the pilot ladder rigging while he finished off applying the wire lashings. He then went to the starboard pilot boarding station and was there while the pilot disembarked.

At that time, there were still fibre mooring ropes on deck that needed to be stowed under deck, covers needed to be put on the wire mooring ropes on the drums and the spurling pipe covers needed to be fitted and secured. The Chief Officer decided these tasks could wait as he and the deck crew were very tired from the loading and port activities starting 21 December 2024. After the pilot ladder was brought in and stowed, the Chief Officer knocked off the daywork deck crew for the rest of the day. The Bridge was manned by the Captain, Second Officer and AB/Helmsman on departure. The sea passage was commenced at 0700 with the main engine set to about 85 RPM. The Third Officer relieved the Second Officer as OOW and the Master handed over the conn to the Third Officer, also at about 0700. The vessel's passage plan was to OPL Port Said, with a call at OPL Skagen for bunkers, stores and waste and sludge disposal.

At 1200 the vessel was making good a course of about 278° and a speed of about 12kn. The main engine RPM was about 84-85. The vessel was following the west-bound lane of the TSS off Hogland.

The Second Officer took over the bridge watch at 1200. The vessel's autopilot was engaged. There was a duty AB on the bridge. The bridge wing doors were closed. Both ECDIS and 1 radar were operating.

The Second Officer recalls that the sky was overcast with some drizzle but good visibility. The wind was SW'ly force 4-5 and sea conditions were moderate

Shortly after taking over the watch, around 1205, the Second Officer started altering course onto a heading of about 245° using the autopilot.

Sometime after this alteration of course, the Second Officer observed that the wind had increased to W'ly force 6 and the sea conditions became rough, with 2-2.5m seas. The vessel began pitching easily, with occasional wave impacts causing spraying over the bow.

We note from the AIS data we have obtained that the vessel's speed appears to have been unaffected by any deterioration in the weather until about 1254, when the vessel's speed over the ground dropped from 12kn to around 11.7-11.8kn, occasionally back to around 11.9kn.

At about 1313, the AIS data shows the vessel's speed over the ground started to decrease significantly, such that the vessel was making just under 9kn by about 1326. We believe that this indicates the vessel's port anchor started dragging on the seabed from about 1313. The ENC shows the seabed in the area is comprised of mud and clay with a depth of about 40-50m. This in turn indicates that about 2 shackle lengths of cable paid out before the vessel started dragging her anchor on the seabed.

At about 1326 the vessel crossed over the Estlink-2 submarine cable. Had the full length of the starboard anchor cable paid out by this time, we estimate the anchor would have been dragging up to about 100m astern of the vessel's GPS antenna. We further estimate the port anchor would have trawled over the cables no more than about 30 seconds later. The EAGLE S was making about 9kn at the time.

Very shortly after, the vessel passed over a Russian submarine power cable followed by a Russian telecommunications cable. Between about 1345 and 1400, the vessel passed over 2 pairs of Nordstream pipelines. The vessel's port anchor and cable were dragging on the seabed throughout this time.

At about 1405, the Second Officer heard the engine telegraph movement logger printer operate and noted that the main engine RPM had dropped to 75 from 84-85. He called the Captain to the bridge. The Captain told the Second Officer to reduce the engine telegraph demand to match the actual RPM then telephoned the Engine Room Control Room and spoke to the Chief Engineer. The Captain asked what was wrong and the Chief Engineer said he would call back in a few minutes.

After 1or 2 minutes the Chief engineer called back and asked if the main engine could be stopped. The Captain checked the navigational situation and moved the vessel to the north, away from the TSS they were approaching while reducing speed. The main engine was stopped at about 1450 and the vessel commenced drifting. The vessel was contacted by Finnish VTS and the Captain told them he needed to stop for a short while.

At some point, the Captain was told by the Chief Engineer the problem was automatic operation of the main engine governor. Various attempts were made to increase the main engine RPM above the critical RPM range (45-52, with 52 being dead slow ahead) but it was not until about 1550 that the vessel got underway again. Full ahead was rung at about 1555.

The Chief Officer took over the watch at 1600 and the Captain left the bridge. The Chief Officer gradually increased main engine to about 82 RPM, which was achieved shortly before 1630

After handing over the watch to the Chief Officer at 1600, the Second Officer remained on the bridge to do paperwork. There appears not to have been any material change in the weather and sea conditions since about 1300.

At about 1620-1630, Finnish VTS called the vessel by VHF radio. The Second Officer answered the call as he was closest to the VHF set at the time. The VTS asked, "Are your anchors secure?" The Second Officer looked at the Chief Officer, who had come to stand nearby, who immediately said, "Of course." The Second Officer then confirmed to the VTS that yes, the anchors were secure. VTS acknowledged and ended the call. It is important to note here that both the Chief and Second Officers recall that it was a simple question and it did not imply that the securing of the anchors should be checked or that the VTS requested that they were checked.

The Chief Officer had not sailed in the Baltic before and he assumed that the VTS enquiry was regarding the anchors was routine and specific to Finnish VTS. However, the VHF call did serve to remind the Chief Officer that the spurling pipes had not been fitted or the mooring ropes put down below. The daywork deck crew had not been required for work since 0630 that morning but the vessel was expecting freezing air temperatures overnight. Around 1700 the Chief Officer decided to call the Bosun to the bridge. He instructed the Bosun to go forward with the 3 OS to put on the spurling pipe covers and to cover the wire mooring ropes on the drums.

Meanwhile, the Captain and Chief Engineer had called the vessel's Technical Superintendent on the Captain's mobile phone from his cabin to report and discuss the main engine governor issue. The Chief Engineer advised that the governor needed to be attended to when the vessel reached OPL Skagen but for now the governor was operating automatically and if necessary could be operated manually.

After speaking with the Technical Superintendent the Captain and Chief Engineer continued talking. At some point the Captain saw the Bosun pass his cabin on the way to the OS cabins. The Captain asked the Bosun what he was doing. The Bosun explained the Chief Officer's instructions to him. The Captain looked out of his cabin window and saw it was getting dark and there was spray coming over the bow. The Captain told the Bosun that the work could wait until the next day. The Captain then telephoned the bridge and told the Chief Officer he had countermanded his instructions to the Bosun.

The rest of the Chief officer's bridge watch up to about 1950 continued normally, although the vessel's speed over the ground was 8.5-9.0kn. The Chief Officer put this down to the weather and the slightly lower main engine RPM.

At some point late in his bridge watch, the Chief Officer observed an unidentified vessel, which it appears was not broadcasting AIS data, approach the EAGLE S's starboard side from the north, passing around her stern than taking up station on her port beam at a range of about 0.1-0.2 miles. At about 1950, the vessel called the EAGLE S on VHF radio and identified herself as a Finnish Coast Guard/Border Force vessel . The Coast Guard vessel stated, "you are dragging something on your port bow." The Chief Officer asked the Coast Guard vessel to approach closer to the bow to identify what was being

dragged. The Chief Officer believed they had perhaps fouled a fishing net. The Coast Guard vessel approached and used her searchlight to illuminate the port side hull at the bow. After a few minutes, the Coast Guard vessel advised, "you are dragging your own anchor".

The Chief Officer did not respond to the Coast Guard vessel but immediately called the Captain. The Captain came to the bridge and took over the conn and communications with the Coast Guard vessel. the Third Officer arrived on the bridge to take over as OOW while the Chief Officer called the Bosun to go forward with him to check on the anchors.

The Chief Officer arrived at the bow first. He looked over the port side of the bow and saw the anchor cable in the water leading aft, along and in contact with the port side hull, with a slight catenary in the cable (the Georgian officers describe this as a "banana"). The Chief Officer reported by handheld radio to the Captain who started slowing the main engine and stopping the ship. The Captain told the Chief Officer not to touch anything until the scene could be photographed. He said he would send the Deck Cadet forward with the ship's camera. In the event, the Deck Cadet used his own mobile phone camera to take photographs of parts of the anchor securing arrangements as identified and directed by the Chief Officer.

The Bosun and daywork deck crew arrived and the bridge switched on the foremast deck lights. One of the first things the Chief Officer notice was that the wire lashing for the port anchor chain was broken and lying in 2 pieces either side of the guillotine chain stopper. The outer ends were still shackled to the windlass frame.

The Chief Officer noted that the guillotine was still in the closed position and the securing turnbuckle was still attached, but it was loose and the guillotine could be lifted up by about 4-5 centimetres. He then noticed that the turnbuckle pin that secured the lower jaws of the turnbuckle to the deck pad-eye, was disengaged from one side of the jaws. It appears that the steel pin was a simple round pin and not threaded. To secure it in place there was a hole in the end for a split pin. The top and bottom or the split pin had sheared off, showing bright metal where the section of split pin remained in the hole in the turnbuckle pin. He also saw the threaded pin of the shackle at the upper end of the turnbuckle was bent upwards.

The Captain stopped the main engine around 2000 and ordered the Chief Officer to heave in the anchor. The Chief Officer realised that most if not all of the 13 shackle lengths of cable attached to the port anchor had run out. The anchor cable was raised by about 2100. The anchor and fittings below the anchor swivel were missing and the Chief Officer reported this to the Captain who in turn reported this to the Coast Guard vessel and to his vessel's Technical Department. The Coast Guard vessel had been in attendance throughout and had kept her searchlight trained on the vessel's port side hull at the bow.

After the anchor cable was brought home, the Captain got his vessel underway again. He contacted the Coast Guard vessel and informed her that he was resuming passage. He thanked the Coast Guard for their assistance. However, shortly after the Coast Guard vessel instructed the Captain to turn back onto a course of 025° and the follow their further directions. The Captain queried the Coast Guard vessel and asked those on board to explain their intentions but they simply responded to follow their instructions. The

Captain contacted his Technical department and after some discussion was advised to cooperate with the Coast Guard and to follow their instructions. Despite repeatedly seeking clarifications and assurances regarding their intentions, the Captain received no information. Finally, he was ordered to a location where he was instructed to anchor so that the Coast Guard could speak to him. At about 2330, the Captain anchored his vessel by 4 shackles of his vessel's starboard anchor in the given position.

9.1 Anchor, chain and brake dynamics during the failure

9.1.1 Brakes not acting simultaneously

When the anchoring arrangement is secured for voyage, the guillotine brake takes (as intended) the full burden of the anchor weight, for the reasons described in this section.

9.1.1.1 Chain slack releases burden on band brake

The chain between the chain stopper and the band brake is slightly loose, according to the recommendation in section 8.4.1 Lifting the anchor at page 114.



While the chain hangs, it does not initially contribute to the overall braking

It can be measured from the image above, that:

1. The chain hangs down from the dash/dotted line by 38cm (the length of the sagitta)
2. The length of the arc below the chord is 4*53 (full chain links) + 4*37 (full chain links minus the link diameter at both ends) = 360cm.

We can approximate the length of the chord with the following formula:

$$c = \sqrt{a^2 - \left(\frac{s}{0.42}\right)^2}$$

c = length of chord, a = length of arc, s = length of sagitta

Inserting s=38 and a=360 returns a chord length of 348.5 cm, implying that there is an 11.5cm slack in the chain. If the sagitta was 10cm longer, the amount of slack chain would be 19cm.

Our estimate is that the anchor chain was normally loose according to recommendations, and allowed for a 10-20cm movement at either end before straightening.

9.1.1.2 The lashing wire geometry involves a tolerance

The wire lashing is implemented in a way that allows a chain movement of an estimated 10 cm, as shown in the image below.



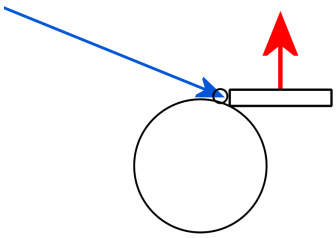
The wire allows for a 10-15cm movement before tightening again

Due to the aforementioned reasons, all the anchor weight was initially on the guillotine bar alone. This situation was in effect during the beginning of the Eagle S voyage on 25 December, 2024.

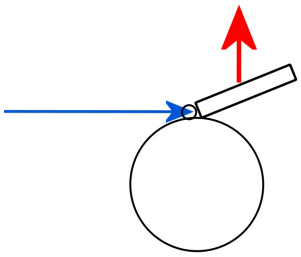
9.1.2 Problematic design of the chain stopper

The chain stopper part of the deck machinery has two design problems, which together cause a critical burden on the guillotine bar, causing it to experience a strong lifting force.

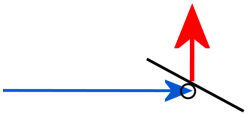
9.1.2.1 DESIGN PROBLEM #1



The anchor chain (blue arrow) will lift up the guillotine bar



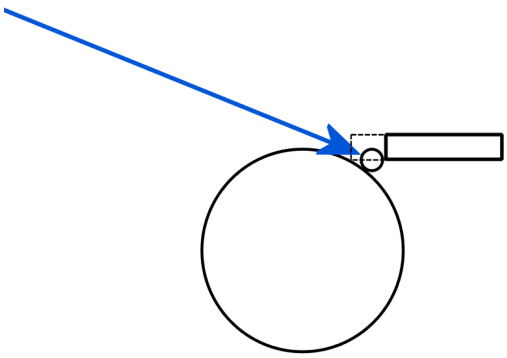
Easier to see



Exaggerated

9.1.2.2 DESIGN PROBLEM #2

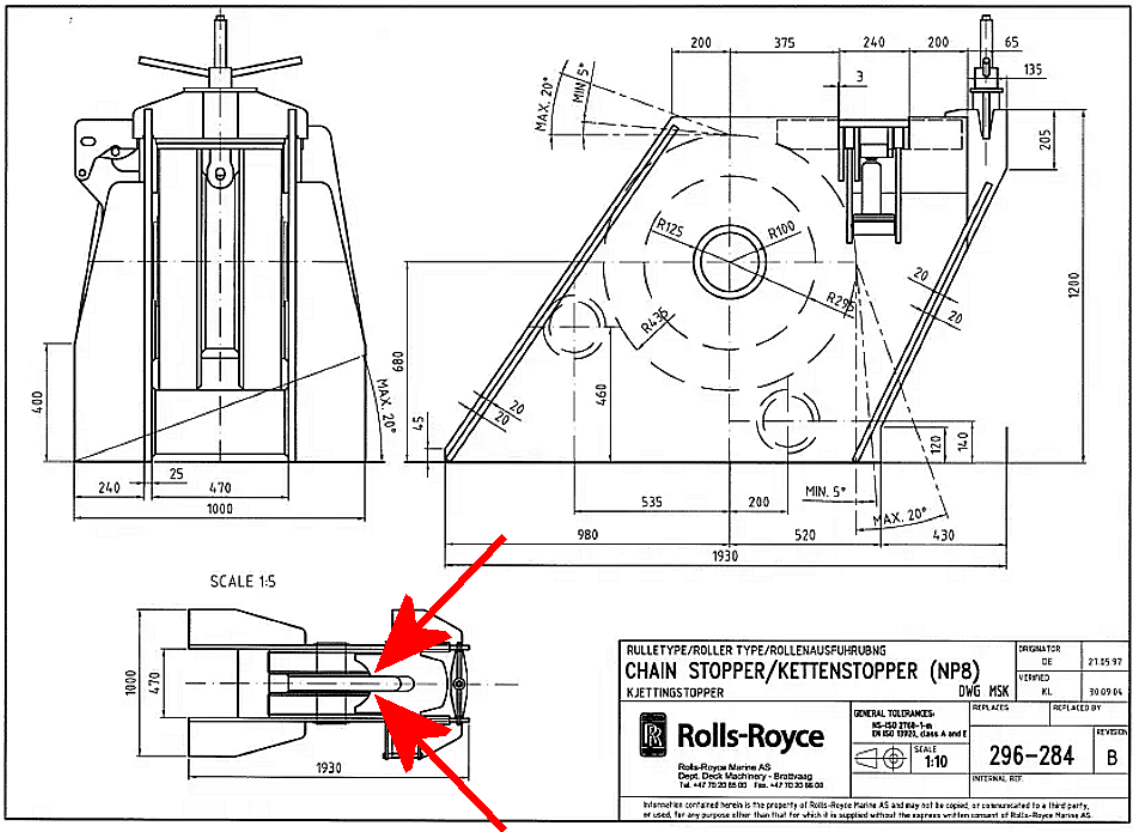
This problem is more serious than the first. The design of the guillotine bar causes it to stop the chain link with only two inner corners of its construction. These will meet rounded areas of the adjacent chain link. The images below illustrate the problem.



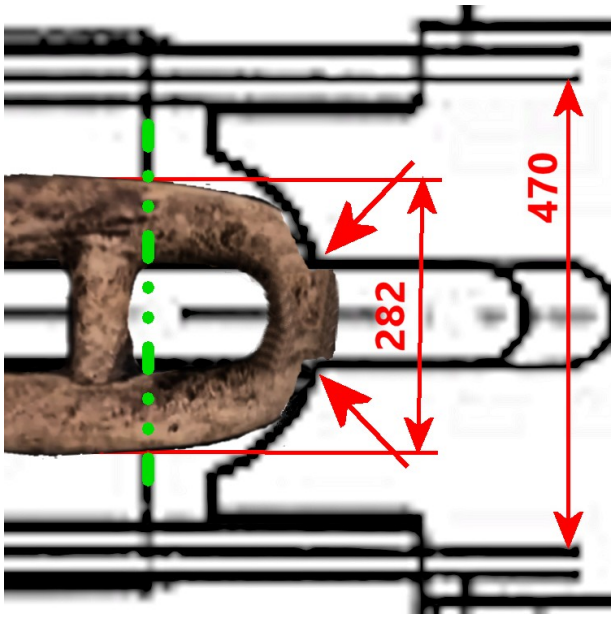
The round shape easily slips through – and creates a lifting force on the bar



The same seen in reality, after numerous chain links have passed through during the anchor incident



The problem locations

A scale-correct image of a chain link inserted into the drawing. As there is a gap between the roller wheel and the guillotine bar, the chain link will, when pulled down by the next link towards the anchor, align along the roller wheel tangent and act as a **wedge between the wheel and the bar**. Thus, it will lift up the bar and, potentially, let the chain through. **The contact point between the chain link and the bar (red arrows) should be at the green dash-dot-dotted line, implying the whole guillotine bar should have originally been some 20 cm more to the left.**	



The chain link may be able to penetrate the gap, as the guillotine bar is badly placed. The guillotine bar should have been, by design, located with its chain-touching edge at top of the roller wheel, then there would be no gap to penetrate and link would not be able to act as a wedge



The yellow dashed line shows, by wear, where the contact point between the chain link and the guillotine bar has been normally. The green line shows where the contact point should be, in order to be safe.

The image above shows the wear on the chain link that is usually in contact with the guillotine bar when the anchor is up. It has been partly under the bar, and has attempted to lift up the bar.

This end of the guillotine bar is too far away from the roller wheel, thus providing a gap. If the bar ended at top of the wheel, there would be no such gap.

The design of this chain stopper model appears insecure. As this design could exist on numerous ships, we encourage involved authorities to undertake a broad review.

9.1.3 The mechanical failure

There has been force from the 11.1-ton anchor acting on the chain.

This force has been transferred via a few chain links between the anchor and the chain stopper.

We believe that this force has been cyclic, due to the sea state and the heave of the ship's bow. A friction factor commonly used for rusty steel surfaces is 0.3-0.4; this friction would appear in the hawse pipe. To counter this, there has also been a constant supply of water, acting as a lubricant. There may also have been mud, doing the same.

By a rough calculation, we estimate that there may temporarily have been up to a 17 tonne pull force on the chain, due to bow accelerations from a wave period of 7 seconds.

This force (minus possible friction) has been taken solely by the guillotine bar, which has, in turn, experienced a lifting force due to aforementioned reasons. This lifting force has been transmitted to the upper shackle, whose bolt is heavily bent as shown in the images below.

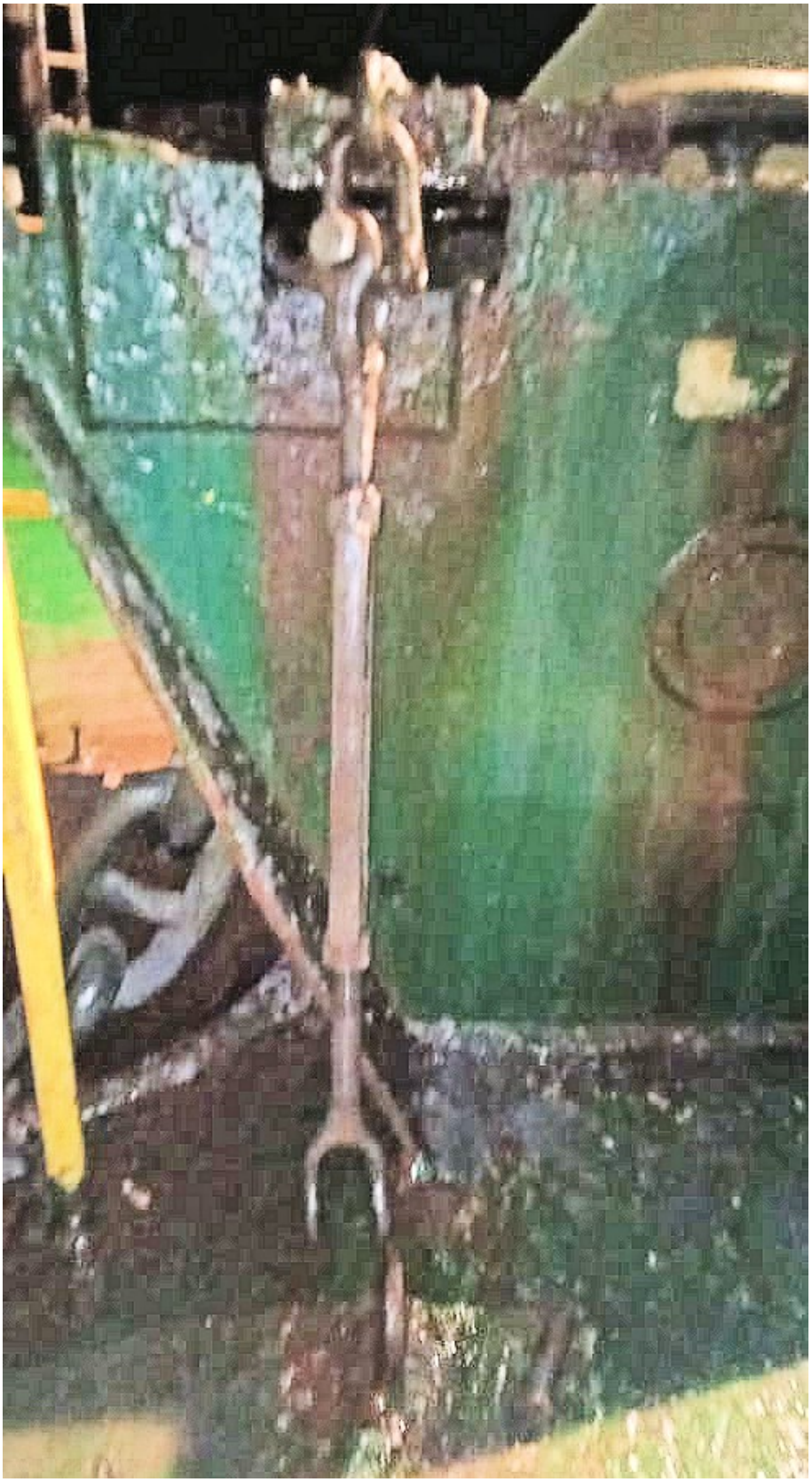




Bent shackle bolt (estimated to 18mm)

We cannot determine how quickly, or with what force, the bolt in the images above was bent, but a common maximum load on 18mm shackles appears to be approximately 13 tonnes (when examining product pages). This is, however, the safe maximum; **destroying it as in the images above would probably require a pull of 15-20 tonnes**.

This lifting force has been transmitted to the turnbuckle shown in the image below.



First images after incident: Loose lower turnbuckle (image digitally enhanced)

The lower end of the turnbuckle has been attached to a pad-eye in the ship deck with a bolt.



First images after incident: Bolt holding turnbuckle end is off (image digitally enhanced)

The bolt has been able to come off because the locking pin at its other end has experienced a mechanical failure. The locking pin is made of rustproof material.



First images after incident: Pin at bolt end is mechanically destroyed (image digitally enhanced)



First images after incident: One end of the failing locking pin; the other end looks similar (image digitally enhanced)

9.2 USE OF LOCKING PINS IN THE CONSTRUCTION

During our inspection of the anchoring arrangement, we could see the use of locking pins in some other parts of the construction as well. We did not search for them in particular and do not know how commonly they have been used.

A locking pin is a convenient way to keep an axis in place when no big sideways forces are expected, that is, when the axis is in balance. The pin allows for quick removal and dismantle. However, the pin locking the bolt at the end of the turnbuckle has been subject to sideways forces that destroyed it; it was not strong enough for this purpose.



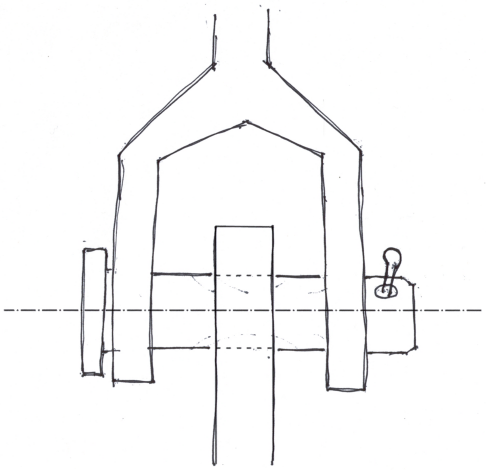
Locking pins in the windlass construction

9.3 REASON FOR MECHANICAL FAILURE

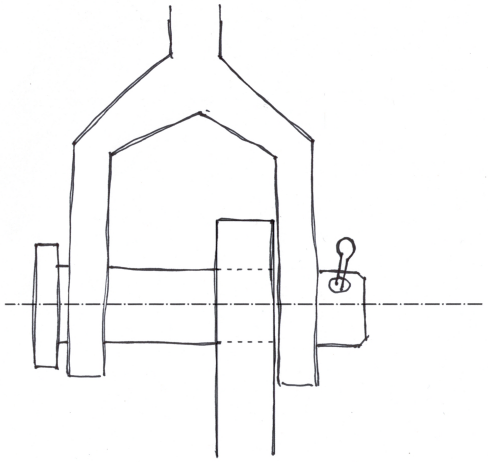
The primary reason for the failure of the locking pin is the force that has acted on the turnbuckle. From parts that have been deformed (the upper shackle screw, shown previously), this force has been considerable, probably in the order of 10 tonnes.

Normally, a turnbuckle should not fail, as it is a balanced construction. However, when the forces get big, small geometrical inaccuracies may have importance.

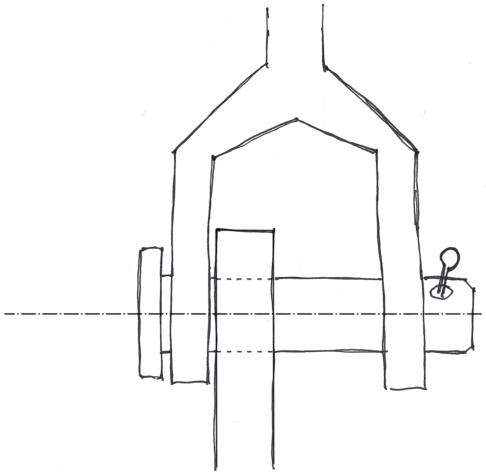
Different situations are shown in the images below. In all cases, the assumption is a 10 tonne force pulling the turnbuckle upwards. Note that the scenarios are exaggerated to better illustrate the logic.



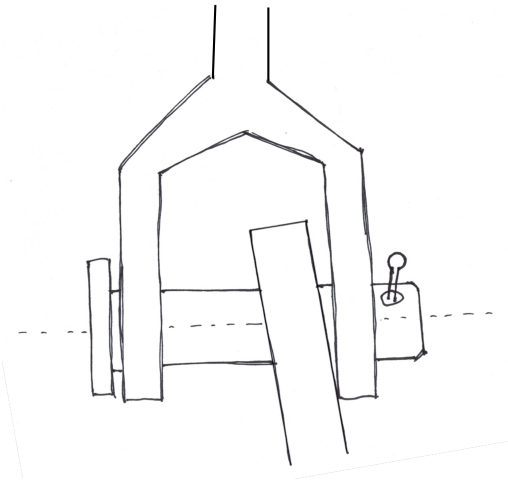
Balanced and ok



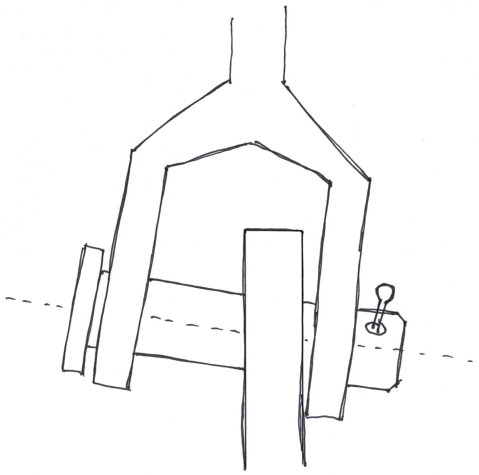
Balanced and ok



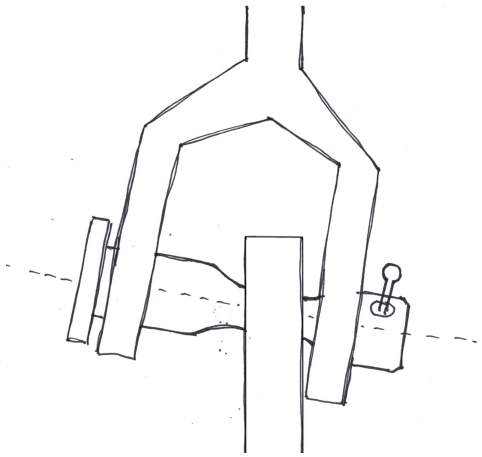
Balanced and ok



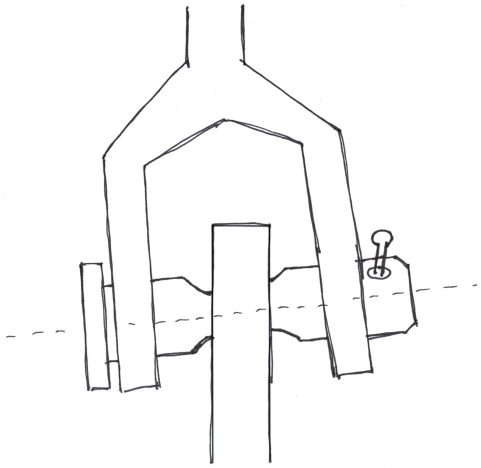
Balanced and ok (even though the deck pad-eye is angled)



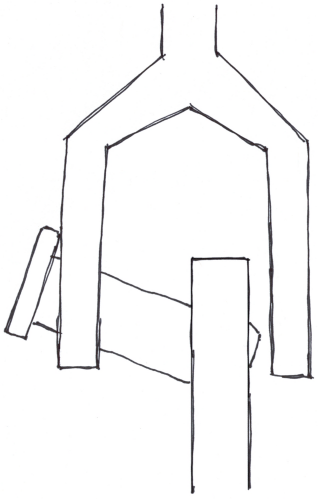
Ugly but ok – the turnbuckle would want to move to left but cannot, since its right side aligns against the deck pad-eye. Hence, the turnbuckle cannot pull out the bolt further.



Ugly but ok - even if the bolt is worn in the middle (and stuck, due to the pull up), the turnbuckle cannot move further left.



Extremely dangerous. The bolt is worn in the middle and has sought a fixed mid-position due to the pull up. From this position it won't move to the right, instead, the turnbuckle slides along the bolt and destroys the pin.



Situation once the pin has failed. The turnbuckle has moved upwards with a few centimetres, allowing the guillotine bar to do the same. The chain stopper has begun to let chain links through, initially at a slow rate.



The red line is straight



We haven't been shown the bolt, but can denote from the first pictures that it indeed is worn in the middle

9.4 Next steps in the process

9.4.1 Lashing wire collapse

Once the initial chain link had passed halfway under and through the guillotine bar, the full burden was taken by the lock #3, the wire lashing.

As the wire went around the sharp corners of the chain stopper frame, it was quickly cut off by the starboard side corner. We haven't been able to see the wire, but have verified this by measuring the lengths of the wire ends from images (see below).



Part of broken lashing wire, at port side of the chain stopper. Notice the tiny white lines, which count individual twines in the wire to determine its length



Part of broken lashing wire, at starboard side of the chain stopper

From the measured lengths of the wire on either side of the break, it can be calculated that the wire has broken at the corner marked by a red circle in the image below.



Lashing wire break point

9.4.2 Band brake rendering

Once brakes #1 (chain stopper, that is, guillotine bar) and brake #3 (lashing wire) were absent, the whole burden of the anchor was taken by the band brake.

The brake bands were renewed and the brake was calibrated at dry dock on 7 June, 2024.

The band brake rendered too early. We cannot definitively state the reason for this, and can only speculate that it could have been badly calibrated at the shipyard, or it could have been sensitive to temperature changes (it was apparently hot in the Turkish shipyard in August compared to the Gulf of Finland at the end of December).

The anchor had only been used 10 times since the previous summer.

A windlass band brake is intended to perform temporary actions only. It is not supposed to take the burden of an anchor unless manned and handled by a deck crew.

9.5 END OF PROCESS

Once the band brake began to render, albeit not initially at a very fast rate, anchor chain was let out and the anchor soon touched the water.

The guillotine bar must have done some jumping at top of the chain, but with intervals of several seconds, or even minutes rather than at a fast rate as when a chain is released uncontrolledly. Hence, it might have taken anywhere from a few minutes to an hour to let out enough chain (45 metres) for the anchor to touch the sea bed.

As the anchor touched the sea bed, the chain pull increased considerably and the remaining part of the chain was released at a higher rate. Eventually, only the bitter end held the chain, that was now out to its full length.

During the event, the brake bands probably heated up considerably, causing them and the metal around to enlarge. This might have caused the bands to partially detach from the metal frame to which they were glued. Similarly, the whole arrangement, including the chain stopper, suffered severe mechanical damage.

The dragging caused a decrease in ship speed, resulting in the main engine automation decreasing the rpm. When the crew discovered it, they attributed it to an engine problem and attempted to fix it by drifting and tuning the engine in various ways.

Eventually, the engine appeared to work in a satisfactory manner and the voyage was continued, with an intention to inspect the engine governor in Skagen, Denmark.

The anchor itself was worn at a fast rate and imposed an increasingly smaller resistance over the hours.

The ship’s engine automation maintained a stable speed, and the autopilot maintained a stable course. During this time (the First Officer’s watch), the majority of cables and pipelines were crossed, these also include the Finnish telecommunications cables.

The ship was stopped and detained by the Finnish Coast Guard. Up to this point, the crew did not know the reason for the problems, nor were they told by the authority who might have had the information. This seems like a failure of communication and co-operation.

Once stopped, the vessel attempted to lift up the anchor but the threads in the swivel link were at this point severely damaged, causing the link to disconnect and the anchor to remain at sea bottom.

10 INSPECTIONS AND DRY DOCKING (ANCHORING AND MOORING)

3-27 March 2021	**Drydock at Guangzhou, China (Norstar Intrepid)** Remarks: Several works performed including anchor chain stopper equipment repair. Quotes/book [MT Norstar Intrepid – 2021 3rd special survey & drydock]: DESCRIPTION OF DEFECT "Port and stbd anchor chain stopper guillotine bar to be removed and fabricated/repaired in shore workshop. Vessel has difficulty in securing port guillotine." REINSTATEMENT ON COMPLETION: On reinstatement guillotine bar to be tested at various places when anchor cables being brought back in so as to prove that chain guillotine engages smoothly.
2021, 2022, 2023	**ABS inspections** (No data)
1 June 2023	**Port State Control, Belgium** (No data)
12-19 April 2024	**Drydock at Ozata Shipyard, Yalova, Turkey** Remarks: Port side mooring winch hydraulics nonfunctional, serviced and tested Ok; new brake bands mounted in anchor windlass and mooring brakes; anchors inspected and Ok.
1 June 2024	**Inspection by ABS** Anchors, anchor chains, windlasses, chain brakes inspected (next inspection by 1 June 2029) Remarks: To clean and paint above mentioned equipment
24 August 2024	**Inspection by IRS** Engines and deck equipment inspected Remarks: One mooring winch seal leakage to be fixed
1 September 2024	**Inspection by IRS (Kandla)** Cargo Ship Safety Construction Certificate
6 September 2024	**Inspection by IRS (Port Mundra)** Cargo Ship Safety Construction Certificate
7-12 September 2024	**On board action [ship daily log]** Anchors, anchor chains, windlasses, chain brakes cleaned and

	painted
15 October 2024	**Inspection by IRS (Skagen)** Cargo Ship Safety Construction Certificate (Underwater Hull Survey) Remarks: None
12 December 2024	**On board action [ship daily log]** Remarks: None about anchoring and mooring arrangement
24 December 2024	**On board action [Mooring Winch Report]** Remarks: Port side mooring winch brake malfunctional
2-5 January 2025	**Port State Control, Finland** Remarks: Multiple
24 February 2024	**Port State Control, Finland** Remarks: Fixed except missing anchor, no remarks about anchoring and mooring arrangement

It appears that the vessel had earlier problems with the chain stopper, as noted in the first entry in the above table.

Fixes for those had been made in dry dock in 2021. The equipment was overhauled and found functional in dry dock in April 2024, after which it was inspected by the American Bureau of Shipping in June 2024

As earlier suggested, the design of the guillotine brake may have imposed a problem (see 9.1.2 Problematic design of the chain stopper on page 122).

11 OVERALL CONCLUSION

We believe that the cause of this incident was multiple interacting parameters. Hence, this is an example of a **system accident**.

We have identified **13 reasons** (8 background reasons and 5 immediate reasons) for the accident:

1. Background reasons

Ship or equipment manufacturer, docking yard

1. **Bad design of the Rauma chain stopper**
   The design causes an unwanted upwards force on the guillotine bar. This caused problems in locking the guillotine bar, which in turn had forced the shipyard to install turnbuckles to restore functional safety. Additionally, the windlass band brake was overhauled and tested in dry dock in August 2024. This overhaul should happen with 4-5 year intervals, yet it rendered too early, only 6-7 months after the overhaul.
2. **Weak attachment of the turnbuckle to the ship deck.**
   The shipyard used a pin-secured bolt instead of a threaded one. The pin failure is the immediate reason for the accident.
3. **Lack of band brake performance indication**
   A deck seaman cannot know how well the band brake works – he tightens it to maximum. He trusts the markings on the equipment. The brake rendering capacity was verified at dry dock approximately six months prior to the incident.
4. **Possible erratic calibration of the windlass band brake during the last dry dock visit.**
   The reasoning is discussed in section 8.2 Regulations regarding the anchoring and mooring arrangement at page 93.
5. **Weak lashing wire implementation**
   The third anchor lock, the lashing wire, was unable to hold the weight of the anchor. It was too weak, and had a disadvantageous geometry that may be outside ship crew members' skill sets in physics.

Regulations and responsibilities

6. **Unclear regulations**
   There is a logical conflict in the IMO regulations regarding the braking capacity of the band brake. There might be a conflict between IMO regulations and OCIMF standards regarding the windlass brake's rendering capacity.

7. **Failing inspections**
   Even though the vessel was inspected by class and had recently been in dry dock, it had not received any remarks (except a non-critical clean&paint need) regarding the anchoring arrangement and brakes. During the Finnish Port State Control, no remarks were made for the starboard side anchoring arrangement, including the chain stopper - which was identical to the port side that failed. Similarly, the port side chain stopper (now with a threaded bolt instead of a bolt/pin) triggered no remarks.

Ship

8. **Wear of the chain stopper**
   The equipment is old and some of the parts are worn or rusty, this decreases the performance of the whole.

2. Immediate reasons

Environment

1. **Cold weather**
   The low temperature may have decreased the efficiency of the band brake.
2. **Bad sea state**
   The bad sea state created unwanted forces on the anchor and lubricated the system.
3. **Worsening weather**
   The worsening weather gave the bridge crew a sensible reason for the decreased vessel speed.

Ship and crew

4. **Main engine governor**
   The main engine governor had four days before required attention. Even though it was temporary, and was classified as non-critical, it provided the crew a logical reason for the loss in engine performance some days later.
5. **The human factor**
   The crew did not realise the cause of the decreased speed and rpm, instead attributing it to the already known problem with the main engine (the governor). After having fixed the engine, the crew did not allocate the speed decrease to a dragging anchor, as the speed seemed normal given the sea state. The off-heading alarm never triggered, as the ship was never off its heading while the anchor was dragging, so the crew were not alerted to the possibility of this issue.

It is also worth noting that the majority (15 of 24) of cable/pipeline crossings happened after the Finnish command was aware of the Eagle S – Estlink 2 connection. The VTS or the Coast Guard could have immediately asked the vessel

to stop, instead of letting it continue and cross (and potentially damage) more cables and pipelines, including the Finnish cables.

We have encountered no signs of intentional damage or sabotage.

We conclude that this accident had multiple causes.

Tomas Gustafsson

12 ATTACHMENTS, PUBLIC

12.1 FINTRAFFIC REPLY TO VTS REQUEST (3 PAGES)

Fintraffic

Päätös 1 (3)

16.1.2025 Julkinen

Asianajotoimisto Herman Ljungberg
Asianajaja Herman Ljungberg

viite: 8.1.2025 toimittamanne tietopyyntö

Tietojen antamista koskeva päätös

Asia

Asianajaja Ljungberg on pyytänyt saada yksityiskohtaiset tiedot tapahtumasta (aluksen liikkeet ja VTS-radioliikenne), joka sattui 25. joulukuuta 2024 noin klo 11:50–12:50 UTC-aikaan, jolloin EAGLE S alus oli TSS-alueella ja sijaitsi Porvoon kaupungin eteläpuolella. Alus hidasti vauhtiaan ja teki AIS-jäljen mukaan noin tunnin ajan sarjan ohjausliikkeitä. Samanaikaisesti aluksen päällikkö ilmoitti Suomen VTS:lle tapahtumasta, joka oli aiemmin luokiteltu pääkoneongelmaksi.

In order to define the geometry and logic of this case (Eagle S manoeuvre and VTS communication), it would be of uttermost importance for us to get details of the event at 25 Dec 2024, from ca 11:50 ... 12:50am (UTC), when the ship was in the TSS and located south of the city of Porvoo. The ship slowed down, and according to the AIS track, made a series of manoeuvres for a duration of ca one hour. Simultaneously, the ship's Master informed the Finnish VTS of an event that was earlier classified as a ME problem.

Päätös

Fintraffic Meriliikenteenohjaus Oy luovuttaa AIS-tiedot EAGLE S aluksen liikkeistä, mutta ei luovuta salassa pidettäväksi luokiteltua VHF-radioliikennettä tai sen sisältämiä tietoja.

Perustelut

Keskusrikospoliisi tutkii 25.12.2025 Suomenlahdella tapahtuneita Estlink 2 sähkökaapelin sekä neljän eri tietoliikennekaapelin vaurioitumista törkeänä tuhotyönä ja törkeänä tietoliikenteen häirintänä (2400/R/941/24). Viranomaisten 25.12.2024 tekemien havaintojen pohjalta on perusteltua syytä epäillä, että Cookinsaarten lipun alla kulkeva tankkeri EAGLE S liittyy vaurioiden

syntymiseen / on osallinen vaurioiden aiheuttamiseen. Esitutkinta on tällä hetkellä kesken. Tilanteessa syntyneitä radiotallenteita hyödynnetään esitutkintamateriaalina.

Käyty viestiliikenne Rajavartiolaitoksen ja EAGLE S aluksen välillä sekä Helsingin meriliikennekeskuksen (VTS) ja EAGLE S aluksen kanssa käymät keskustelut on Keskusrikospoliisin toimesta 10.1.2025/14.1.2025 luokiteltu toistaiseksi salassa pidettäväksi viranomaisen toiminnan julkisuudesta annetun lain (621/199) 24 § 1 mom. 3. kohdan mukaisesti.

Helsingin poliisilaitos on 10.1.2025 pyytänyt olemaan luovuttamatta Rajavartiolaitoksen ja EAGLE S aluksen välillä käytyä radioliikennettä. Viestiliikenteen sisällön katsotaan olevan salassa pidettävää viranomaisen toiminnasta julkisuudesta annetun lain (621/199) 24 § 1 mom. 5., 8. ja 9. kohtien mukaisesti.

Myös Rajavartiolaitos on 10.1.2025 tehnyt päätöksen olla luovuttamatta Rajavartiolaitoksen ja EAGLE S aluksen kanssa käytyä radioliikennettä koskevia tietoja toistaiseksi. Käyty viestiliikenne on luokiteltu salassa pidettäväksi viranomaisen toiminnan julkisuudesta annetun lain (621/199) 24 § 1 mom. 5., 8. ja 9. kohdan mukaisesti.

Sovelletut säännökset

Alusliikennepalvelulaki (623/2005) 16 §

Julkisuuslaki (621/1999) 24 §

Valitusosoitus

Tähän päätökseen saa hakea muutosta valittamalla hallinto-oikeuteen. Valitusosoitus on liitteenä.

Yhteyshenkilö

Sari Talja, Operatiivinen johtaja

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Allekirjoitukset

Fintraffic Meriliikenteenohjaus Oy

Rami Metsäpelto, Toimitusjohtaja

Liitteet

Valitusosoitus

1 12.2 IMO GUIDELINES ON VDR OWNERSHIP AND RECOVERY (3 PAGES)

INTERNATIONAL MARITIME ORGANIZATION
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IMO

E

Ref. T1/2.02

MSC/Circ.1024
29 May 2002

**GUIDELINES ON VOYAGE DATA RECORDER (VDR)
OWNERSHIP AND RECOVERY**

1 The Maritime Safety Committee, at its seventy-fifth session (15 to 24 May 2002), approved the annexed Guidelines on voyage data recorder (VDR) ownership and recovery which have been developed to support provisions of the revised SOLAS regulation V/15, as amended by resolution MSC.99(73), and, in particular, to support the carriage requirements for voyage data recorders contained in the revised SOLAS regulation V/20, which are expected to enter into force on 1 July 2002.

2 These Guidelines reflect the five basic issues relevant to VDR ownership and recovery, which are ownership, custody, recovery, read-out and access to the VDR information, as envisaged by the revised SOLAS chapter V.

3 In view of the complexity of the matter, close co-ordination and co-operation among interested parties, as appropriate, in any recovery operation of a VDR is encouraged.

4 Member Governments are invited to bring the annexed Guidelines to the attention of all parties concerned.

***

ANNEX

**GUIDELINES ON VOYAGE DATA RECORDER (VDR)
OWNERSHIP AND RECOVERY**

Ownership of VDR information

1 The ship owner will, in all circumstances and at all times, own the VDR and its information. However, in the event of an accident the following guidelines would apply. The owner of the ship should make available and maintain all decoding instructions necessary to recover the recorded information.

Recovery of VDR and relevant information

2 Recovery of the VDR is conditional on the accessibility of the VDR or the information contained therein.

.1 Recovery of the VDR information should be undertaken as soon as possible after an accident to best preserve the relevant evidence for use by both the investigator[1] and the ship owner. As the investigator is very unlikely to be in a position to instigate this action soon enough after the accident, the owner must be responsible, through its on-board standing orders, for ensuring the timely preservation of this evidence.

.2 In the case of abandonment of a vessel during an emergency, masters should, where time and other responsibilities permit, take the necessary steps to preserve the VDR information until it can be passed to the investigator.

.3 Where the VDR is inaccessible and the information has not been retrieved prior to abandonment, a decision will need to be taken by the flag State in co-operation with any other substantially interested States[2] on the viability and cost of recovering the VDR balanced against the potential use of the information. If it is decided to recover the VDR the investigator should be responsible for co-ordinating its recovery. The possibility of the capsule having sustained damage must be considered and specialist expertise will be required to ensure the best chance of recovering and preserving the evidence. In addition, the assistance and co-operation of the owners, insurers and the manufacturers of the VDR and those of the protective capsule may be required.

Custody of VDR information:

3 In all circumstances, during the course of an investigation, the investigator should have custody of the original VDR information in the same way that the investigator would have custody of other records or evidence under the Code for the Investigation of Marine Casualties and Incidents.

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[1] The term *investigator* refers to the Marine Casualty Investigator as per the terms of the Code for Investigation of Marine Casualties and Incidents.

[2] Refer to paragraph 4.11 of the Code for the Investigation of Marine Casualties and Incidents, as adopted by resolution A.849(20).

Read-out of VDR information:

4 In all circumstances the investigator is responsible to arrange down loading and read-out of the information and should keep the ship owner fully informed. In some cases, the assistance of specialist expertise may be required.

Access to the VDR information:

5 A copy of the VDR information must be provided to the ship owner at an early stage in all circumstances.

6 Further access to the information will be governed by the applicable domestic legislation of the flag State, coastal State and other substantially interested States as appropriate and the guidelines given in the Code for the Investigation of Marine Casualties and Incidents.

7 Any disclosure of VDR information should be in accordance with section 10 of the Code for the Investigation of Marine Casualties and Incidents.

12.3 Statement from Gard (not included in the Police's Pre-Trial Record, 10 pages)

Witness statement in relation to The Finnish National Bureau of Investigation ongoing investigating of the anchor dragging damage from tanker "Eagle S"

Jarle Fosen, Gard Senior Loss Prevention Executive and anchor expert

Question 1 - What can cause the anchor to drop when ship is under way.

When leaving the anchorage:

- The anchor should be secured in position (housed in status) securely stowed in the hawse pipe before commencing the voyage with the winch brake, bow stopper and additional wire lashing.
- Excessive slack may cause «hammering» of the anchor to the ship hull and loss of the D-shackle securing pin. Winch brakes must be applied. Chain stoppers to be engaged. Further secured with lashings with turnbuckles or other similar fasteners. Windlass clutch must be disconnected from the gear while at sea to avoid risk of damage.
- Due to a twist in the anchor chain (that can develop over a period of time while at laying at anchorage), the anchor is unable to sit snuggly against the hawse pipe. If there is an adverse weather, the waves continuously pound the anchor which can break the wire lashing. The bow stopper contributing to the securing assembly can "also be" compromised.
- It is also worthwhile noting that the brake in its fully tightened state might not offer the required holding power if the brake lining is worn out. This will be evident from the threads on the brake spindle. Please refer to the attachment 1 below, explaining the working of an anchor brake. From the vessel pictures shared, I reckon that the vessel had a similar kind installed on board.

Accidental deployment of an anchor during voyage, without the crew's knowledge, remains rare but can be possible due to the following factors:

- Due to mechanical or operational failures in the anchor securing. Anchors must be fully secured before departure using multiple securing mechanisms, including the windlass brake, bar stopper, and pelican hook/devil's claws or wire lashing or tightened with bottle screws. Failure to do so can lead to unintended anchor deployment.
- Missing anchor and chain incidents have been reported where the lashing rod hook was found broken on deck, and the windlass gearbox was damaged when not disengaged. This suggests that the chain stopper and brake might not have been properly engaged during the voyage.
- Poor upkeeping (poor maintenance) of anchor securing equipment increases the likelihood of accidental release.
- Due to a twist that might appear in the anchor chain after hoisting and staying for long periods at anchor, the anchor may not sit snugly against the hawse pipe during

the voyage. This can lead to the anchor being continuously pounded by waves, potentially breaking the wire lashing and compromising the bow stopper. Chain twist can make the chain difficult to fit over the windlass gypsy when weighing anchor and prevent the anchor from setting correctly. Swivel connectors can help prevent chain twist and jamming.

Therefore, unintentional anchor dropping whilst underway can only happen in case where both the wire lashing and bow stopper have been opened or compromised and thereafter, the winch brake was inadvertently released or due to its maintenance condition did not hold properly.

Ref. Appendix 1 for pictures of anchor windlass and securing items.

When approaching an anchorage:

- The wire lashing is the first to be removed when preparation for anchoring is made.
- Closer to the anchoring position, the bow stopper is lifted and clutch engaged to lower the anchor to water level or even lower (depending on the water depth).
- Finally, it can be either let go (gravity) or lowered with winch power (walking back).

Question 2 - Should someone from the crew, based on his position at the ship, have noticed that the anchor has dropped, or that it is dragging the seabed? If so, at which point that should be noticed and by whom?

On large vessels, particularly those with the bridge located far aft, an unintentional anchor dropping, may not be immediately or easy to detect by the crew. On smaller vessels, particularly those with the bridge located forward, an unintentional anchor dropping, should be easier to detected by the crew.

A dragging anchor might not impact vessel steering or performance before the anchor and chain touch the seafloor. The unintentional anchor dropping might not happen or drop fast (“freely”) but rather in stages due to wave movements, if the brake is still holding a little bit on.

But when an anchor is intentionally paid out by “let go” (released freely under gravity), there is loud sound made by the links rolling over the windlass, that is even audible from the bridge wing aft, based on weather conditions. For all personnel located on main deck forward of accommodation are also very likely to hear that the anchor cable is paying out by freefall “let go”.

The brake in an optimum condition will hold the anchor in place, this is an information that should be establish in this case – whether the brake was fully applied when this happened, or it was inadvertently released or not holding due to worn out brake bands?

Hence, if the anchor paid out in daylight hours, it should be easier to noticed (except for tea break / lunch periods). During dark hours, it is more difficult but may still possibly be heard by the watchkeeping officer if the bridge wing door was kept open.

Bridge Crew (Officer of the Watch - OOW):

- Unusual vibrations: The OOW might notice unusual vibrations or sounds coming from the hull, indicating the anchor chain is under strain.
- Speed and navigation anomalies: The ship's speed may decrease unexpectedly, and navigation instruments might show deviations from the planned course.

Engine Room Crew:

- Engine load changes: The crew might observe changes in engine load or performance, as the anchor dragging can affect the ship's propulsion and speed.

Question 3. Could the weather on the scene have affected that the crew have not noticed the anchor to drop? Can the weather affect the ships speed and sailing? (Weather conditions attached)

In this specific case the weather conditions seem to be good, I'm not a mariner, but I guess in this case it should not have impacted the that the crew have not noticed the anchor to drop.

But, on a general note, weather conditions may significantly impact the crew's ability to notice an unintentionally dropped anchor and can also affect the ship's speed and sailing if the anchor is dragging on the sea floor. Bad weather does impact the vessel speed. Counter currents will reduce the speed and beam seas and swells will cause the vessel to roll.

- **Impact of weather on detecting an accidentally dropped anchor:**
    - Reduced Visibility: Heavy rain, fog, or storms can reduce visibility, making it harder for the crew to visually inspect the anchor chain and surrounding waters.
    - Increased Noise: Strong winds and rough seas can create a lot of background noise, which might mask the sounds of the anchor chain dragging or unusual vibrations.
    - Distractions: Adverse weather conditions often require the crew's full attention on navigation and safety, potentially delaying the detection of anchor issues.
    - Access to main deck and the forecastle area might be restricted when passing through bad weather or storms, due to personnel safety.
    - In such preparations for passing bad weather and storms, there are procedures in place to make sure the vessels watertight integrity is not jeopardized and surely making sure the anchor is safely stowed.

- **Impact of weather on ship's speed and sailing with a dragging anchor:**
    - Wind and Currents: Strong winds and currents can exert additional forces on a ship, causing it to drag the anchor and chain more easily when anchored stationary in an anchorage. This can lead to unexpected changes in the ship's speed and direction. When sailing with a dragging anchor the wind and currents, it might be a bit more difficult to distinguish what is the effect from a dragging anchor versus the weather and current conditions.
    - Increased Drag: Rough seas can increase or decrease the drag on the anchor chain, if the holding ground is good the anchor might cause the ship to slow down or change course but is holding ground is poor the anchor and chain might slip from the bottom.
    - Erratic Movements: The ship if a dropped anchor holds fast, may experience sudden erratic movements, such as yawing or swaying, which can further complicate navigation and control.
- **Preventive measures**
    - Enhanced Monitoring: In adverse weather, the crew should increase the frequency of position checks and closely monitor navigation instruments.
    - Anchor Alarms: Using anchor alarms on GPS and ECDIS systems can help detect dragging early, even in poor visibility.
    - Preparedness: The crew should be prepared to take immediate action if dragging is detected while at anchorage, such as ready the engine power or re-anchoring in a safer location or leave the anchorage.

By being aware of these factors and taking proactive measures, the crew can better manage the risks associated with adverse weather conditions and anchor storing/securing issues.

Question 4 - If the ship is under way and dragging an anchor, does that effect on the course of the ship (When on autopilot or hand steering).

In this case, again I am not a master mariner, but as the anchor touched the bottom and reduced the speed as well, an impact on the course would be apparent. This I guess may be established from the “course recorder.”

Question 5 - If the ship has dropped an anchor while under way and after that engines are stopped, can the vessel be drifting with the currents when the anchor is in the bottom of the sea. If so, at which speed compared to the current? (The distance of anchor chain can be drifted?)

Again, I am not a master mariner, this question would be hard to provide an exact mathematical calculation to. However, in a general note, it is the weight of the anchor plus the cable paid out that holds the vessel in place.

If the holding ground is good – mud, sand, clay then even with strong currents like 4knots, vessel can hold her position. It is also important to understand that a vessel with higher draft is more susceptible to anchor dragging than a one with a lesser draft.

The reason why a vessel maintains her position at anchorage is the manner in which anchorage is approached and the anchor paid out (can be dropping or lowering under power).

The scenario at hand is unique in the manner that anchor dropped while vessel moving at a considerable speed. Therefore, anchor did not provide same kind of holding power as it would when vessel anchors intentionally. Hence, the distance that vessel travelled with her anchor dropped can be large when the anchor does not hold.

In case the anchor does hold, the maximum distance vessel would drift from its original position is calculated as the "swinging circle" which takes into account the length of cable paid out (minus the vertical extent). Vessel's position beyond the swinging circle is an indication of her dragging anchor.

Question 6 - How does the depth of the sea and the material of the seabed affect the anchor dragging?

Yes, the nature of holding ground does affect how well anchor would hold. Some of the good holding grounds are mud, sand, clay and some of the poor holding grounds are gravel, shells, rocky seabed.

Two commonly used formulae to calculate the amount of cable to pay out are:

- Amount of cable required (in shackles) = 1 ½ √water depth in metres (Admiralty Manual of Seamanship)
- Minimum amount of cable required (in metres) = 4 x depth of water in metres (D J House – Seamanship Techniques)

Question 7 - Do you think that it is technically possible to drag an anchor for 89 kilometers while the vessel is under way?

Yes, it is worth noting that generally only those anchor dragging incidents which cause damage to subsea infrastructure, grounding or pollution get public attention.

Therefore, media coverage can lead to the speculation that such incidents are uncommon or suspicious – however such incidents should in most cases be attributed to poor seamanship practices, equipment failure or improper stowage of anchors.

The submarine cable industry had generally believed the main cause of faults to be from fishing vessels. However, the increasing use of the new Automatic Identification System (AIS) technology has changed this view and revealed the extent of threat of damage from anchors of cargo ships are just as high. Ref. study made by British Telecom, who commenced the use of Automatic Identification System (AIS) data back in 2006 to monitor ship movements in the UK in the vicinity of submarine cables.

Reference made to International Cable Protection Committee recently issued article on Feb 2025: https://www.iscpc.org/publications/icpc-viewpoints/damage-to-submarine-cables-from-dragged-anchors/

That list several examples of anchor dragging while under way:

- One of the most significant anchor dragging events in recent history occurred off Sicily in 2008, where a ship dragged its anchor for 300 km, damaging six submarine cables. Such incidents can disrupt multiple cables in proximity, magnifying the impact of an event. Ref: https://www.iscpc.org/documents/?id=201
- Another example is the incident between the Channel Islands and Cornwall, UK where a vessel deployed anchor in poor weather, causing damage to several telecommunications cables. Ref: https://www.bbc.com/news/world-europe-jersey-38141230
- There was another incident in March 2016 where a vessel dragged its anchor causing damage to telecommunications cables and a power cable, which cut off the electricity supply to the Isles of Scilly4 for a significant period of time. Ref: https://www.woottonandwootton.co.uk/case-studies/testing-projects/isles-scilly-55km-33kv-subsea-cable-fault
- The Chilean flag container ship Aconcagua cut three of the then 4 cables linking the United States to Europe in 2002 while sailing from Philadelphia to New York City. The captain erroneously attributed the reduction in the ship's speed during a gale to the wind when in fact it was the ship's anchor dragging. Investigation revealed that the anchor windlass had only been secured with the brake and the chain stopper had not been used.
- The Liberian flagged vessel Blue Princess damaged three submarine cables in the Red Sea in 2012. Over a period of 12 hours on 17th February 2012, SEA-ME-WE 3, EASSy, and EIG, causing multiple cable faults. The vessel could be tracked using AIS as crossing the cables at a similar time as faults were reported and appeared to become fastened to the cable with the speed reducing to zero at the time of the final fault during that period.
- Several cruise ships anchored in Lyme Bay lost their anchors during the COVID-19 pandemic. The MAIB report highlighted that The International Association of Classification Societies (IACS) advises that the anchoring equipment is not designed to hold a ship of fully exposed coasts in rough weather or to stop a ship that is moving or drifting. Ref: https://assets.publishing.service.gov.uk/media/6062ee7be90e072d97f8765b/2021-SB1-CruiseShipAnchorFailures.pdf
- An Incident in the Great Lakes, Michigan of an anchor being dragged without detection is reported6 as having damaged pipelines and 5 cables with the anchor having been deployed for 36 hrs covering approx. 600km causing

significant damage. Ref:
https://eu.detroitnews.com/story/news/local/michigan/2019/07/08/anchor-strike-biggest-risk-line-5-few-incidents-great-lakes/1616215001/

https://www.ntsb.gov/investigations/AccidentReports/Reports/MAB1912.pdf

It is important to highlight that owners/operators of subsea cables and pipelines have in place repair plans, procedures and cable ships are in strategic global locations dedicated to repairing submarine telecommunications cables.

By enforcing stricter operational standards, leveraging technology, and enhancing crew training, the maritime community can significantly reduce the risk of damage to this critical global subsea infrastructure.

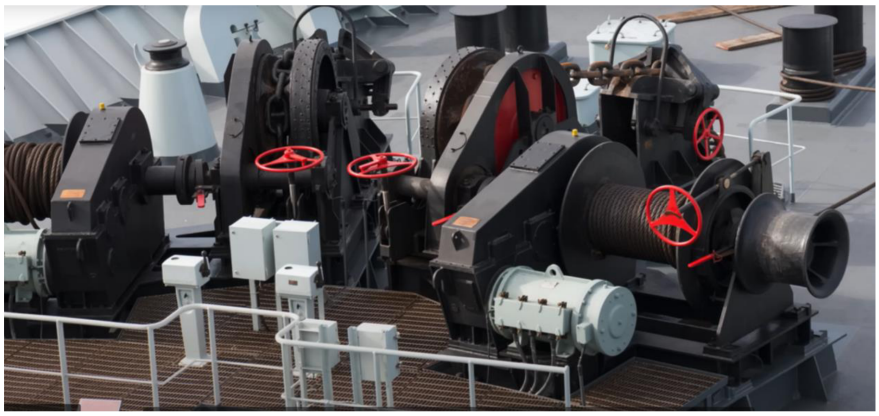
If some of those questions are not in your area of expertise, we don't expect you to have answers all of them.

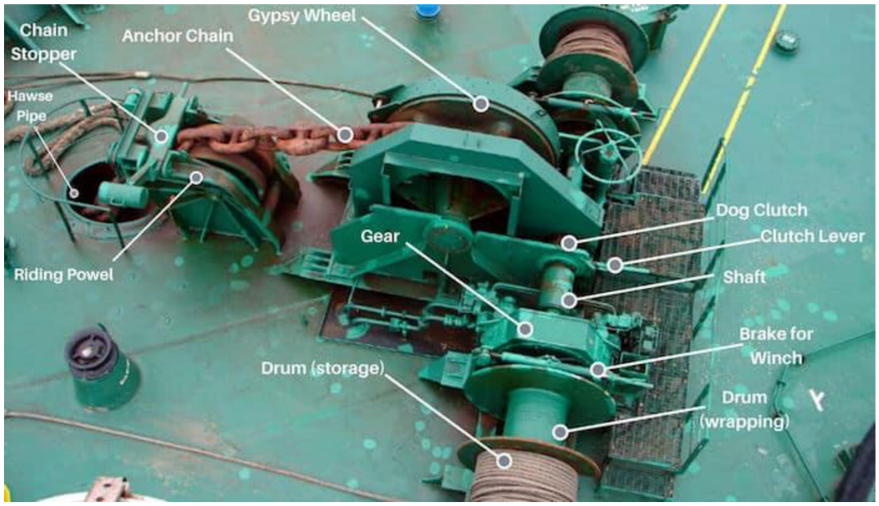
And additionally, we would like to take your comment on the things you already have discussed with us via email and seems to be more in your area:

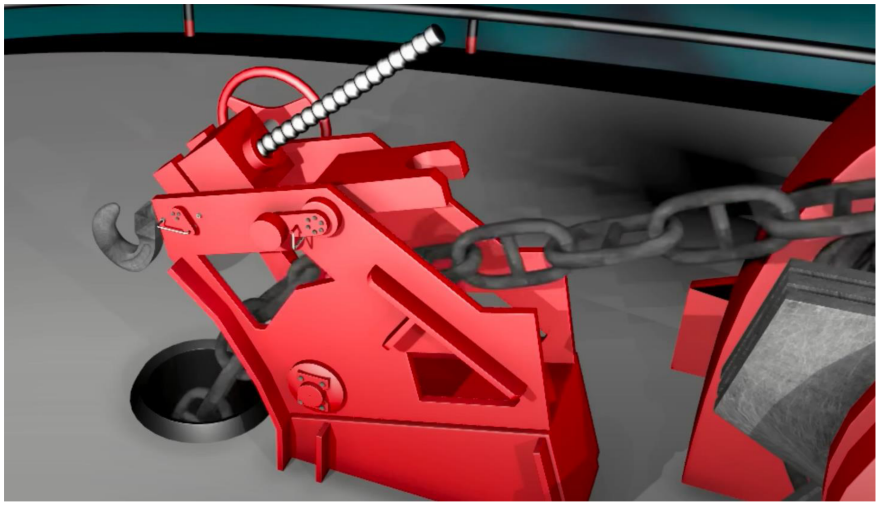
- Causes of anchor drops while the ship is under way
- What factors make it possible to happen without the crew's knowledge
- Statistics (or previous cases in history) of anchor drops while the ship is underway
- Based on your experience is it possible that Eagle S have dragged their anchor without noticing it (we can discuss it more in the interview and maybe show some data we have gathered on the incident if necessary)

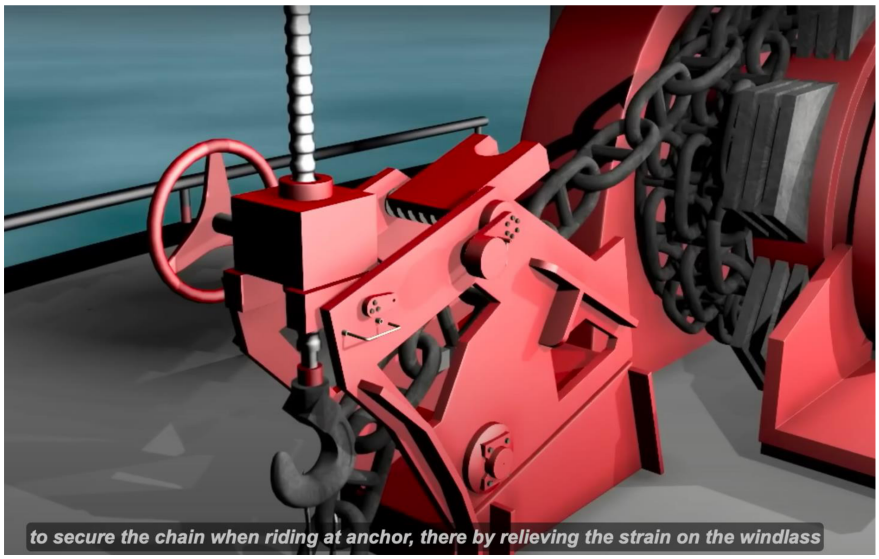
See the separate Gard loss prevention presentation on Anchor losses, damages and dragging.

Attachement 1 – Anchor, windlass & break pictures








to secure the chain when riding at anchor, there by relieving the strain on the windlass


- Procedure For Anchoring a Ship at Sea
Share
Anchor Secured in Hawse Pipe Opening

12.4 EXCERPTS FROM THE SHIP MANAGER'S SECURITY MANUALS

12.4.1 Safety, safety inspections and accident investigations

From "PENINSULAR MARITIME MANUAL FOR HSEQA, REV No. 00/JUL 2023, CHAPTER:05 - SHIPBOARD SAFETY ORGANISATION, page 2/20

5 SHIPBOARD SAFETY ORGANISATION **Rev. 0 - 01 Jul 2023**

The Master MUST take a personal interest in ensuring the safety of the ship and personnel.

*Complete & send **Q 4** Monthly HSE Statistics to the office at the end of every month.*

5.1 SAFETY OFFICER/CHIEF ENGINEER **Rev. 0 - 01 Jul 2023**

Considering his qualification and experience the Chief Engineer will be the safety officer and OH&S representative onboard our managed vessels. Safety Officer shall have attended a "Shipboard Safety Officer" course or equivalent and be familiar with requirements of his duties.

The Chief Engineer as the Ship's Safety Officer is responsible to the Master for compliance with the duties ascribed to him as given below but not limited to:

1. Conducting safety inspections on a monthly basis using form Q16 and the necessary follow-up.

2. Ensuring that the investigation of all accidents, incidents, dangerous occurrences and near misses is carried out.

3. Ensuring compliance with the Company's Safety Instructions.

4. Attending HSE Committee Meetings. Subsequent to the HSE committee meeting, the Safety Officer will verify if corrective actions have been taken for all the defects, which were considered to be potential safety hazard.

5. Assessing the condition of the personal protective equipment gears on board from time to time in order to ensure that personnel safety is not impaired.

6. Conducting periodical safety audits and tours.

7. To monthly review on board adherence to Company's Permit to work system and Risk assessment procedure

1 ***12.4.2 Moorings and anchoring (crew demand etc.)***

2 From "Peninsular maritime – MOORINGS, CHAPTER: 19 – MOORINGS", pages 52-53/56

19.18 PERSONNEL **Rev.0-01 July 2023**

As mooring is a critical operation ,following are the requirements for personnel involved in mooring operations:

1) There should be designated person in charge (PIC) at forward and aft mooring and anchoring station. Normally, Chief Officer remains the PIC for forward station and one of the OOW as aft station.

2) Minimum numbers of personnel required at each location apart from PIC should be TWO.

3) Toolbox meeting prior to mooring and anchoring operations must be completed by the PICs with all the crew involved.

4) The crew involved in the mooring operations should be familiarized with mooring and anchoring equipment and should be experienced.

5) In case of a third party personnel involved , He should participate under the supervision of the PIC.

6) Where there are insufficient officers onboard to cover the the mooring station and bridge team requirements, *senior AB or Bosun* (having minimum 03 years sea time) and having undergone ISTR (Integrated Safety Training for Ratings) course may supervise the operation as per master's discretion.

7) In case any crew member is involved in his first mooring and anchoring operation, he should act as an observer only and use this opportunity to learn the safe mooring practices. Officer in-charge of the mooring and mooring station shall monitor the crew closely to ensure his personal safety during such training.

19.18.1 Role and responsibilities of Mooring and Anchoring team

Supervising officer and his/her team members must be familiar with the ship's equipment and its limitations, and must be competent to carry out mooring, unmooring and anchoring operations safely.

It is the responsibility of supervising officer and his team to ensure that mooring and anchoring operations are conducted safely and as per guidelines laid down in the company procedures.

The supervising officer shall ensure that:

1. The mitigating conditions of the risk assessment are always in place, including testing of the mooring and anchoring equipment prior to the operation.
2. Inspect the mooring and anchoring equipment prior to the operation to verify the satisfactory operation of the equipment and its safety features.
3. Each member of his team is appropriately dressed and using adequate PPE.
4. All mooring and anchoring equipment's are used safely within their design parameters.
5. He/ She must have an overview of the situation to ensure the safety of his team during the entire operation.
6. Effective communication is maintained between his team and the wheelhouse.

The members of the Mooring and Anchoring team shall be responsible for safe mooring and anchoring operations. Additionally, they shall:

1. Execute the Mooring and Anchoring plan as discussed by the team leader.
2. Inspect the mooring and anchoring equipment prior to the operation to verify the

satisfactory operation of the equipment and its safety features.
3. Keep a close eye on the performance of the mooring equipment to ensure the SWL is not exceeded at any time.
4. Ensure own safety and the safety of other team members.
5. Maintain clear lines of communication with the team leader.
6. Exercise STOP work authority if the need arises.

In addition to the Supervising officer, the minimum number of ratings that shall constitute each stations must be as per below table:

OPERATIONS	Forward Station	Aft Station
Dropping Anchor	1	Na
Heaving Anchor	1	Na
Mooring At Berth	2 *	2
Unmooring at berth	2 *	2
Mooring STS	2 *	2
Unmooring STS	2 *	2
Mooring SBM / CBM	2 *	1
Unmooring SBM / CBM	2	1
Other special mooring	2 *	2

* For Vessel with deadweight greater than 50000 tons, 3 ratings shall be employed for each forward mooring station.

*Master has the discretion to increase the manning level as required bythe prevailing circumstances and special requirements of the situation.

13 REMARKS TO THE POLICE'S PRE-TRIAL RECORD

This chapter focuses on the Pre-Trial Investigation Record by the Finnish Police, 2400/R/941/24 26.5 2025

The Pre-Trial Record comprises approximately 600 pages. We make remarks about the record as below. The page numbers mentioned in the notes are valid for the Finnish version of the Pre-Trial Record.

13.1 INTERROGATIONS MADE BY THE POLICE (CONFORMITY)

We note that there is full conformity among the statements made by the ship's crew during Police interrogations.

13.2 POLICE FORENSICS (THE FIRST ANCHOR LOCK)

We note that the Pre-Trial Record contains an "Attachment #10", where at **page 476** the Forensic Laboratory of the Finnish Police has conducted an investigation on the bolt holding the lower end of the guillotine bar's turnbuckle attached to the pad eye that is welded onto deck.

The laboratory concludes that neither the bolt nor its locking pin show any signs of tools usage on them.

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LAUSUNTO 518/3/25 476

10.4.2025 1(4)

Tutkimuksen tilaaja: Keskusrikospoliisi PL 285 01301 VANTAA	Ilmoituksen numero 2400/R/941/24 Tutkimuspyynnön numero 2400/R/941/24/TEK/4 Tutkimuspyynnön päivämäärä 14.01.2025

Pyydetyt tutkimukset / tuotteet

Onko näytteissä 16 ja 17 irtoamistapaa selvittäviä jälkiä?

Onko näytteissä 16 ja 17 työkalun jättämiä jälkiä?

SALASSA PIDETTÄVÄ
JulkL (621/1999) 24.1 §:n 3 k
L (____/____) ___ §:n ___k

Rikostekniseen laboratorioon toimitettu tutkimusaineisto

Näyte	Tilaajan tutkimus- ja lausuntopyyntöön kirjaama näytekuvaus	Vastaanotettu
16	Lukitustappi. Eagle S:n vasemman puoleisen ankkurin lukituslaitteen luota kannelta taltioitu.	15.01.2025
17	Lukitustappi. Eagle S:n vasemman puoleisen ankkurin lukituslaitteen luota kannelta taltioitu.	15.01.2025

Tutkimustulokset

Näytteen 17 lukitustapin (kuva 1) toisessa päässä on tapin läpi menevä reikä ja sen sisällä on kaksiosainen sokka. Sokka on todennäköisesti katkennut joko toisesta päästä tai molemmista päistään, koska se ulottuu molemmilta puolilta tapin ulkopinnan tasolle. Lisäksi sokka on litistynyt voimakkaasti kummaltakin puolelta lukitustappia (kuvat 2 ja 3). Näytteen 17 lukitustapissa eikä siinä olevan sokan päissä havaittu työkalun käyttämiseen viittaavia jälkiä.

Näytteen 16 lukitustapissa ei ole paikkaa sokalle. Näytteessä 16 ei havaittu työkalun jättämiä jälkiä.

Johtopäätökset

Näytteissä 16 ja 17 ei havaittu sellaisia jälkiä, jotka selvittäisivät niiden irtoamistapaa.

Lisätietoja

Tässä lausunnossa ilmoitetut tulokset koskevat Rikosteknisen laboratorion vastaanottamaa tutkimusaineistoa.

Dokumentin saa kopioida vain kokonaisuudessaan.

KESKUSRIKOSPOLIISI
Rikostekninen laboratorio
Tikkurilantie 30, 01370 VANTAA

FINAS
Finnish Accreditation Service
T079 (EN ISO/IEC 17025)

POLIISI
KESKUSRIKOSPOLIISI

LAUSUNTO 518/3/25 476

10.4.2025 1(4)

Tutkimuksen tilaaja: Keskusrikospoliisi PL 285 01301 VANTAA	Ilmoituksen numero Tutkimuspyynnön numero Tutkimuspyynnön päivämäärä	2400/R/941/24 2400/R/941/24/TEK/4 14.01.2025

Pyydetyt tutkimukset / tuotteet

Onko näytteissä 16 ja 17 irtoamistapaa selvittäviä jälkiä?

Onko näytteissä 16 ja 17 työkalun jättämiä jälkiä?

SALASSA PIDETTÄVÄ
JulkL (621/1999) 24.1 §:n 3 k
L (___/___) ___ §:n ___k

Rikostekniseen laboratorioon toimitettu tutkimusaineisto

Näyte	Tilaajan tutkimus- ja lausuntopyyntöön kirjaama näytekuvaus	Vastaanotettu
16	Lukitustappi. Eagle S:n vasemman puoleisen ankkurin lukituslaitteen luota kannelta taltioitu.	15.01.2025
17	Lukitustappi. Eagle S:n vasemman puoleisen ankkurin lukituslaitteen luota kannelta taltioitu.	15.01.2025

Tutkimustulokset

Näytteen 17 lukitustapin (kuva 1) toisessa päässä on tapin läpi menevä reikä ja sen sisällä on kaksiosainen sokka. Sokka on todennäköisesti katkennut joko toisesta päästä tai molemmista päistään, koska se ulottuu molemmilta puolilta tapin ulkopinnan tasolle. Lisäksi sokka on litistynyt voimakkaasti kummaltakin puolelta lukitustappia (kuvat 2 ja 3). Näytteen 17 lukitustapissa eikä siinä olevan sokan päissä havaittu työkalun käyttämiseen viittaavia jälkiä.

Näytteen 16 lukitustapissa ei ole paikkaa sokalle. Näytteessä 16 ei havaittu työkalun jättämiä jälkiä.

Johtopäätökset

Näytteissä 16 ja 17 ei havaittu sellaisia jälkiä, jotka selvittäisivät niiden irtoamistapaa.

Lisätietoja

Tässä lausunnossa ilmoitetut tulokset koskevat Rikosteknisen laboratorion vastaanottamaa tutkimusaineistoa.

KESKUSRIKOSPOLIISI
Rikosteknninen laboratorio
Tikkurilantie 30, 01370 VANTAA

Dokumentin saa kopioida vain kokonaisuudessaan.

FINAS
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POLIISI
KESKUSRIKOSPOLIISI

LAUSUNTO 518/3/25 477

10.4.2025 2(4)

Näytteiden loppukäsittely

Näyte	Loppukäsittely
16	Näyte palautetaan
17	Näyte palautetaan

Tutkimusmenetelmät RLAB-MUO2*

*) Akkreditoitu tutkimusmenetelmä **) Akkreditoimaton tutkimusmenetelmä

Lisätietoa tutkimusmenetelmistä on saatavilla RTL-netistä tai Rikosteknisestä laboratoriosta erikseen pyydettäessä.

Lisätietoja akkreditoinnista

Rikosteknninen laboratorio on FINAS-akkreditointipalvelun akkreditoima testauslaboratorio T079, akkreditointivaatimus SFS-EN ISO/IEC 17025. Akkreditointi kuuluu European co-operation for Accreditation (EA) monenkeskiseen tunnustamissopimukseen EA MLA. Akkreditoimilla tarkoitetaan kansainvälisiin kriteereihin perustuvaa menettelytapaa, jonka avulla toimielimen (tässä tapauksessa Rikosteknisen laboratorion) pätevyys tuottaa tutkimustuloksia ja johtopäätöksiä on luotettavasti todettu. Akkreditoituun pätevyysalueeseen sisältyvät tutkimusmenetelmät ovat nähtävissä verkkosivuilta www.finas.fi/toimijat. Lausunnon laatiminen sisältyy akkreditoinnin piiriin.

Pientä osaa Rikosteknisen laboratorion käyttämistä tutkimusmenetelmistä ei ole akkreditoitu. Tämä johtuu pääsääntöisesti siitä, että kyseinen tutkimusmenetelmä on harvoin käytetty tai sitä sovelletaan harvinaislaatuisella tavalla, jolloin menetelmää ei ole voitu liittää akkreditoinnin piiriin. Akkreditoimattomien tutkimusmenetelmien käytössä noudatetaan Rikosteknisen laboratorion laatujärjestelmän määrittelemiä menetelmäkohtaisia laadunvarmistusmenettelyjä, joilla tutkimusten laatu varmistetaan.

Yhteydenotot

Muotojälkitutkimusalueen päivystys (virka-aikana) p. 0295 486 324, ritke.rtl.krp@poliisi.fi

Keskusrikospoliisin Rikosteknisen laboratorion lausunto ei ole yksittäisen henkilön vaan viranomaisen antama asiantuntijalausunto. Mikäli tutkinnanjohtaja, syyttäjä tai asianosaiset haluavat pyytää lausunnosta lisätietoja tai muita selvityksiä, pyydämme olemaan yhteydessä ko. tutkimusalueen päivystäjään (yhteystiedot edellä). Asianosaisten yhteydenottojen tulee kuitenkin tapahtua tutkinnanjohtajan tai syyttäjän kautta. Tutkimusalueen päivystäjään tulee olla yhteydessä myös silloin, kun laboratorion asiantuntija halutaan kutsua oikeuteen todistamaan.

KESKUSRIKOSPOLIISI
Rikosteknninen laboratorio
Tikkurilantie 30, 01370 VANTAA

Dokumentin saa kopioida vain kokonaisuudessaan.

FINAS
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POLIISI
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10.4.2025 3(4)

Kuvat



Kuva 1. Näytteenä 17 oleva lukitustappi



Kuva 2. Näytteen 17 lukitustapissa olevan sokan toinen pää

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Dokumentin saa kopioida vain kokonaisuudessaan.

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10.4.2025 4(4)



Kuva 3. Näytteen 17 lukitustapissa olevan sokan toinen pää.

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Dokumentin saa kopioida vain kokonaisuudessaan.

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13.3 Police forensics (the third anchor lock)

We note that the Pre-Trial Record contains an "Attachment #11", where at **page 481** the Forensic Laboratory of the Finnish Police has conducted an investigation on the anchor lock #3, the lashing wire.

The laboratory concludes that the breaking point of the lashing wire does not imply a cut with a cutter tool.

POLIISI
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LAUSUNTO 518/1/25 002

481

5.2.2025 1(3)

Tutkimuksen tilaaja: Itä-Uudenmaan poliisilaitos PL 98 01301 VANTAA	Ilmoituksen numero 2400/R/941/24 Tutkimuspyynnön numero 2400/R/941/24/TEK/1 Tutkimuspyynnön päivämäärä 08.01.2025

Pyydetyt tutkimukset / tuotteet Onko näytteissä 1 ja 2 leikkaavan työkalun jälkiä?

SALASSA PIDETTÄVÄ

JulkL (621/1999) 24.1 §:n 3 k
L (____/ ____) ___ §:n ___k

Rikostekniseen laboratorioon toimitettu tutkimusaineisto

Näyte	Tilaajan tutkimus- ja lausuntopyyntöön kirjaama näytekuvaus	Vastaanotettu
1	ESINE: Leikattu hydraulisella leikkurilla Eagle S aluksen vasemmanpuoleisen ankkurikoneiston vieressä vasemmalla puolella kannella olleesta katkenneesta vaijerista pala. Vaijerin paksuus 25mm.	08.01.2025
2	ESINE: Leikattu hydraulisella leikkurilla Eagle S aluksen vasemmanpuoleisen ankkurikoneiston vieressä oikealla puolella kannella olleesta katkenneesta vaijerista pala. Vaijerin paksuus 25mm	08.01.2025

Tutkimustulokset Näytteinä 1 ja 2 on kaksi vaijerin kappaletta, joiden rakenne on tutkittavissa päissä osittain hajonnut (kuvat 1 ja 3). Vaijerin kappaleiden tutkittavien päiden useassa langassa on hankautumiseen viittaavia jälkiä sekä terävän esineen aiheuttamia jälkiä (kuvat 2 ja 4).

Johtopäätökset Näytteissä 1 ja 2 olevat jäljet eivät sovi leikkureiden jättämiksi.

Lisätietoja Tässä lausunnossa ilmoitetut tulokset koskevat Rikosteknisen laboratorion vastaanottamaa tutkimusaineistoa.

Näytteiden loppukäsittely

Näyte	Loppukäsittely
1	Näyte palautetaan
2	Näyte palautetaan

Tutkimusmenetelmät RLAB-MUO2*

*) Akkreditoitu tutkimusmenetelmä **) Akkreditoimaton tutkimusmenetelmä

Lisätietoa tutkimusmenetelmistä on saatavilla RTL-netistä tai Rikosteknisestä laboratoriosta erikseen pyydettäessä.

Dokumentin saa kopioida vain kokonaisuudessaan.

KESKUSRIKOSPOLIISI
Rikostekninen laboratorio
Tikkurilantie 30, 01370 VANTAA

FINAS
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Tutkimuksen tilaaja: Itä-Uudenmaan poliisilaitos PL 98 01301 VANTAA	Ilmoituksen numero 2400/R/941/24 Tutkimuspyynnön numero 2400/R/941/24/TEK/1 Tutkimuspyynnön päivämäärä 08.01.2025

Pyydetyt tutkimukset / tuotteet Onko näytteissä 1 ja 2 leikkaavan työkalun jälkiä?

SALASSA PIDETTÄVÄ
JulkL (621/1999) 24.1 §:n 3 k
L (___/___) ___ §:n ___k

Rikostekniseen laboratorioon toimitettu tutkimusaineisto

Näyte	Tilaajan tutkimus- ja lausuntopyyntöön kirjaama näytekuvaus	Vastaanotettu
1	ESINE: Leikattu hydraulisella leikkurilla Eagle S aluksen vasemmanpuoleisen ankkurikoneiston vieressä vasemmalla puolella kannella olleesta katkenneesta vaijerista pala. Vaijerin paksuus 25mm.	08.01.2025
2	ESINE: Leikattu hydraulisella leikkurilla Eagle S aluksen vasemmanpuoleisen ankkurikoneiston vieressä oikealla puolella kannella olleesta katkenneesta vaijerista pala. Vaijerin paksuus 25mm	08.01.2025

Tutkimustulokset Näytteinä 1 ja 2 on kaksi vaijerin kappaletta, joiden rakenne on tutkittavissa päissä osittain hajonnut (kuvat 1 ja 3). Vaijerin kappaleiden tutkittavien päiden useassa langassa on hankautumiseen viittaavia jälkiä sekä terävän esineen aiheuttamia jälkiä (kuvat 2 ja 4).

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Lisätietoja Tässä lausunnossa ilmoitetut tulokset koskevat Rikosteknisen laboratorion vastaanottamaa tutkimusaineistoa.

Näytteiden loppukäsittely

Näyte	Loppukäsittely
1	Näyte palautetaan
2	Näyte palautetaan

Tutkimusmenetelmät RLAB-MUO2*

*) Akkreditoitu tutkimusmenetelmä **) Akkreditoimaton tutkimusmenetelmä

Lisätietoa tutkimusmenetelmistä on saatavilla RTL-netistä tai Rikosteknisestä laboratoriosta erikseen pyydettäessä.

Dokumentin saa kopioida vain kokonaisuudessaan.

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Lisätietoja akkreditoinnista

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Pientä osaa Rikosteknisen laboratorion käyttämistä tutkimusmenetelmistä ei ole akkreditoitu. Tämä johtuu pääsääntöisesti siitä, että kyseinen tutkimusmenetelmä on harvoin käytetty tai sitä sovelletaan harvinaislaatuisella tavalla, jolloin menetelmää ei ole voitu liittää akkreditoinnin piiriin. Akkreditoimattomien tutkimusmenetelmien käytössä noudatetaan Rikosteknisen laboratorion laatujärjestelmän määrittelemiä menetelmäkohtaisia laadunvarmistusmenettelyjä, joilla tutkimusten laatu varmistetaan.

Yhteydenotot Muotojälkitutkimusalueen päivystys (virka-aikana) p. 0295 486 324, ritke.rtl.krp@poliisi.fi

Keskusrikospoliisin Rikosteknisen laboratorion lausunto ei ole yksittäisen henkilön vaan viranomaisen antama asiantuntijalausunto. Mikäli tutkinnanjohtaja, syyttäjä tai asianosaiset haluavat pyytää lausunnosta lisätietoja tai muita selvityksiä, pyydämme olemaan yhteydessä ko. tutkimusalueen päivystäjään (yhteystiedot edellä). Asianosaisten yhteydenottojen tulee kuitenkin tapahtua tutkinnanjohtajan tai syyttäjän kautta. Tutkimusalueen päivystäjään tulee olla yhteydessä myös silloin, kun laboratorion asiantuntija halutaan kutsua oikeuteen todistamaan.

Dokumentin saa kopioida vain kokonaisuudessaan.

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KUVAT



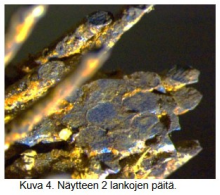
Kuva 1. Näyte 1.



Kuva 2. Näytteen 1 lankojen päitä.



Kuva 3. Näyte 2.



Kuva 4. Näytteen 2 lankojen päitä.

Dokumentin saa kopioida vain kokonaisuudessaan.

FINAS
Finnish Accreditation Service
T079 (EN ISO/IEC 17025)

13.4 Interrogations made by the Police (the VDR)

According to the Pre-Trial Record, the Police had already at 24 January 2025 been able to access the recorded data in the VDR. This conclusion results from:

- The interrogation made on 24 January, 2025 with the Second Officer and the sentence below, found on **page 73**:

  "MERKITÄÄN: Kuunnellaan 1 minuutin ja 50 sekunnin tallenne Eagle S -aluksen VDR:stä (Voyage Data Recorder). Tallenne alkaa noin klo 16:19 laivan aikaan (UTC+3)."

- The interrogation made on 24 January 2025 with the First Officer and the sentence below, found on **page 99**:

  "MERKITÄÄN: Soitetaan kuultavalle laivan VDR tallenteelta ääninauhaa 25.12.2024 klo 15.20 alkaen. Äänitiedosto M2- STBD RADAR - BRIDGE FWD 241225,125956,M2,0000000 kohdasta 19.24 alkaen."

- The interrogation made on 31 January 2025 with the Master and the sentence below, found on **page 132**:

  "*MERKITÄÄN: Soitetaan kuultavalle laivan VDR tallenteelta ääninauhaa 25.12.2024 klo 15.20 alkaen. Äänitiedosto M2- STBD RADAR - BRIDGE FWD 241225,125956, M2,0000000 kohdasta 19.24 alkaen."*

These confirm our statements in section 4.3 VDR – the Voyage Data Recorder at page 7.

13.5 The Police's request to the FMI (weather information)

The protocol has, on page 535, a statement from the Finnish Meteorological Institute. FMI is asked by the Police to give an overview of the weather conditions at two locations, for two times:

1. at 59° 57.53330' N 26° 09.96810' E for 12:13 UTC+2

   The statement expresses the wind strength at 12:13 as "8-13 m/s" and the wind gust as "11-15 m/s". However, according to FMI's own historical weather data collected at the Kallbådagrund lighthouse/weather station, the wind strength was 13 m/s and the wind gust 15.7 m/s.

   At 12:13 UTC+2 the position of the Eagle S was lat, lon = 59.95894931681751 26.16658386207145, which is shown in the picture after this section.

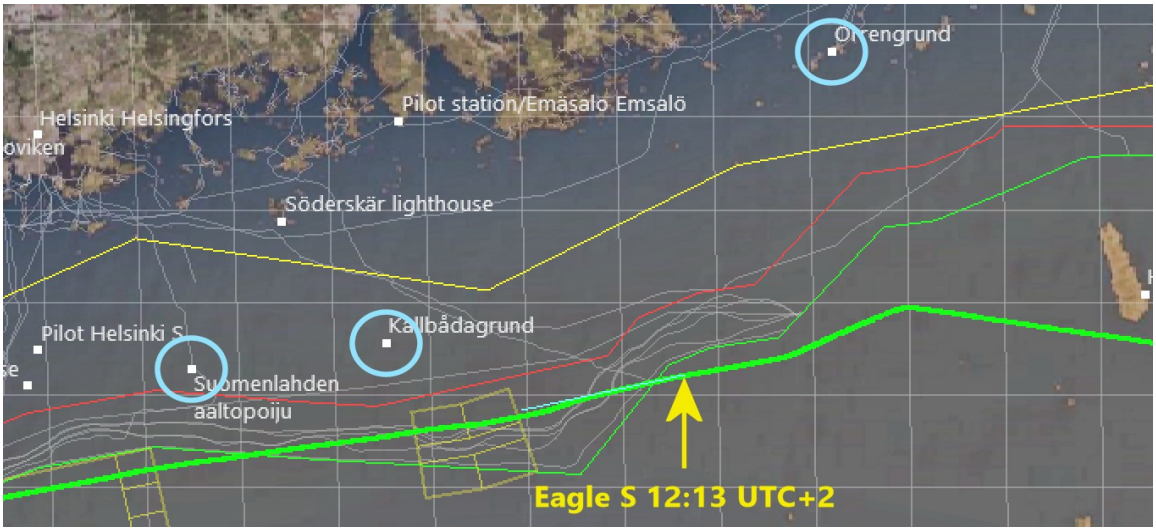
   As the Kallbådagrund weather station is far closer to the Eagle S route, and as the distance from Eagle S to the Orrengrund weather station at 12:13 was over 38 km, we suggest that the Kallbådagrund observations give a more accurate

representation of the wind conditions in effect at 12:13.

The statement refers to the "Suomenlahden aaltopoiju" wave sensor buoy (lat, lon = 59,965004167, 25,235164444) and the values 2.0 and 2.9 m for significant and maximum wave height. However, at 12:13 the distance between this buoy and the Eagle S was over 52 km. We suggest that the Copernicus Marine data of 2.1 and 3.3 m for significant and maximum wave height give a more accurate representation of the wave conditions in effect.

2. at 59° 48.89220′ N 24° 40.09380′ E for 18:43 UTC+2

At 18:43 UTC+2 the Eagle S was already being detained (had passed Helsinki), hence this observation has no relevance for the actual cause of the incident.



Eagle S at 12:13 UTC+2, the Kallbådagrund and Orrengrund weather observation stations and the "Suomenlahden aaltopoiju" wave sensoring buoy shown by blue circles

13.6 PICTURE TEXT (CHAIN STOPPER)

Picture text, at **page 372**:

11. Yleiskuva Eagle S tyyrpuurin puoleisen ankkuripelin kettinkipidättimestä

The picture shows the starboard side chain brake and the turnbuckle holding the guillotine bar down to ship deck. The picture text is as follows:

Eagle S aluksella ketjulukko varmistetaan aluksen kanteen vanttiruuvilla (eng. Bottle screw). Kongsberg Marinetime Finland Oy:n poliisin pyynnöstä suorittamassa tutkimuksessa todettiin, että vanttiruuvi ei kuulu ketjulukon alkuperäiseen kokoonpanoon vaan se on asennettu jälkikäteen. (ETPK liite 26)

In English:

On the Eagle S, the chain lock is secured to the ship's deck with a bottle screw. An investigation conducted by Kongsberg Marinetime Finland Oy at the request of the police found that the bottle screw is not part of the chain lock's original assembly but has been installed afterwards. (ETPK Appendix 26)

We emphasise again that the "original assembly" is **unclear, as Kongsberg has not shown what it should be**. The reason for the shipyard having installed a bottle screw is most likely that the guillotine bar hasn't stayed sufficiently down, due to a weak design of the original construction. We have pinpointed this in section 9.1.2 Problematic design of the chain stopper at page 122.

13.7 Traficom's statement (the windlass)

The Pre-Trial Report contains, on the above mentioned page, a statement from Finnish authority Traficom:

Liikenne- ja viestintäviraston lausunto Eagle S:n telakointiraporteista

The statement holds a text on **page 573**, third paragraph:

On tärkeää huomata, etteivät ankkurivinssien jarrujärjestelmät olleet keskenään identtiset. Esimerkiksi vasemmanpuoleisessa vinssissä jarrun kiristysvarsi oli lähes 20 cm pidempi kuin oikeanpuoleisessa.

In English:

It is important to note that the brake systems of the anchor winches were not identical. For example, the brake tension arm on the port winch was almost 20 cm longer than the starboard winch.

We note that this is – to our knowledge – the **only** difference between the port side and starboard side winches. Additionally, we believe that Traficom means the **tension screw ("kiristysruuvi"), not the tension arm ("kiristysvarsi")**.

The excess length of this screw is irrelevant.

13.8 Kongsberg's statement (the chain stopper)

The Pre-Trial Report contains an "Inspection Report" attachment #26 on **page 574 (Fi)** and on **page 586 (Eng)**;

We do not wish to comment on the report in general, but only on two specific observations:

1) The inspection examines the **current state** of the windlass and anchor brake arrangement. However, this does not necessarily relate to its state **prior to the incident**.

   The equipment has been under extreme stress due to what appears to be an unintentional anchor release and pull. This has most certainly damaged the equipment, changing its state.

   This is a logical parameter. We suggest that Kongsberg should have emphasised this in its report.

2) On **page 590**, we find the following text:

   Stopper pawl found with later made additional locking device, which is able to tight by rigging screw to deck

   Kongsberg however fails to describe how the locking of the guillotine bar should work. From the included pictures we can see, on the opposite side of the chain brake, a rather weak construction with the following explanatory text:

   Locking support plate for locking pin of stopper pawl is bent to fwd direction

   We are sceptical about this "locking pin of stopper pawl" construction, if it is intended to be the sole securing method for keeping the guillotine bar in locked/lowered position.

   We suggest that Kongsberg should have pinpointed precisely in the report how the construction is supposed to work.

In addition, a background for the construction would have been useful for all involved parties. For example, where was it made, in Finland, in China on Rauma licence, …? Is it a common solution, is the model maintained, are spare parts available, etc? This information does not appear to have been requested.

13.9 Logical problem in graph with comparison of vessel speeds

The Pre-Trial protocol contains a graph where the speeds of three vessels are compared to each other, over a time axis. The two other vessels in the vicinity of the Eagle S are "Perth 1" and "Xin Xin Shan 2".

The graph contains a **leap of logic** (fin: "looginen kuperkeikka", swe: "logisk kullerbytta") that is hard to see:

At the beginning (left) of the chart, all three vessels are very near each other. The Eagle S is about to pass Perth 1, which Eagle S now has on it's starboard beam. The Xin Xin Shan

2 is also very near, in the order of less than 1 Nm, and to be passed shortly on its port side.

But at the end of the graph, the two other vessels have continued with normal (slightly decreased) voyage speeds, while the Eagle S has

- slowed down at 10:13:04, then
- completely stopped (to fix the engine), then
- drifted in the opposite direction, and eventually
- reached steady voyage speed again at approximately 13:07:00.

After the above mentioned time window of almost three hours, **the two other vessels are almost one and a half hour ahead of the Eagle S**. The vessels are no longer near each other.

This implies that the environmental conditions **are no longer comparable** in the right half of the graph. It has been shown elsewhere in this report, that the hard winds and worsening sea state came from the Southwest, and that the Eagle S experienced a bad weather peak at its very precise location. Simultaneously, the wave sizes increased as they built up in eastward direction.

The graph in the Police's Pre-Trial Record contains a hidden, logical weakness. The graph does not reveal that the speed comparison between Eagle S and Perth 1+Xin Xin Shan 2 holds an almost 1½ hour time (or location) offset after the Eagle S stop.

The Eagle S might, being "left behind", have experienced a different (worse) sea state than the other two vessels. This may have affected the Eagle S's speed in a different way, in relation to the two other vessels.

We find the right half of the graph below to be scientifically weak.

