aibn Accident Investigation Board Norway

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REPORT Sjø 2010/01

REPORT ON MARINE ACCIDENT
FEDERAL KIVALINA - IMO NO. 9205885
GROUNDING AT ÅRSUNDØYA, NORWAY
6 OCTOBER 2008

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This report has been translated into English and published by the Accident Investigation Board Norway (AIBN) to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

AIBN has compiled this report for the sole purpose of improving safety at sea. The object of a safety investigation is to clarify the sequence of events and root cause factors, study matters of significance for the prevention of maritime accidents and improvement of safety at sea, and to publish a report with eventually safety recommendations. The Board shall not apportion any blame or liability. Use of this report for any other purpose than for improvements of the safety at sea should be avoided.

Photo of ferry on the Norwegian west coast: Bente Amandussen

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NOTIFICATION OF THE ACCIDENT

Federal Kivalina ran aground at 0510 hours on 6 October 2008 at Årsundøya in Møre and Romsdal county, Norway. There were 21 crew members and a pilot on board. The ship was fully loaded with aluminium oxide. No one was injured and there was no pollution of the external environment.

The Accident Investigation Board of Norway (AIBN) received notice of the grounding at 0620 hours from the Rescue Coordination Centre for Southern Norway. The AIBN proceeded to Kristiansund on the same day and further to the site of the accident on the morning of 7th October.

Figure 1: Grounding of the Federal Kivalina, 6 October 2008 at Skarvbergneset, Årsundøya.

SUMMARY

The subject of the safety investigation is the grounding of the bulk ship Federal Kivalina at Skarvbergneset, Årsundøya on 6 October 2008 at 0510 hours (local time). There were 21 crew members and a pilot on board. The ship was fully loaded with 35,700.8 tonnes of aluminium oxide to be unloaded at Hydro Aluminium AS' quay facility at Sunndalsøra. The grounding resulted in material damage only to the forepart of the ship.

The analysis of the accident revealed a gradual loss of control over the navigation, which started as early as from the pilot boarding place at Grip, before the pilot came on board. The loss of control occurred gradually, without the ship's bridge crew or the pilot noticing this. The necessary corrective measures were thus not implemented in time.

The investigation revealed that the ship's bridge crew was not sufficiently prepared for the five-hour voyage from the pilot boarding place to the quay. Further analysis revealed that, after arrival at the pilot boarding place at Grip, the bridge team did not function as intended. This means, in part, that the ship's bridge crew did not function as a bridge team, and in part that there were concurrent and mutual expectations among the ship's bridge crew and pilot that it was not necessary to function as a bridge team, and in part that the piloting service did not stipulate sufficient requirements that the pilot shall be part of the bridge team. The criteria for when the ship could safely come alongside the quay were left to an individual assessment on board the vessel. The owner of the quay facility, the ship's agent/terminal representative and the piloting service did not make sufficient preparations for the assignment for the pilot and the ship's bridge crew.

The investigation of the marine accident revealed six areas where the AIBN finds it necessary to make safety recommendations for the purpose of improving marine safety. These safety recommendations are aimed at the ship management company, the Norwegian National Coastal Administration, the operator of the quay facility and the ship’s agent/terminal representative.

1. FACTUAL INFORMATION

1.1 Details about the ship and the accident

Figure 2: Federal Kivalina. Photo: KV Njord.

Details about the ship

Name of the ship	:	Federal Kivalina
Call sign	:	VRWK5
IMO no.	:	9205885
Owner	:	Federal Oceans Ltd. Hong Kong
Ship management co./ISM-responsible:		Anglo-Eastern Ship Management Ltd.
Insurance - P&I	:	Dex Serv. Limited
Assurance – hull & machinery	:	Groupama Transport
Ship type	:	Bulk carrier
Build year / place / no.	:	2000 / Oshima Shipbuilding Co., Japan / 10277
Flag state	:	Hong Kong
Port of registry	:	Hong Kong
Classification society	:	DNV
Hull material	:	Steel
Length over all (LOA)	:	199.99 meters
Breadth	:	23.76 meters
Gross tonnage	:	20,659
Main engine type	:	1 ea. Kawasaki MAN B&W 6S46MC-C
Engine power	:	7877 kW
Rudder and propulsion type	:	1 ea. semi spade rudder, 1 ea. 5-blade fixed pitch type
VDR – type	:	SVDR-3200, Transas
Radar	:	2 ea. JRC 9700 series, arpa, 10cm (S-band) and 3cm (X-band)
GPS	:	3 ea. Furuno
AIS	:	R3-AIS Shipborne Class A Transponder System, SAAB
ECDIS hardware	:	NAVI Sailor 3000 ECDIS, Transas with electronic charts: - Electronic navigational chart (ENC) - Admirality Raster Chart Services (ARCS) - Transas TX-97 vector chart

Figure 3: Federal Kivalina. Photo: NRK

Details about the accident

Time and date	:	0510 (local time, UTC +2), 6 October 2008
Accident location	:	Skarvbergneset, Årsundøya, Norway, position N 63° 5.33' Ø 7° 57.12'
Persons on board	:	21 crew members and 1 pilot (state pilot)
Personal injuries/fatalities	:	None
Damage to the ship	:	Hull damage and water ingress forward bottom
Environmental damage	:	None

Figure 4: Federal Kivalina by Sunndalsøra, Norway. Photo: Aure Avis

Details about the cargo, quay facility and the ship's agent

Type and quantity of cargo	:	Aluminium oxide, 35 700.80 tonnes
Cargo owner	:	Hydro Aluminium AS
Owner of quay facility and quay operator:		Hydro Aluminium AS
Terminal representative	:	Shipping Service AS
Ship agent	:	Shipping Service AS

1.2 Course of events[1]

The ship arrived at Puerto Cabello, Venezuela on 4 August 2008. Two days later the ship was notified about the charter involving aluminium oxide from Vila Do Conde, Brazil to Karmøy, Norway. At the end of August the ship sailed to Vila Do Conde

On 18 and 19 September, the Federal Kivalina loaded on board a total of 35,700.80 tonnes of aluminium oxide, distributed equally among all cargo holds. According to the contract of affreightment signed by the captain on 18 September, the cargo was to be delivered to one of Hydro Aluminium AS' facilities at Karmøy, Høyanger, Årdalstangen, Sunndalsøra and/or Husnes.[2]

The ship left Vila Do Conde at 0136 hours on 20 September 2008. The ship estimated that it would arrive at its port of discharge, Hydro Aluminium AS' quay facility at Karmøy, on 4 October 2008. This information was submitted to the ship management company, Anglo-Eastern Ship Management (AESM) and the local agent in Karmøy. The ship was instructed by Fednav (Belgium) N.V. on 22 September that the correct port of discharge was Sunndalsøra.

On 23 September, Shipping Services AS, the ship's agent for Sunndalsøra, informed the master on board Federal Kivalina about the quay facility's restrictions, which stated a maximum depth of 9.3 m. The master informed the agent that the ship's estimated draught would be 10.70 m (0 trim) upon arrival at Sunndal. Shipping Service AS informed the master that they would arrange for tugboats to keep the ship clear of the quay until sufficient cargo had been discharged. This entailed that the ship would have to be held approximately 4 meters away from the quay with the aid of two tugboats for about 14 hours.

The day before, the ship requested that the ship management company purchase electronic navigational charts (ENC) covering the approach to Sunndalsøra. The codes for the electronic charts were ordered by the ship management company from its regular chart distributor in Canada on 23 September. Within 24 hours, the ship received an e-mail with the necessary codes to open these charts. The bridge crew attempted to install the charts, without success. ARCS (Admiralty Raster Chart Services - overview charts) were ordered on the same day, and these were installed. The ship management company also ordered navigational charts (paper) for the approach to Sunndalsøra via the ship's agent. These charts were to be brought out with the pilot boat at Grip.

The weather worsened when the ship came northwest of Ireland, necessitating a change of course. This delayed the ship by nearly two days. The time of arrival at the pilot boarding place was changed several times. The final arrival time at the pilot boarding place at Grip was reported to the piloting service as 0400 hours on 6 October.

On 5 October, the day before the accident, the pilot called the Kvitsøy piloting service around 1000 hours, and received two pilot assignments. The first pilot

[1] All times stated in local time, i.e. UTC +2 in Norway and UTC -3 in Brazil.
[2] All locations in Norway.

assignment was subsequently cancelled, while the pilot assignment for Federal Kivalina was postponed. In the evening of 5 October, the pilot received a new message that the assignment would be delayed further, and that the ship would arrive at the pilot boarding place at Grip at around 0400 hours the next morning.

Well before arrival at the pilot meeting site at Griphølen on the morning of 6 October, the master was called to the bridge. At this point, the second officer was the navigator on duty. Both the second officer and the master concentrated on navigation of the ship up to the pilot boarding place. The cadet (midshipman) came to the bridge at 0315 hours to keep watch.

The pilot received a phone call from Kvitsøy piloting service around 0200 hours and took the pilot boat out from Kristiansund port at around 0230 hours.[3]

The ship arrived at the pilot boarding place at about 0330 hours. When the ship contacted the pilot boat, they were told to sail two nautical miles further in before the pilot would come on board.

The weather at Grip was a strong breeze to moderate gale (10.8-17.1 m/s) from the north-northwest, moderate visibility (5 nautical miles), temperature 8°C and heavy seas (5 m) to the southeast. It was dark, and sunrise did not occur until 0740 hours.

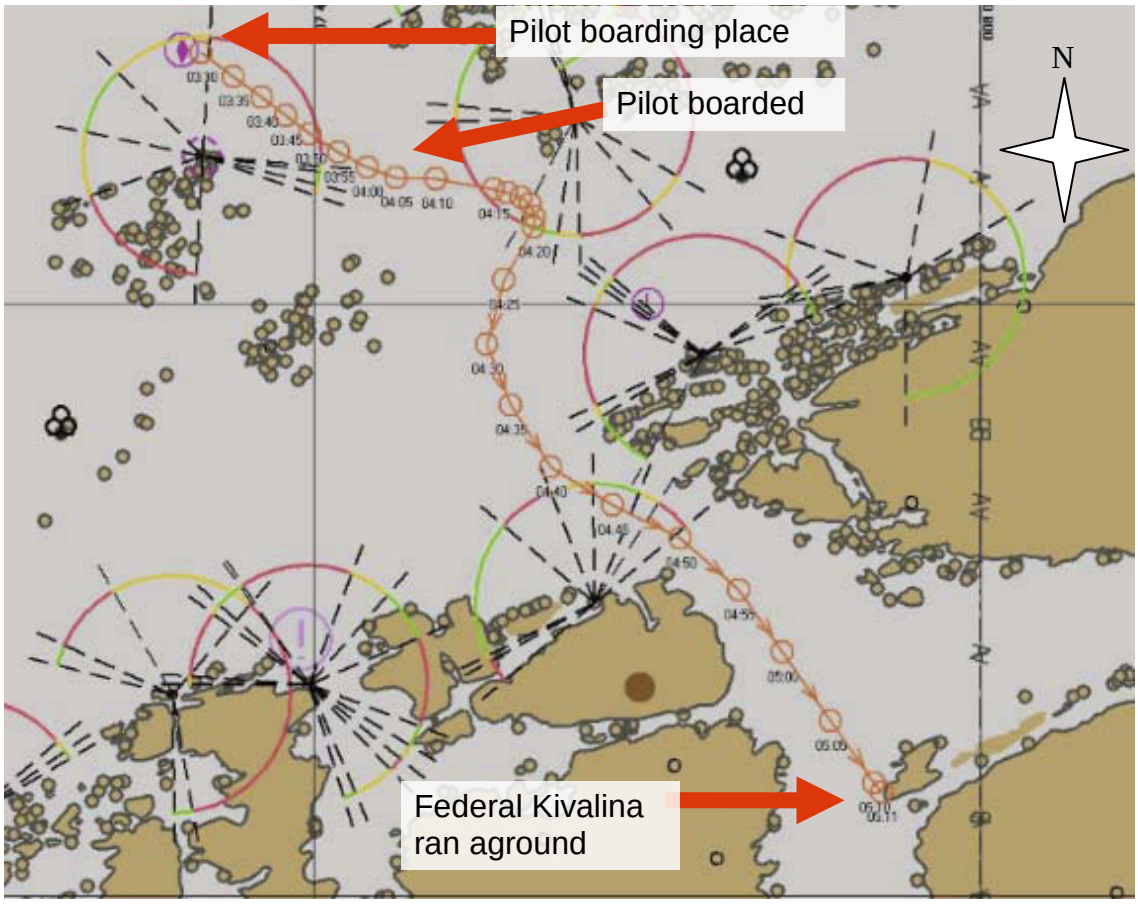

Figure 5: Overview of the ship's movements from Griphølen and south-easterly to the site of the accident at Skarvbergneset, Årsundøya.

[3] The pilot was on board the pilot boat for about 1.5 hours before he went on board the Federal Kivalina.

Just before 0400 hours, the chief officer and a helmsman came to the bridge. The chief officer took over the navigational watch from the second officer. The cadet's task was to be lookout and the helmsman took over the helm. Up until the ship ran aground, the chief officer mostly stayed on the port side of the bridge, between the port radar, port bridge wing and the chart table.

At 0402 hours, about 3 nautical miles southeast of the pilot meeting site, the pilot boarded the Federal Kivalina, and was received by the second officer.

At 0404 hours, the pilot arrived on the bridge. The master welcomed the pilot, and informed him about the vessel's course and speed. The pilot confirmed that the information was received and understood by repeating the course and the speed. Immediately after this, full speed was ordered based on a joint understanding between the master and the pilot. The pilot received confirmation that the draught was 10.70 metres. Safe depth at the quay is 9.3 metres.

The pilot boat brought navigational charts for the approach from Griphølen to Sunndalsøra, which were handed over to the second officer, who took the navigational charts up to the chart table on the bridge. The second officer handed over the ’pilot card’ to the pilot and waited for an opportunity to talk with the pilot so that he could draw up the passage plan.

The pilot perceived the ship to be behaving as expected. Progress and steering capacity were satisfactory.

A few minutes later and prior to the approach to Talgsjøen, the Federal Kivalina met and yielded to a northbound vessel.

The ship gained speed and reached 12 knots after about 40 minutes. The ship then kept a speed of 12-13 knots until the time of the accident. The approach to Sunndalsøra was expected to take 5 hours

At 0420 hours, following attempts by the pilot to connect his own PC to the AIS onboard using the pilot plug, the pilot informed the master that the AIS was not functioning correctly.

Sometime between 0420 and 0430 hours, the second officer left the bridge without a plan for the passage between Griphølen and Sunndalsøra having been established in the map. This was explained by the pilot being fully occupied with navigating. The second officer left the bridge to rest.

At 0438 hours, the master called the electrician to the bridge, and the master and the electrician started searching for the error in the AIS.

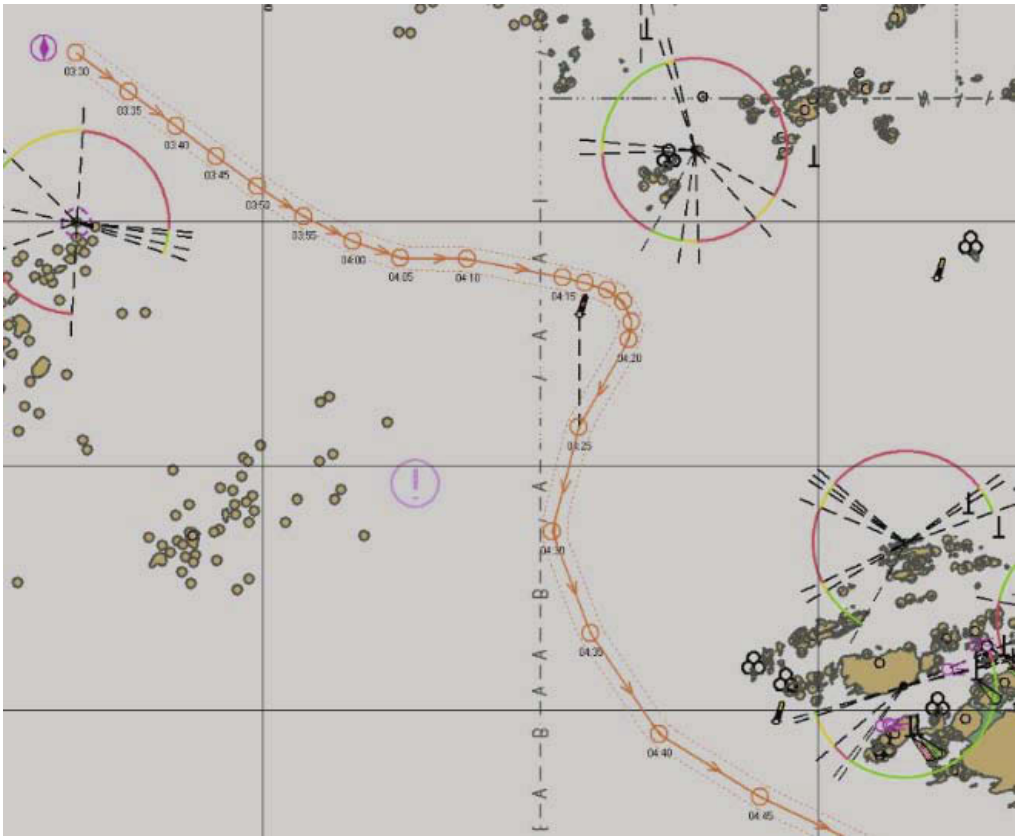

Figure 6: The ship's movements from Griphølen (0330 hrs) and towards the southeast to Talgsjøen (0445 hrs).

At 0452 hours, the ship was in the middle of the fjord in Talgsjøen between Ausfallet at Golma and Kolvikbukta at Nordlandet. The pilot ordered the ship to head for the beacon at Skarvbergneset, Årsundøya by keeping a steady course of 149 degrees. The ship maintained this course until reaching the accident site. There were no other ships nearby.

Visibility improved with some smaller local clouds, and the sea had calmed with only some waves (significant wave height of 1.25 m). The port radar was set at 3 nautical miles and functioned normally, without disturbances from sea and wind conditions. The same was probably true of the starboard radar.

The pilot's experience indicated that when the wind is from the northwest, the wind conditions at the quay facility at Sunndalsøra may be too harsh for ships to safely go alongside the quay. This was especially the case as the ship had to be held away from the quay due to the deep draught. For ships of this size, anchorage is only available in Freifjorden. A decision regarding anchoring had to be made at least 30 minutes before reaching the anchorage site.

As the pilot did not know how the weather conditions at the Hydro quay were, he called the shift manager at the quay facility and asked whether there was a lot of wind at the quay. The shift manager initially answered that the wind was very strong. When the pilot said that it would therefore be best to anchor up pending better weather, the shift manager responded by saying the wind was not so bad. The pilot then argued that this was necessary because the ship had to be kept away from the quay using tugboats. This was repeated several times. Then the pilot asked for

the telephone number to the tugboat. The conversation concluded just before 0500 hours.

At 0500 hours, the pilot and the master agreed that they should anchor in Freifjorden if there was too much wind in Sunndalsøra. In order to receive confirmation of the weather conditions at the Hydro quay, the pilot wanted to telephone the tugboat before making a final decision. As he did not have the telephone number of the tugboat, he telephoned the ship’s agent. The distance to the anchoring location was then about 7.5 nautical miles, or 40 minutes of sailing.

At the same time, the cadet went aft to the chart table to take the ship’s position.

Between 0500 and 0503 hours, the chief officer observed on the port side radar (S-band, range 3 nautical miles) that the ship was heading towards land. The chief officer was not familiar with the pilot's passage plan, but previous experience indicated that the pilot often followed a passage plan which took them near land. He did not consider the situation to be dangerous. At this time, the ship was between 2.3 and 1.7 nautical miles from Skarvbergneset.

At about 0503 hours, the cadet asked the chief officer to check that the position taken at 0500 hours is correct. The chief officer goes aft to the chart table. At 0504 hours, the chief officer sends the cadet down from the bridge.

Just before 0505 hours, the pilot called the tugboat. As the tug was not along the Hydro quay, it could not confirm the weather conditions. The pilot therefore considered the best course of action would be to anchor and wait for better weather, and notified the tugboat accordingly. The conversation was concluded at 0507 hours.

Just after 0505 hours, the master asked the chief officer to state the position in order to enter this in the AIS. The chief officer read out the position, probably from one of the GPS units in the chart table. At the time, the ship was about 1.2 nautical miles from Skarvbergneset at Årsundøya. After that, the master stood together with the electrician, trying to make the AIS work properly. The chief officer remained by the chart table.

Just before 0510 hours, the chief officer sees that the pilot is standing at the back of the chart table. The chief officer then proceeded to the port side radar which showed that the ship was going straight towards land, and that the distance to land was very short, about 300 metres – corresponding to 1.5 ship's lengths. He then went over to the port side wing platform. The chief officer called upon the master's attention and stated that they were very near land. The master immediately summoned the pilot.

The pilot went from the chart table to the bridge and ordered 10 degrees starboard.

Immediately afterwards, the pilot and the master ordered hard starboard at the same time.

The ship only made a few degrees of the turn before running aground on Skarvbergneset, Årsundøya. It took less than 45 seconds from when the chief officer called for the master's attention until the ship ran aground. The ship ran

aground at a speed of 12 knots and came to a standstill just before 0511 hours. The distance between the bow and land at the beacon light on Skarvbergneset was about 10 metres.

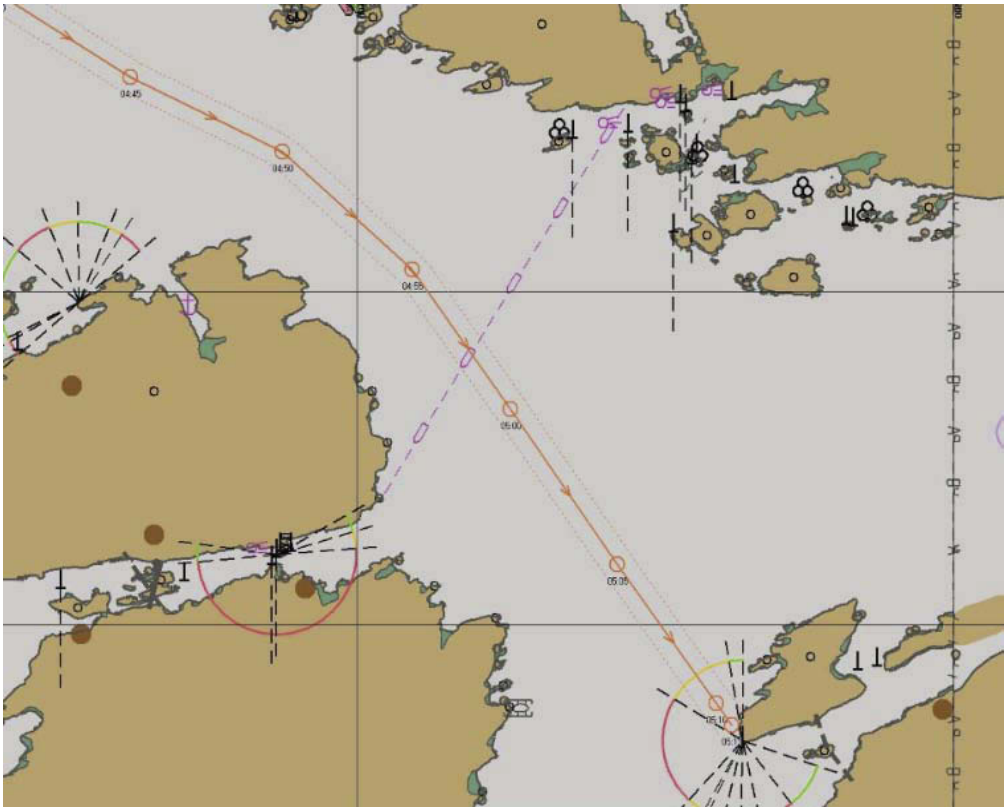

Figure 7: The ship's movements from Talgsjøen (0445 hours) and south-eastwards to the accident site at Skarvbergneset, Årsundøya (0511 hours).

The following were on the bridge at the time of the accident: the master, chief officer, helmsman, pilot and electrician.

The main engine was stopped and, due to uncertainty concerning the state of the ship, the master, in consultation with the pilot, decided not to try and go astern. In parallel with the pilot handling the necessary notification of the incident to the Norwegian authorities, the ship's crew was notified and gauging of the tanks and surveying the extent of the damage were initiated.

1.3 Extent of the damage

Based upon data about the ship's movements, the deceleration from 12 knots to 0 took about 25 seconds. The forward part of the ship was resting on a rocky seabed.

The grounding resulted in no physical injuries and no oil spills.

The extent of the damage was limited to material damage to the ship's hull. The hull damage was limited to the bow section and water intrusion to the forward compartments and up to about 5.5 metres above the baseline. The affected forward compartments were the forepeak, bow thruster room, double bottom tanks (ballast) Nos. 1 and 3, port and starboard sides. A bulge also formed in the bulkhead

between the forepeak and cargo hold No. 1, but no water intruded into the cargo hold.

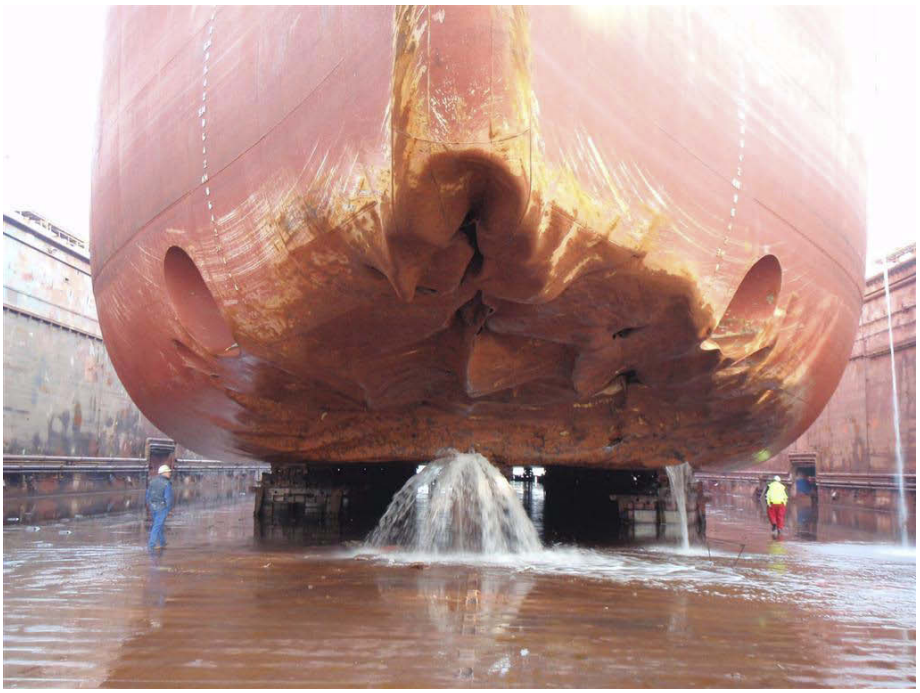

Figure 8: The picture is from the dry-dock in Gdansk and shows the ship seen from the front. The impression is from frame 200 and forwards. For the reader's information, the thruster tunnel is located between frames 211 and 241. In addition, there was damage to the longitudinal girders and shell plating at frame 116. About 130 tonnes of steel was replaced. Photo: DNV

The ship and the cargo were salvaged by a salvage company working on behalf of the ship's owner.

After unloading the cargo, the classification company DNV assessed the extent of the damage, and the ship was permitted to sail under its own power to Gdansk, Poland for final repairs.

1.4 Extent of collection of information

The AIBN has held conversations and interviews with involved parties and witnesses. Information has also been obtained from the ship, from the involved parties and others. The ship's S-VDR[4] gave information about the position of the ship, its speed and sound recording from the bridge.

The police routinely tested the bridge crew and the pilot for alcohol intoxication. There were no indications of alcohol intoxication.

1.5 The ship, the owner and the ship management company

The Federal Kivalina is a conventional bulk carrier with six cargo holds and six hatches. The vessel is equipped with three large cranes on the ship's centreline between every other hatch.

[4] S-VDR = Simplified Voyage Data Recorder.

The bulk carrier is equipped with a six-cylinder reversible two-stroke 7877 kW diesel engine and one rudder. The total load capacity (dead weight) is about 36,600 tonnes. Based on the information about the ship's manoeuvring characteristics, it is estimated that the bow of the vessel will leave the track of the previous course about 1.5 to 1.7 cables[5] from the position where the wheel was put hard over. This is assuming that the ship is fully loaded, going at full speed and under favourable weather conditions.

The ship has previously delivered cargo to Hydro Aluminium AS at Karmøy. Neither the ship nor the bridge crew on board had sailed to Sunndalsøra previously.

1.5.1 The ship owner and ship management company

The ship is owned by Federal Ocean Ltd. in Hong Kong, which is controlled by Fednav Limited, registered in Canada.

Fednav Limited is a privately owned Canadian company with headquarters in Montreal. The freight is primarily dry bulk on a global scale. Of the fleet of 73 ships 21 ships are owned by Fednav Limited and 52 ships are chartered[6]. Federal International Limited is the commercial operator of the bulk ship. Fednav (Belgium) N.V. in Antwerp is one of the companies in the group and is charged with the task of handling the group's commercial interests in Europe.

Anglo-Eastern Ship Management (AESM) is a ship management company[7] which provides technical and crew management services to almost 300 ships owned by several different ship owners. The ship management company had had the responsibility for the operation of the ship in accordance with the ISM Code since 1 August 2007.

At the time of the accident, the ship management company had a valid Document of Compliance (DOC) in accordance with the ISM Code. This applied for a number of different ship types including bulk ships. The document is issued for and on behalf of a number of flag states, including the flag state of Hong Kong. DOC was issued by DNV and is valid until 17 April 2012. The most recent annual audit of the ship management company was carried out on 25 April 2008.

The ship management company has its own training centre in India, Anglo-Eastern Maritime Training Centre. It is used for training the crews of the ships which the ship management company operates. DNV SeaSkill has certified the training centre, the training simulator system and the training programs, see Table 1.

[5] One cable length = 1/10 nautical mile ≈ 185 meters.
[6] According to http://www.fednav.com/ on 5 February 2009.
[7] According to definitions used by Lloyd MIU, third party operator is used as a term for ship management company. This (Third Party Operator) is defined as ’a company which undertakes control, management, operation or agency of a period chartered ship. The Third Party Operator includes period charterers, pool operators, bareboat charterers, and third party commercial managers. They have no known corporate relationship with the Beneficial Owner’, www.llloydsmiu.com.

Table 1 Overview of relevant certificates for Anglo-Eastern Training Centre, India

Type of certificate	**Expiry date**
Certification of Maritime Education & Training[8]	19 December 2012
Certification of Maritime Simulator Systems[9] – Bridge operation, Cert. type PC, Class B.	6 May 2013
Certification of Learning Programs[10]- STCW - Bridge Team Management – Level 2	29 January 2011
Certification of Learning Programs - General- – Risk Assessment Course	6 October 2011
Certification of Learning Programs - ECDIS	18 December 2010

1.5.2 The ship's statutory and classification certificates

DNV has carried out the inspections, issued classification certificates and issued statutory certificates on behalf of the flag administration in Hong Kong. This includes ISM and ISPS certificates.

At the time of the accident, all the ship's necessary classification and statutory certificates were valid:

- The ship had been through the annual and intermediate survey on 1 February 2008.

- On 9 September 2008, DNV implemented an external audit of the ship's safety systems (ISM/SMC Renewal Audit & ISPS/ISSC Renewal Verification). At the time, the Federal Kivalina was in Vila Do Conde, Brazil. The result of the audit was one non-conformity for deficient maintenance of on board equipment. Five observations were also made. The non-conformity includes a description of how the display of the AIS is not in satisfactory order and that no repairs have been requisitioned. The non-conformity was deleted the same day by DNV based upon written confirmation from the master that repair of the AIS had been requisitioned. The AIBN has not been able to clarify whether the AIS was repaired, when and by whom.

1.5.3 The ship's bridge equipment

The vessel is equipped with traditional bridge arrangements where instrument desks, an electronic chart machine, two radar consoles (port side: 10 cm (S-band), starboard side: 3 cm (X-band)) and the position for hand steering have been located in a row in the middle of the wheel house, see Figure 9. Manoeuvring of the main

[8] Verification of the statutory compliance of the training centre's management systems.
[9] Verification that the simulators used are in accordance with DNV's own standard, No. 214 Maritime Simulator Systems.
[10] Verification that the training courses are in accordance with DNV's own standard, No. 3.201 Learning Programmes and other relevant industry standards.

engine and bow thruster takes place from the instrument desk on the starboard side. Due to the location of the ship's cranes, the hand steering position has been shifted a bit to starboard to give the helmsman a free line of sight forward. The chart table is located behind the row of instruments. This is also where the ship's three GPS receivers and echo sounder are located. When it is dark a curtain is drawn in front of the chart table.

The AIS receiver and the pilot plug have been placed in front of the wheel house, along the centreline. The line of sight straight forwards from the AIS is blocked by the large cranes, which block the sightlines about 3 degrees to either side.

The ship was equipped with two independent GPS units and one DGPS unit. Both of the independent GPS units can give the ship's position to the AIS, while the DGPS unit gives the position to the electronic chart machine. The GPS units are fitted at the starboard end of the chart table. The bridge crew experienced that one of the GPS units was not functioning in a satisfactory manner a few days prior to the accident. This was corrected by the ship's electrician, but the ship's AIS did not receive any positions from the GPS units after this. The bridge crew explains that this may be the reason why the ship's AIS did not send out any information about the ship's position. The AIS was replaced with a new one when the ship arrived at Sunndalsøra.

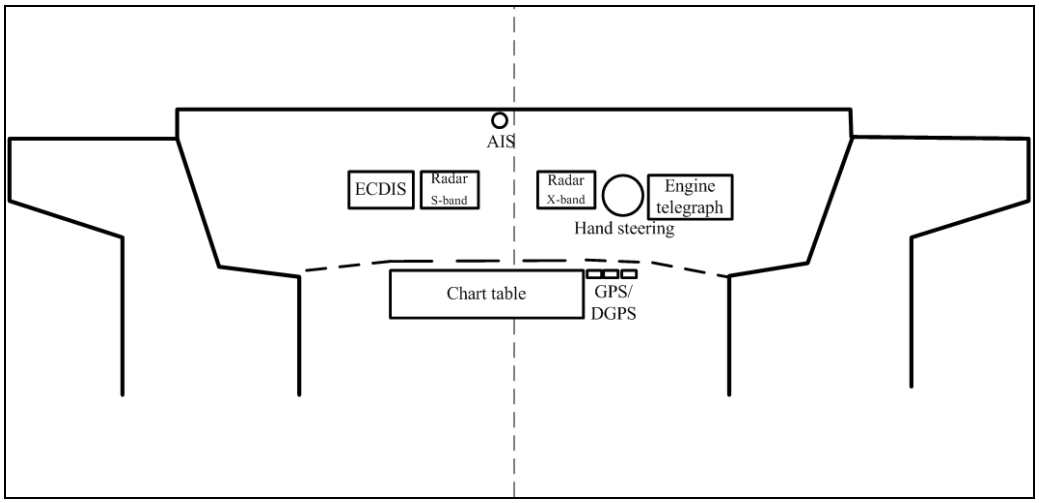

Figure 9: Simplified sketch of some of the ship's bridge equipment. Due to the location of the ship's cranes, the hand steering position has been shifted a bit to starboard to give the helmsman a free line of sight forward.

Before running aground, the port side radar (10 cm, S-band) was set at 3 nautical miles. The starboard radar was probably also set at 3 nautical miles. According to the bridge crew and the pilot, both radar units functioned in a satisfactory manner.

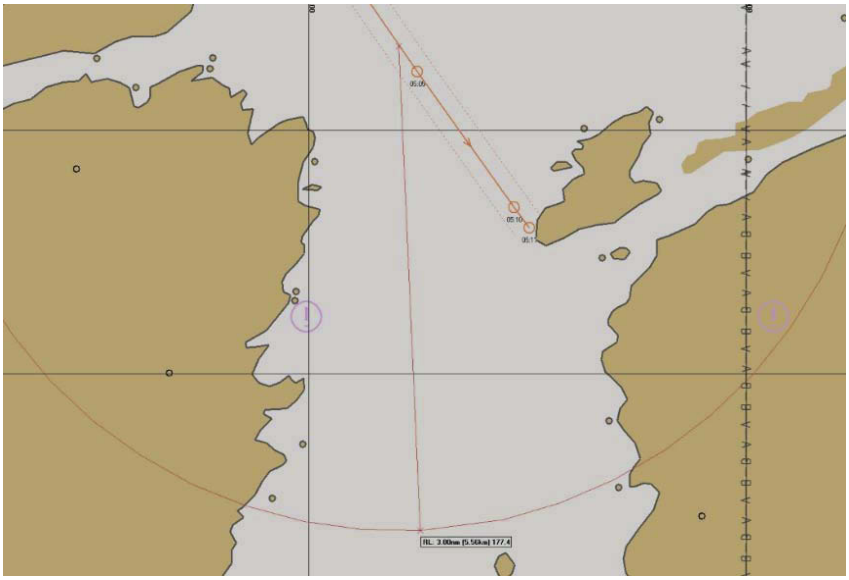

Figure 10: The minimum area (red arc) shown with an overview chart with a radius of 3 nautical miles at 0504 hours.

1.5.4 The ship's chart systems

The ship bases safe navigation on approved paper charts. The maritime charts (paper charts) which the ship had on board upon leaving Vila Do Conde, Brazil did not include the main chart for the approach to Sunndalsøra, specifically from Griphølen to Sunndalsøra. According to the ship management company, there was no access to navigational charts (paper charts) for the Norwegian coast in the loading port in Brazil. The ship only got these charts at the same time when the pilot came on board at Griphølen. The charts were ordered by the ship on 23 September through the ship management company in Hong Kong and the local agent in Kristiansund. In addition, the ship has an electronic chart machine (Transas ECDIS[11]) as one of its navigational aids. The chart machine satisfies the IMO ECDIS standard and can also display electronic charts from other systems. The ship management company has equipped the ship with the following electronic chart systems:

- Electronic navigational charts (ENC[12]) for parts of Northern Europe.
  The ship has had a regular annual subscription to a number of electronic navigational charts (ENC) for Northern Europe since October 2005. The subscription includes a small area in Norway limited to the coast between Mandal and Kristiansund.
  The distributor of the electronic navigational charts is Marine Press of Canada, which delivers weekly updates of the charts in the form of CDs to the ships. The CDs are sent to the ship management company's office in Hong Kong which distributes them to the ships.

[11]ECDIS = Electronic Chart Display and Information System. A common term for navigation information systems which meet the requirements given by IMO's "IMO Performance Standards for ECDIS".
[12] ENC = Electronic Navigational Chart is a term for official map data produced in accordance with international standards. ENC, which are based on vector data, consists of points which are geo-referenced by coordinates and the connections between them. Vector data can be presented in layers and be adapted to the purpose of the use.

- Raster charts[13] from the British Admiralty.
  The ship uses the map service from the British Admiralty Raster Chart Services (ARCS).
  The ARCS raster charts for the Norwegian coast are only overview charts and do not have the necessary degree of detail to prepare a complete passage plan and for navigation.

- Transas TX-97 vector charts
  TX-97 vector charts are produced in-house by Transas, based on official paper charts.
  Like ARCS, these charts are not approved as substitutes for paper charts or as part of an EDCIS system.
  The ship subscribed to these maps for the entire world with the exception of Canada, Australia and Norway.

On 23 September 2008, the ship ordered electronic navigational charts for the approach from Griphølen to Sunndalsøra. This was three days after the ship left Vila Do Conde and a day after Fednav Limited notified the ship that the correct port of discharge was Sunndalsøra (at the same time, Norwegian paper charts to be delivered at the pilot boarding place were ordered). An email requesting such an order was sent to the ship management company in Hong Kong, which then routed the order to Marine Press of Canada and the ship's agent in Sunndalsøra. The ordered electronic charts were the following:

- ARCS for Norway, corresponding to BA nos. 245 and 2306.

- ENC for Norway nos. 35, 36 and 128

Within 24 hours, the ship received two separate emails from the chart distributor with the codes necessary to install the ARCS charts and ENC. The bridge crew contacted the ship management company in Hong Kong after two unsuccessful attempts at installing the ENC on the chart machine. The bridge crew received a message to the effect that they would receive paper charts on board at Griphølen and that this would be satisfactory for now, given the circumstances.

The ARCS charts were installed in the chart machine. These are only overview charts and do not have the necessary degree of detail to prepare a complete passage plan.

After the grounding, when the ship finally arrived at Sunndalsøra, one of the ship management company's representatives installed the relevant ENCs between Griphølen and Sunndalsøra in the chart machine.

After the accident, the ship has on several occasions ordered ENC for *other* areas of the Norwegian coast.

[13] A raster chart is based on raster data which means that it is a digital image of a paper chart (scanned). It is not necessarily a system which meets the requirements for ECDIS and it is therefore not necessarily approved as being equivalent to paper charts for navigation.

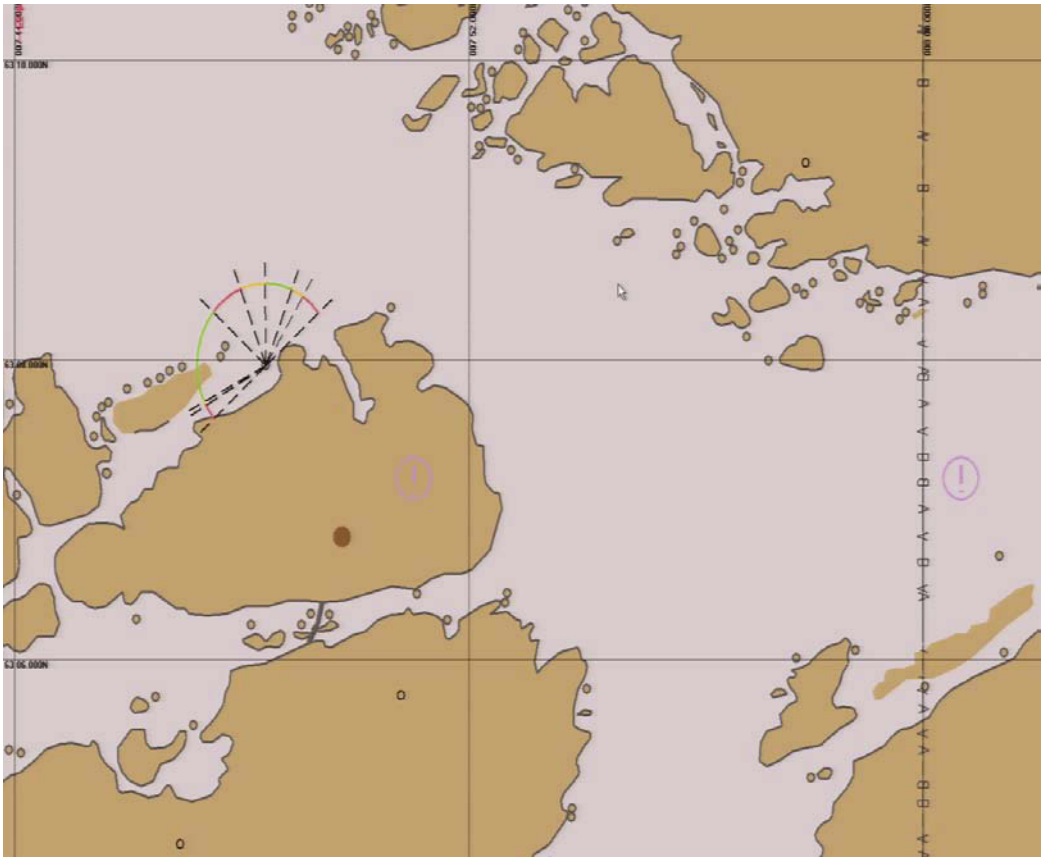

Figure 11: Reconstruction of what was shown on the ship's ECDIS before and when the accident occurred. For Talgsjøen, the overview map (ARCS) only showed the contours of land, but no details such as depths, buoys, beacons and beacon lights. The reconstruction may differ somewhat from what was actually shown.

1.5.5 The ship's manoeuvring characteristics and earlier accidents

The orders for starboard 10 degrees and then hard starboard were given when the ship was one ship length (about 180 metres) from the shoals. From S-VDR, one can see how the ship's steered course changes a few degrees to starboard. This indicates that the ship's control system responded to the order. The short distance to land and the ship's speed and manoeuvre characteristics indicate that the order was given too late to be able to make an evasive manoeuvre.

1.5.6 Preparation of the voyage

The second officer prepared two passage plans for the voyage (voyage no. 06/08). According to the plans, they were reviewed by all the deck officers.

The difference between the two passage plans is the destination. While the first states Karmøy as the port of discharge, the second states Sunndalsøra as the port of discharge.

The plans are prepared on the basis of the same template. The overview states port of departure, draughts and destination port, in addition to a guideline description, date and who participated during the Bridge Team Meeting.

- Both plans also state 10.7 m (forward and aft) as the expected draught when reaching the destination port.

- Both plans state that the Bridge Team Meeting took place on 18 September 2008. The master has only signed off on the passage plan to Sunndalsøra. The other navigation officers have signed both.

- The main part of the page is a guide to the passage plan consisting of 15 points. The first point specifies that the passage plan shall be established from "quay to quay". This is in accordance with the requirement in the STCW code Chapter VII, Section A-VII/2, Part 2.5.

Detailed passage plan with crew manning level

- The passage plan gives more detailed information about the passage. It refers to the level of staffing of the bridge, standard notes about what the navigator should be alert to, how often and how positions should be determined.

- In cases where staffing on the bridge shall be at level 4, it is indicated that a position must be taken every five minutes by taking a visual bearing or by radar or GPS.
  From leaving Vila De Conde and until the pilot boarding place, staffing shall be level 4. The guidelines explain that staffing level 4 means three navigators and one sailor, where one may be the master and another may be the pilot. According to the procedures of the ship management company, the passage from Griphølen to Sunndalsøra required staffing level 4.

- Both plans state the pilot boarding place as the destination, respectively pilot boarding place No. 1 west of Kvitsøy and Griphølen. I.e., the plans only apply until the pilot boarding place. The last part of the passage from the pilot boarding place and in to the quay is not described in any of the plans.

According to the ship management company, the procedures are specific with regard to the requirement that a "quay to quay" passage plan be prepared before the ship leaves the quay. In the opinion of the ship management company, even though the second officer had not done this, there was plenty of time to plan the final leg to the originally planned port of discharge (Karmøy), as the passage took approximately 14 days. But the ship management company points out that the same thing is not possible for Sunndalsøra, since they did not have the necessary navigational charts on board.

1.5.7 The deck officers' competence

At time of the accident, the crew on board consisted of 21 sailors and one pilot. With the exception of the chief officer (Ukraine) and the second officer (Sri Lanka), the crew was from India. The deck crew consisted of the master, three deck officers and seven other deck crew, including one cadet. The engine crew consisted of the chief engineer, three engineering officers, one electrician and three other engine crew. In addition, there were two crew members in connection with catering. The ship followed a three-watch system on the bridge during sea passages.

The ship was built and classified for operation with an unmanned engine room and has a crew in the engine room in the daytime only when in open seas. During coastal passages and passages with a pilot on board, a watch will be established in the engine room and the bridge crew is increased as per ship's procedures.

The master was able to get some rest in the afternoon the day before the grounding. He came up on the bridge at around 1600 hours to mark the position at which he wanted to be summoned and he sent routine reports to the ship management company. After dinner at about 1800 hours, the master went to his cabin to sleep. The weather was poor, but he slept well nonetheless.

The master had left orders that he should be summoned when they approached land. He was summoned and came up on the bridge at about 0055, well before they approached Griphølen.

The master, age 40, had a deck officer category 1 certificate and had been on board since July 2008. This was his first passage on board the Federal Kivalina and for the ship management company. He worked for another ship management company from 2000 to 2007. He had brief experience as master. He had experience from the same type of ship and had sailed as an officer on larger ships, and also on ships of a similar size. This was his first passage to Sunndalsøra. According to the ship management company, he had attended a number of courses, including

- 'Ship manoeuvring simulator and bridge teamwork', February 2006
- 'Bridge team management – level 2 (Management)', June 2008.

The chief officer, age 37, had a deck officer category 2 certificate and had been on board since August 2008. He signed on in Venezuela and was contracted until February 2009. He had not previously sailed with the Federal Kivalina and was only associated with the ship management company for this one assignment. He had worked as a chief officer since 2002. The chief officer had attended several courses, including

- 'Bridge team and resource management', May 2005
- 'Radar navigation – management level', September 2007

The second officer, age 36, had a deck officer category 2 certificate. He had little experience as second officer. He had attended several courses, including

- 'Electronic Navigational System', October 2005

1.5.8 Excerpts from the STCW Code and the ship management company's safety management system

According to the ship management company's safety management system, which is based on the STCW Code, the master is responsible for there being sufficient watches to maintain safe navigation. Under the master's guidelines, the navigator on duty is responsible for navigating in a safe manner and with particular focus on preventing collisions and groundings.

According to ship's procedures, forming part of the safety management system, the responsibility for navigation of the ship remains with the navigator on duty even if the master enters the bridge. The master will only assume this responsibility when the hand-over has been agreed. When the pilot comes on board, this does not relieve the master and the navigator on duty of their responsibility and tasks in assuring the safe navigation of the ship. The tasks for the navigator have been defined in the ship's procedures and entail, among other things:

- The navigator on duty shall ensure sufficient lookout. The person designated as outlook shall be dedicated to this task. The purpose of a lookout includes detecting hazards as early as possible. In the introduction to the procedure[14] it is emphasised that the lookout requirements are the most basic and important function of the bridge crew. The procedure emphasises that the navigator on duty shall only be assigned the lookout function in daylight and under the condition that the situation has been carefully assessed to be safe with only the navigator on duty as lookout. The procedure also emphasises that "the lookout must not be given permission to leave the bridge during the watch and shall be given access to the bridge facilities for tea, coffee, etc."

- The navigator on duty shall only go to the chart table when necessary and prudent as regards the navigation. Satisfactory lookout shall be maintained.

- The navigator on duty shall ensure that course, position and speed are checked at sufficiently frequent intervals, using the navigational aids to do this and to ensure that the ship follows the passage plan.

- Depending on the type of passage, the position shall be taken between every hour (ocean passage) and down to every fifth minute and every minute during coastal passages and when in restricted waters, respectively.

- The navigator on duty shall provide personnel on bridge watch, including the lookout, with all necessary instructions and information to ensure a good watch.

- The navigator on duty shall immediately notify the master if any danger occurs in connection with the navigation.

- The responsibility for safe navigation remains with the master and navigator on duty even if there is a pilot on board.

- If there is any doubt relating to the pilot's actions or intentions, the navigator on duty shall seek to resolve this with the pilot. However, if the matter remains unresolved, the navigator on duty shall immediately notify the master and implement any necessary measures until the master arrives on the bridge.

According to the procedure, the ship's bridge crew shall hand over the pilot card to the pilot[15]. They shall furthermore request to receive all necessary information concerning the passage from the pilot. The procedure emphasises the importance of

[14]Anglo-Eastern Group, Shipboard Procedures Manual, Ch: SBP 201A 3.7
[15] Anglo-Eastern Group, Shipboard Procedures Manual, Ch: SBP 201A 3.14

discussing the passage plan with the pilot and the master being aware of the pilot's intentions.

According to the STCW code, the master and/or the officer in charge of the navigational watch shall co-operate closely with the pilot and maintain an accurate check on the ship's position and manoeuvring[16].

1.5.9 Description of the conditions in the passage between Griphølen and Sunndalsøra– Den norske los 4 (the Norwegian pilot 4) [17]

The passage route from Griphølen to the Hydro quay at Sunndalsøra is described in Den norske los 4. The passage route is considered to have relatively clean seabed conditions and dangerous shoals are marked. There are no alternative routes for ships of this size.

The only anchorage for ships of this size is in Freifjorden. Any anchoring decisions must be made well in advance of reaching the anchorage. With the ship going at full speed, the decision must be made no later than 30 minutes before arriving at the anchorage.

If the ship has already passed the anchorage, it is the opinion of the Norwegian National Coastal Administration that there are several places further into the fjord where it is possible to come about. As the ships transporting aluminium oxide are considered relatively large and heavy, this is a manoeuver which pilots wish to avoid, as a matter of experience.

Den norske los (the Norwegian Pilot) does not recommend anchoring off Sunndalsøra as the ship may be hit by violent squalls coming down the mountainsides there.

1.6 The piloting service

1.6.1 The pilot duty and the purpose of having pilots on board

Pursuant to the Regulations relating to the duty to use pilots in Norwegian waters[18] Federal Kivalina was required to use a pilot from the pilot boarding place at Grip and in to Sunndalsøra.
The duty is based on the *purpose of the Pilot Act* to "ensure an efficient piloting service, which can contribute to safeguard maritime traffic and thus the environment …"[19]. *The main purpose of the piloting service* is to "contribute to safeguarding maritime traffic and the environment by providing the ships' crews with necessary local water knowledge[20].

The piloting service is operated by the maritime traffic departments of the Norwegian Coastal Administration. Møre and Trøndelag maritime traffic area includes the waters in Møre and Romsdal, Sør-Trøndelag and Nord-Trøndelag

[16] STCW-code Section A-VIII/2 part 3-1, 49.
[17] Den norske los 4, Chapter VII, page 216, the Norwegian Mapping and Cadastre Authority Sea (2008)
[18] FOR 1994-12-23 Regulations relating to duty to use pilots in Norwegian waters:
[19] Act of 16 June 1989 relating to the piloting service, etc.
[20] www.kystverket.no and the National Coastal Administration's annual report 2007.

counties up to the border with Nordland County. The maritime traffic departments are led by a pilot's guild master. Annually, about 46,000 pilot assignments are carried out in Norway.

Pilotage means providing guidance for vessels in connection with navigation and manoeuvring. A state pilot is a pilot in the employ of the State. A pilot is a person who possesses a pilot's certificate issued pursuant to the Pilot Act. The act entails no changes to the rules which apply to the responsibility of the vessel master, or whosoever is in command in his/her place. The pilot is responsible for the pilotage. The vessel master or whosoever is in command in his/her place can leave it to the pilot to issue orders on behalf of the vessel as regards progress, navigation and manoeuvring.

In the Service Instructions for State Pilots[21] it is stated that 'the state pilot must not take over the navigation or manoeuvring of the vessel before relevant information has been exchanged with the duty officer, such as a) the vessel's position b) heading c) speed" [22].

The Norwegian Coastal Directorate has stipulated provisions relating to booking pilots[23]. This entails that vessels shall book at least 24 hours in advance. This booking shall furthermore be followed up by at least five hours' notice as well as a final confirmation two hours before arrival at the pilot boarding place. The pilot booking shall be directed to the relevant piloting station or piloting service centre. When booking a pilot, the vessel must submit information which includes the estimated arrival at the pilot boarding place/departure from port, draught and destination port. The ship management company often uses a shipping agent as the point of contact between the ship and the piloting service.

The Kvitsøy piloting service centre at Kvitsøy assigns pilots in Rogaland, western Norway and Møre and Trøndelag maritime traffic areas. The Kvitsøy piloting service sorted under the western Norway maritime traffic department.

The Norwegian Coastal Administration has specified instructions for the piloting service. The instructions stipulate that "the piloting service's main task is to ensure a flexible and efficient utilisation of the pilot corps within the framework of applicable laws and agreements and any other provisions."[24]

The personnel who assign pilots at the piloting service centres have a number of tasks which include collecting relevant information about the ship and the pilot assignment and communicating such information to the pilot in connection with assigning the pilot. The instructions describe what this may entail and mention obtaining and communicating information about the vessel's draught, information relating to port conditions and whether a tugboat has been ordered.

[21] 7.8 Tjenesteinstruks for statsloser <Service Instructions for State Pilots> and 7.12 Losenes oppgaver og plikter i forbindelse med losoppdraget, <The pilots' tasks and duties in connection with a piloting assignment>, The Norwegian Coastal Administration.
[22] 7.12 Losenes oppgaver og plikter i forbindelse med losoppdraget <The pilots' tasks and duties in connection with a piloting assignment>, Item.3. The Norwegian Coastal Administration.
[23] Stipulated by the Norwegian Coastal Directorate on 20 April 1988.
[24] Chapter 7.4 Instructions for the piloting service, Doc. No. MT-HB-7.4, 09 Jan. 2006, the Norwegian Coastal Administration.

The instructions emphasise that a safe piloting service depends on planning and that great emphasis must therefore be placed on maintaining good and flexible notification and information routines between the piloting service and the pilot.

The pilot boarding place for the approach to Sunndal is at Grip. The pilot boarding place at Grip is about 1 nautical mile north of Grip lighthouse. Today, the pilot boat travels out from Kristiansund. The pilot boarding place is open to all wind directions and the sea, and by current personnel safety standards can only be used in good weather. As of November 2009, there is a proposal to move the pilot boarding place further in.

1.6.2 The pilot assignment

From experience, the pilots in this area know that the Hydro quay facility can be exposed to the weather when the wind is north-westerly. This may make it unsafe to come alongside the quay. This applies to an even greater degree when the ships have a draught which exceeds the depth at the quay facility.

It was therefore necessary to make an assessment of whether it was safe to come alongside the quay or whether the ship should anchor and wait for better weather.

The pilot had no specific information about the weather conditions at the quay before coming on board. This resulted in that this information had to be obtained at the same time as the pilot assignment was carried out.

The pilot had little information about the ship – he had obtained information himself (from AIS) about the ship's draught being too great for the quay. There was some uncertainty related to whether the ship had stated the correct draught via the AIS as the pilot has previously experienced that the information is not necessarily correct. The correct draught was only confirmed when the pilot came on board.

1.6.3 The pilot's competence

The pilot has broad experience from sailing in the overseas merchant fleet. He had valid certificates and a health certificate. The pilot took the first pilot exam in 1984 and started as a pilot on Hurtigruten (the Coastal Steamer). He has taken several pilot exams since, most recently in 1998 and has worked as a state pilot in several districts. He has been a state pilot in Kristiansund since 1997.

The pilot has participated in several courses including SAS Crew Resource Management in 1996.

1.6.4 Sleep and rest

On Wednesday, 1 October, the pilot started his work period. Information from the Norwegian Coastal Administration shows that the pilot on board the Federal Kivalina had had irregular working hours in the days before the accident. Some of the working hours during the preceding days were during the day, while some of the working hours were at night. The working hours for each assignment, including travel time, varied from one hour to a little more than eight hours. Any unforeseen waiting periods, administrative work and preparations for piloting have not been included.

1.6.5 Norwegian provisions for use of waters

The (Norwegian) Maritime Traffic Regulations[25] stipulate provisions which apply to the use of fairways in a number of areas along the coast.

The purpose of the Regulations is to reduce the risk of shipping accidents in Norwegian waters, as well as contribute to the efficient management of maritime traffic. For the different areas, and depending on a number of different factors, the Regulations stipulate to varying degrees requirements for:

- permission from the maritime traffic centre to use the waters,
- daylight requirement,
- capacity limitations (maximum allowed draught, length, width and height)
- visibility limitations,
- limitations as to where a vessel may meet and pass other vessels,
- traffic separation,
- use of tugboats

Other regulations have also been established in connection with the (Norwegian) Maritime Traffic Regulations. For example, for large vessels which are to sail to or from Sture and Mongstad (and depending on the type of cargo) requirements are stipulated with regard to securing permission from the maritime traffic centre, visibility limitations, speed limitations and use of tugboats[26].

The Regulations do not encompass the approach to Sunndalsøra.

1.6.6 Example from Sweden relating to normative criteria and restrictions on quays and related facilities

In 2004, Swedish authorities introduced a change in which normative criteria and restrictions for the maritime traffic areas were associated with the piloting service[27]. The Swedish authorities have stipulated normative criteria and restrictions as to which ships may operated in the area (criteria relating to the length, breadth and draught of the ship, etc.) and operating criteria. The operating criteria set limits for wind speed, current, use of tugboats, the characteristics of the tugboats (such as bollard pull), night limitations, etc., for when the operation can be carried out in a safe manner.

[25] FOR 1998-12-11 No. 1273: Regulations relating to maritime traffic in certain waters

[26] FOR 1992-07-21 no. 566: Regulations relating to use of the approach to the harbour terminals at Sture and Mongstad in Hordaland county.

[27] See for example http://www.sjofartsverket.se/templates/SFVXPage____1514.aspx and http://www.sjofartsverket.se/templates/SFVXPage____590.aspx

These criteria have been established partly on the basis of experience accumulated over a long period of time, and partly based on risk analyses and evaluations from an appointed group of experts. The criteria have been given for each individual quay and are stipulated on the basis of the waters, the harbour and the characteristics of the quay. Changes in the normative criteria and restrictions are stipulated by an appointed group of experts from the Coastal Administration and the Swedish Board of Transportation, and are based on risk analyses, simulations, etc..

The normative criteria and restrictions are associated with the piloting service through the stipulation by the authorities that piloting may not be carried out if the criteria for the ship or the operating criteria are not met. A reservation is made that prevailing conditions may set further limitations on when it is safe to pilot. Allowance is made for exceptions from the normative criteria.

Currently, there are no quay facilities in Sweden where the criteria accept the piloting of a ship which is to dock at a quay when its draught is greater than the maximum depth at the quay.

1.7 The cargo, cargo owner and quay facility

Figure 12: A tugboat assists in keeping the ship clear of the quay since the draught is too great. For ships with an equivalent load capacity to the Federal Kivalina, 6000-9000 tonnes of aluminium oxide are usually unloaded, and it may take up to 24 hours before the ship can lay alongside the quay. Photo: Aura Avis

The ship was fully loaded with aluminium oxide[28], also called alumina, which is extracted from bauxite. Aluminium oxide is used in the production of aluminium.

[28] IMO regards aluminium oxide as being in a category with poor floating capabilities and not constituting any chemical hazard, cf.. IMOs Code of Safe Practice for Solid Bulk Cargoes, 2004 (BC Code), gruppe C 'Sandy calcined metallurgical grade alumina',

1.7.1 Charter party - Deciding the quantity of cargo, port of discharge

On 18 and 19 September, the Federal Kivalina loaded on board a total of 35,700.80 tonnes of aluminium oxide, distributed equally among all cargo holds. According to Hydro Aluminium AS, it is clarified with the ship management company, among others, about the water depths at the time of entering into the charter agreement. According to the agreement, the cargo was to be delivered at Karmøy, Høyanger, Årdalstangen, Sunndalsøra and/or Husnes.

On 19 September 2008, the day before the ship left Vila Do Conde, Hydro Aluminium AS decided that the cargo of 35,700 tonnes of alumina was to be delivered to Hydro's quay in Sunndalsøra instead of Karmøy.

The ship was almost fully loaded and it was estimated that the ship would have a draught of 10.70 metres upon arrival at the port of discharge. As the depth of the quay facility at Sunndalsøra is less than the ship's draught, the ship's agent planned to keep the ship approx. 4 meters away from the quay during the first 24 hours of the unloading using tug boats. The ship would then have an adequate draught to be able to lie alongside the quay.

1.7.2 Ship arrival at the Hydro Quay, Sunndalsøra

On 23 September, three days after the Federal Kivalina left Brazil, it was agreed that Shipping Service AS would be the ship's agent upon offloading in Sunndalsøra.

Shipping Service AS in Kristiansund has broad experience with assignments like this, and is actually the agent for all ships delivering aluminium oxide to the Hydro quay in Sunndal. At the same time, they also perform tasks on behalf of Hydro Aluminium AS, such as being the terminal representative for the Hydro quay in Sunndal.

On 23 September, Shipping Service AS communicated the following restrictions to Fednav (Belgium) N.V. and directly to the ship:

> *”Restrictions:*
> *LOA 200 / Beam 32,5 / Max draft 9,3* / Airdraft 43 (suspension bridge) *) the max draft varies with the tidal variations, max draft based on your ETA is 9,90*
>
> *On arrival vessel will be kept 4 metres off the berth by the assistance of 2 tugs during the first part of disch operation until safe draft of 9,90m has been reached to go alongside. This is normal procedure at Sunndal and both pilots and tugs are well experienced in this operation.”*

This information about the restrictions corresponded to the information that Hydro Aluminium AS had stated to BIMCO[29] and Den norske los (the Norwegian pilot)[30].

[29] See www.bimco.com code 109177

[30] According to the Norwegian pilot, the pillar quay is 307 meters long and made of concrete. The depths along the quay are measured at 8.9 – 10.6 meters with most of the depths at 9.3 meters or less. Furthermore, the Norwegian pilot describes ”large ships steer up along the east side of the bay and come alongside with the port side. There is a back eddy at the quay which complicates going alongside the quay, and this is particularly noticeable at low tide. There is also a large flush coming from the plant approximately under the middle of the quay.

The ship's master reports an anticipated draught (10.7 metres, 0 trim), and further communication between the ship and Shipping Service AS related to details regarding how the ship would be kept away from the quay. The master calculated that approx. 4000 tonnes of cargo must be offloaded before the ship could go alongside the quay. It was expected that offloading this amount would take approx. 14 hours.

Hydro Aluminium AS uses its own offloading equipment, and this restricts the position of the ship to no more than 6-7 metres away from the quay. It is the length of the suction offloader which sets this restriction.

The offloading equipment (suction offloader) is fitted with an anemometer. The suction offloader is secured with a storm anchor during use, and will automatically disconnect in wind speeds of 20 m/s. To avoid deterioration of the cargo, offloading will be stopped in heavy rain.

Federal Kivalina's dimensions and loading quantity are normal for ships that arrive at the Hydro quay in Sunndal for offloading. There are quite a few arrivals with cargos of this size during the year, approx. 20-25.

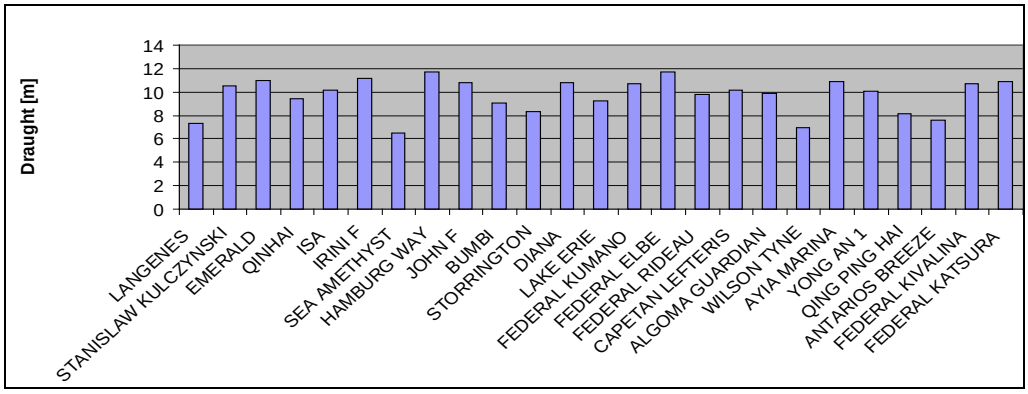

*Figure **13** Draught of the ships (meters) calling at the Hydro quay in Sunndal for offloading of aluminium oxide. Only the first 10 months of 2008. Information on the draughts of the ships is from the AIS. The greatest permitted draught for the quay facility is 9.3 metres.*

The following figures are based on ships' arrivals at the Hydro Quay in Sunndal for offloading of aluminium oxide during the period January up to and including October 2008.

- 25 ships arrived at the quay during this period, which corresponds to a ship arrival every 12th day.

- An average of 23,700 metric tonnes was offloaded per ship.[31].

- 17 of the ships arrived at the quay with a draught greater than 9.3 meters, i.e., every 18th day a ship called at the Hydro quay in Sunndal with a draught exceeding the restrictions of the quay facility. The greatest draught for one ship was 11.7 meters. It is therefore customary to keep the ships away from the quay during offloading.

[31] The ships may contain larger cargos that those offloaded at the Hydro quay in Sunndal, as some of these ships go on to other Hydro Aluminium AS quay facilities.

- 8 of the ships anchored in Freifjorden *before* calling at the Hydro quay in Sunndal[32].

In the experience of Shipping Service AS, the ships calling at the quay facilities with aluminium oxide have usually not been in Sunndal previously. In most cases, the ship's agent provides a navigational chart for the approach with the pilot boat (delivered at the pilot boarding place at Griphølen).

1.7.3 The quay facility and its history

The quay facility is private, and is owned and managed by Hydro Aluminium AS. It was put into operation in 1954. Since then, there have been no improvements to the quay facility which have resulted in changes to the depth at the quay. In 2003, a suction offloader was installed for offloading aluminium oxide.

Hydro Aluminium AS' own assessments of which ships and quantity of cargo that can arrive at the quay facility are considered in relation to whether it is possible to keep the ship far enough from the quay in order to avoid contact with the ground, while still being possible to use the quay facility's own offloading equipment. The essential parameters are therefore the ship's draught and width.

Hydro Aluminium AS sees no safety-related problems with poor weather conditions and the fact that the ship is held away from the quay during an unloading operation.

Hydro Aluminium AS and the ship's agent are not aware of any damage to vessels as a result of contact with the bottom while being moored at the quay.

There are no weather restrictions for when it is safe for a ship to come alongside the quay. According to Hydro Aluminium AS this is an assessment which must be made by the ship.

Practice has been that the pilot has contacted the quay facility to obtain information on weather conditions and, based on this, the pilot advises the ship's master, whether it is safe to come alongside the quay or whether the ship should anchor in Freifjorden.

1.7.4 Applicable laws and regulations for quay facilities

1.7.4.1 *Regulations relating to safe loading and unloading of bulk carriers*[33]

The regulations are stipulated by the Norwegian Coastal Administration (Kystverket) and the Norwegian Maritime Directorate pursuant to the Harbours and Fairways Act Chapter 8[34] and the Ship Safety Act

[32] There may be several reasons for ships anchoring away from the quay, for example bad weather or to wait for other ships to pull away from the quay.
[33] FOR 2003-08-29 no. 14: Regulations relating to safe loading and unloading of bulk carriers. See http://www.lovdata.no/for/sf/nh/xh-20030829-1114.html
[34] ACT-1984-06-08-51, The Act relating to Harbours and Fairways, etc. (The Harbours and Fairways Act), Section 8. In LOV-2009-04-17-19, The Act relating to Harbours and Fairways, the provision in Section 40 is partially new and partially supersedes the prevailing Section 8, first subsection. "Owners of harbours and

> *"The purpose of the Regulations is to enhance the safety of bulk carriers calling at terminals in Norway in order to load or unload solid bulk cargoes, by reducing the risks of excessive loads and physical damage to the ship's structure during loading or unloading. The Regulations therefore establish harmonized suitability criteria for these ships and terminals, and harmonized procedures for cooperation and communication between these ships and terminals."* [35]

The regulations apply to all bulk vessels, regardless of flag, arriving at a terminal in Norway for loading or unloading of regular bulk cargo. The regulations also apply to all terminals (quay facilities) where bulk ships arrive. The regulations stipulate functional requirements for both the vessel master, the terminal operator (the operator of the quay facility) and the terminal representative.

The vessel master is obliged to inform the terminals of[36]:

- draught upon arrival and planned draught upon departure,
- necessary time for ballasting or de-ballasting of ballast,
- the ship's greatest length and the ship's breadth

Before and during loading or unloading operations the vessel master must ensure that the ship is securely moored, with due consideration of local weather conditions and weather reports.

As part of the requirements related to the terminal suitability the regulations require that the terminal operator ensures that "[t]erminals shall only accept bulk carriers for loading or unloading of solid bulk cargoes that can safely berth alongside the loading or unloading facility, taking into consideration water depth at the berth, ship's maximum dimensions, mooring arrangements, fenders, safe access and possible obstructions to loading or unloading operations."[37]

The terminal representative is obliged to inform the vessel master of the following[38]:

- Features of the berth or quay of which the master may need to be aware, including the position of fixed and mobile obstructions, fenders, bollards and mooring arrangements.
- Minimum water depth alongside the berth and in the approach and departure channels.
- Notification regarding unusual mooring arrangements.

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harbour terminals must ensure that the harbour facilities are operated and maintained such that users' need for harbour and transportation services in the harbour are met in a safe and efficient manner…".

[35] Section 1.

[36] Chapter 7 and Appendix 3.

[37] Chapter 5a and Appendix 2.

[38] Chapter 8a and Appendix 5.

- Any restrictions on ballasting or de-ballasting.
- Maximum draught permitted.

The terminal representative is responsible for taking all precautionary measures to avoid damage to the ship from the loading or unloading equipment and inform the master if damage occurs.

The regulations do not stipulate any technical requirements for quay facilities.

1.7.4.2 *Kristiansund and Nordmøre Port IKS*

Sunndal Port District has been part of the inter-municipal Kristiansund and Nordmøre Port since 2004.

The port district's own regulations, FOR 2002-11-11 No. 1284: Regulations relating to use of and tidiness in ports, Kristiansund Municipality, Møre and Romsdal, do not apply to Sunndal municipality. Regulations for Sunndal Municipality have, as of February 2009, been subject to review by the Norwegian Coastal Administration.

The Hydro quay in Sunndal has not been subject to review or approval by the Norwegian Coastal Administration or Kristiansund and Nordmøre Port IKT in terms of technical requirements or which tasks which can be carried out at the facility.

1.8 Weather conditions

1.8.1 Weather conditions at the accident site

At 0400 hours, the weather at Griphølen was a strong breeze to moderate gale (10.8-17.1 metres/second) north northwest (NNW)[39], moderate visibility (5 nm), temperature of 8 °C, and heavy seas (5 m significant wave height) to the south-east. The cloud cover was low and it rained when the Federal Kivalina approached Talgsjøen. After a while, the clouds cleared, with only light showers.

The special forecast from the Norwegian Meteorological Institute for the area, valid for 0500 hours (local time) indicated significant wave heights of 3.5 metres at the inlet to Talgsjøen and 1.25 metres at Årsundøya.

[39] The closest measuring station is Kristiansund Airport. On 6 October, at 0500 hrs., the station measured 8.9 m/s as the strongest average wind, direction 280 degrees and gusts of 17.6 m/s. This is in accordance with the weather forecasts.

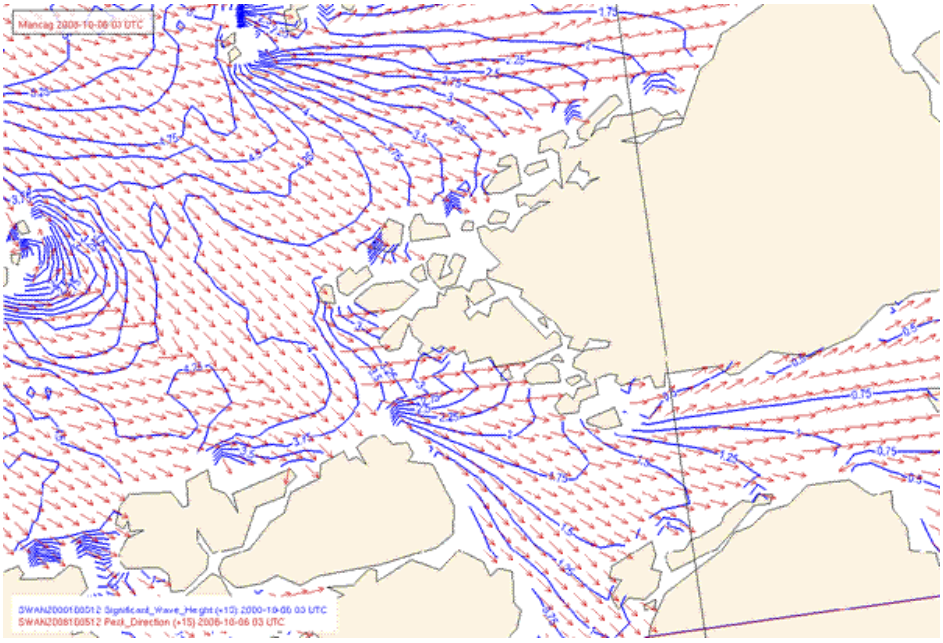

Figure 14: Simulation of the wave conditions carried out by the Norwegian Meteorological Institute. The diagrams indicate significant wave heights (Hs) and the direction of the wave field. The prognosis was valid for 0500 hours local time on 6 October.

The AIBN has not been able to establish relevant current information but according to testimonies there was a weak current toward the northwest.[40]

1.8.2 Weather conditions at the quay facility

Previous pilot experience has shown that wind conditions in Sunndalsfjorden can be significantly different from the conditions in Talgsjøen and Freifjorden, especially when the wind comes from a north-westerly direction. Depending on wind direction, wind speeds at the Hydro quay can vary considerably. This is due to the topography of the Sunndalsfjorden and the fact that the quay facility can be leeward from the mountains.

According to the Norwegian Meteorological Institute, the weather conditions at the facility were a moderate breeze (7.5 m/s) with squalls of 17.1 m/s. The wind direction came from a westerly/north-westerly direction.

40 This is in accordance with the general comments from the Norwegian Pilot. According to the Norwegian Pilot ”the tidal current will enter the fjord with rising water and exit with falling, and it is usually at its strongest about 3 hours before and after high and low tide. Except for marked narrow locations, the tidal currents are generally weak. The current conditions will to a large extent be determined by wind conditions and by the amounts of fresh water which are added to the fjord.” The Norwegian Pilot 4, Chapter VII, Page 209. The Norwegian Mapping and Cadastre Authority Sea (2008/2009). At about 0345 hours there was high tide and therefore about 1 hour and 15 minutes before the accident.

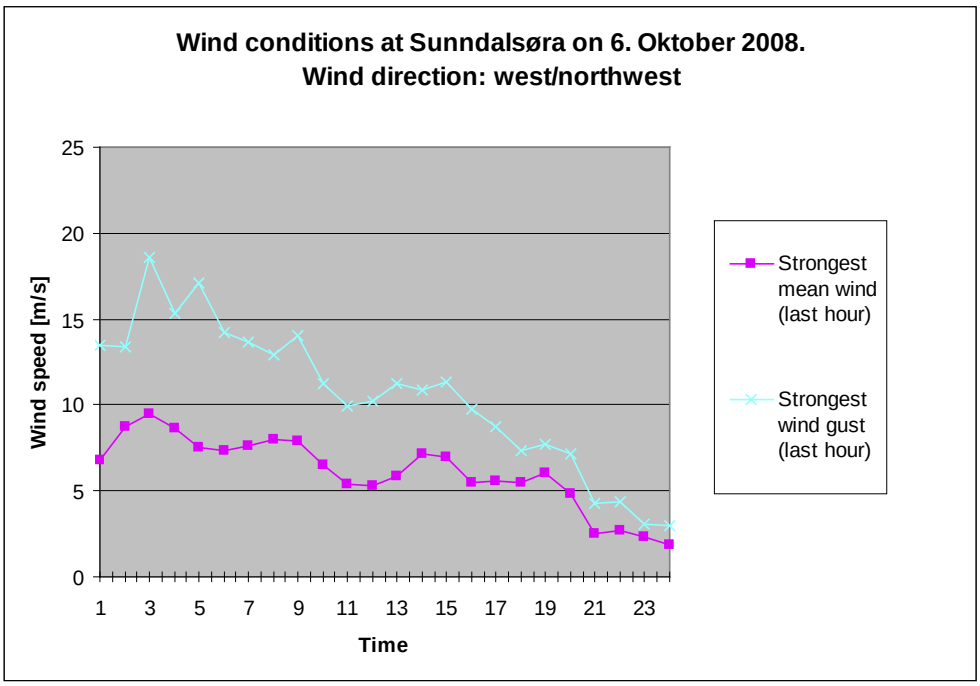

Figure 15: Wind conditions at Sunndalsøra. The Norwegian Meteorological Institute has an automatic measuring station at Sunndalsøra with observations every hour. The measuring station is located behind the Hydro quay at the river inlet. The AIBN has not evaluated whether these figures are representative of the actual weather conditions at the Hydro quay with the wind direction at the time. Source: The Norwegian Meteorological Institute.

2. ANALYSIS BY AIBN

2.1 Introduction

The course of events has been established with the use of the STEP[41] model. The analysis is based on ISIM[42], a method developed and used by the Transport Safety Board of Canada. The purpose of the analysis is to determine safety factors[43] of significance for the prevention of marine accidents and improvements of safety at sea. The AIBN shall not apportion civil or criminal blame or liability.

The analysis deals with the following questions:

A loss of control occurred, which resulted in the bulk ship running aground at a speed of 12 knots. How did this loss of control resulting in the grounding occur? See Chapter 2.2.

Why was there not sufficient communication and cooperation between the pilot and the bridge crew so that navigational safety was further reinforced after the pilot boarding place? See Chapter 2.3.

Why was the bridge crew not sufficiently prepared for the approach after Griphølen and in to the Hydro quay in Sunndal so that they could recognize indications of the loss of control and implement the correct countermeasures? See Chapter 2.4.

Why was it necessary for the pilot to clarify the wind conditions at the quay facility simultaneously with navigating the ship? See Chapter 2.5.

When was it safe to come alongside the quay? See Chapter 2.5.2.

Based on conversations with the ship's crew, the pilot, an assessment of the ship's movements prior to the grounding and other information collected, such as the engine-room telegraph and printout of the gyro course, there is nothing to indicate that there was anything abnormal or wrong with the ship's manoeuvring systems or propulsion machinery. Therefore, the AIBN concludes that the ship's propulsion, manoeuvring capability and navigational aids were functioning normally. There are no technical circumstances which may be considered contributing factors to the grounding.

The AIBN has been given access to information from the ship management company relating to other incidents involving the ship in 2008. Based on this information, the AIBN cannot see any direct links between these and the grounding at Årsundøya.

[41] Sequential Time Events Plotting
[42] Integrated Safety Investigation Methodology.
[43] A safety factor is an event or condition that increases safety risk. In other words, it is something that if occurring in the future, would increase the likelihood of an incident. A distinction is made between contributing safety factor and safety issue. The latter is a safety factor that can be regarded as having the potential to adversely affect the safety of future operations. A safety issue is a characteristic of an organisation or a system. The definitions are retrieved from Australian Transport Safety Board.

2.2 Increasing loss of control

This chapter analyses the course of events in order to explain how the loss of control occurred and the factors which may have contributed to the grounding.

2.2.1 A model for analysis of the course of events

The following model[44] is used in the analysis of the course of events in order to understand the gradually increasing loss of control on board the ship:

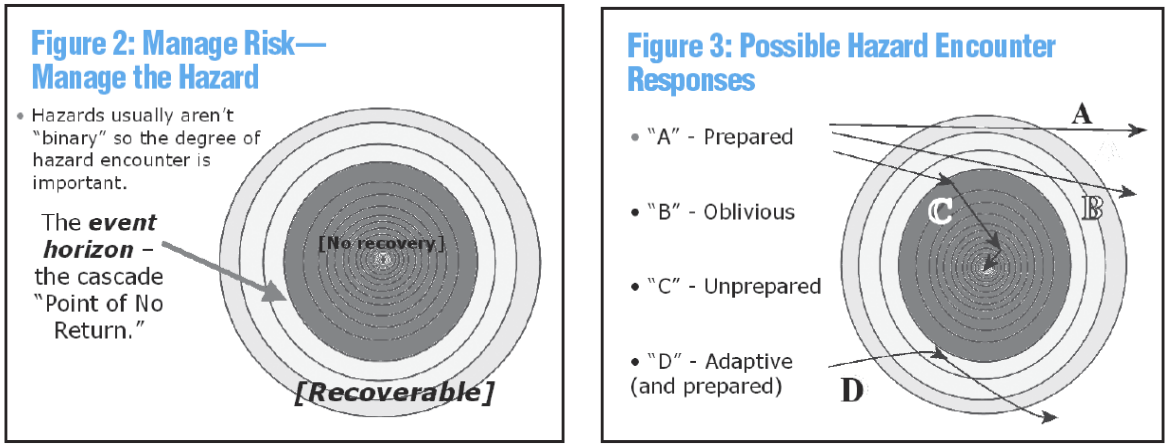

Figure 16: Source: April–June 2007 ISASI Forum – "Accidents & Astrophysics" by Rick Clarke
At left: Hazards illustrated as astrophysical black hole. When approaching a hazard the loss of control may increase gradually until a point of no return.
At right: Possible hazard encounter responses

The idea behind this model is that a hazard can be compared to what in astrophysics is called a black hole. The danger zone around the hole is illustrated as a funnel with increasing gravity the closer to the centre one comes. If you get too far into the funnel, there is a risk of becoming trapped in the black hole and an accident occurs.

In case A, one goes through the danger zone, but so far up the funnel that there is no risk of being caught. This can be due to the crew being sufficiently prepared to meet a hazard situation by recognising indications of gradual loss of control.

In case B, one is further down the funnel, right at the event horizon on the point of no return. This track illustrates situations with a gradual loss of control, but where the level of total loss of control is not reached. After a while, one moves away from the hazard and gradually regains control.
Persons involved following this track are probably not aware of the existing hazard, or they are unaware of how great the risk actually is. Even if an accident does *not* occur, the incident is undesirable as there is a greater loss of control over the situation.

In case C, one is steering unprepared straight down the funnel and "disappears into the black hole" resulting in an accident occurring. The loss of control takes place

[44] Clarke, R. "Accidents & Astrophysics" April-June 2007 ISASI Forum.

gradually, until finally the point of no return is reached and it is no longer possible to regain control.

In case D, one is about to do the same as in C, but this is avoided as the crew is trained in *similar* situations, recognises indications of increased loss of control and carries out correct countermeasures at the correct time. At the same time the ship has the necessary properties to regain control.

2.2.2 Gradually increasing loss of control

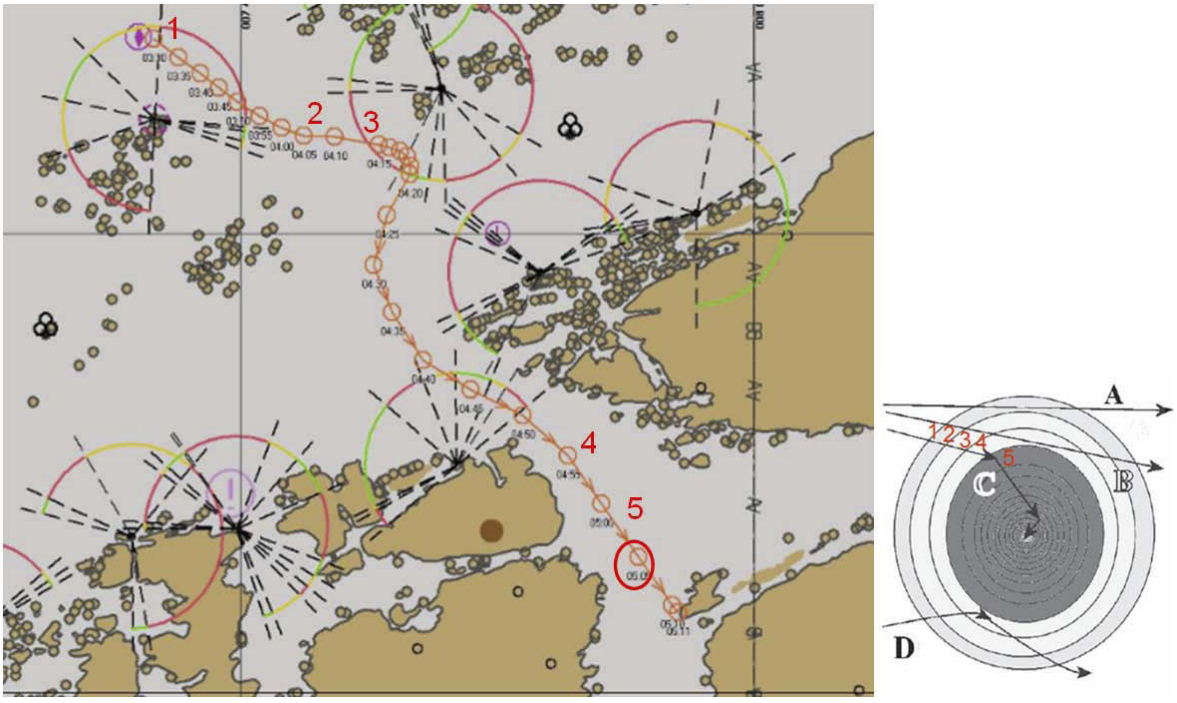

Figure 17:
On left: the red circle indicates the area where, according to the pilot, the ship should have changed course to starboard. This is approx. 1.2 nm from Skarvbergneset, 6 minutes before the ship ran aground. On right: Illustration of the loss of control (1-5) on board the Federal Kivalina based on the 'black hole model'.

The model illustrates the gradually increasing loss of control in relation to navigation, ref. the above figure.

The first four steps result in a gradual loss of control, but only at Step 5 does the ship reach a state where control over the situation cannot be regained, resulting in the ship running aground.

1: When the ship arrived at the pilot boarding place, the ship’s bridge crew no longer had the necessary navigational charts and they had no passage plan to guide them. Even after the necessary navigational charts were in place on board, the bridge crew did not familiarize themselves with the passage route, and did not establish a passage plan.

2: Inadequate exchange of information between the pilot and the ship's bridge crew regarding the planned passage route and the ship's capabilities. This is based on the actions taken by both the pilot and the bridge crew:

2a: When the pilot comes on board further in than the pilot boarding place and the ship is ordered to sail at full speed ahead right after the pilot arrives on the bridge, there is no time to communicate with the bridge crew regarding the passage route. The waters and the speed demand that full attention be given to the navigation.

2b: The ship's bridge crew does not communicate with the pilot regarding the ship's capabilities or their lack of planning the passage.

3: The ship's bridge crew did not participate actively in the navigation after the pilot came on the bridge. This meant that the pilot was the only person on the bridge who was actively engaged in the navigation.

4: After the course was set for the beacon on Skarvbergneset, Årsundøya, the pilot was busy clarifying the wind conditions at the quay facility, and whether the ship should anchor.

5: This turned the pilot's attention away from the navigation during the last 15 minutes before the ship ran aground. The result was that there was no effective navigation or control of the passage while the ship maintained a steady course towards Skarvbergneset. The ship's bridge crew did not react until the ship was approximately 300 metres – 1.5 ship's length – from land. There was not enough time to execute a successful evasive manoeuvre and the ship ran aground at a speed of 12 knots.

The course of events shows that the bridge crew and the pilot did not identify the increasing loss of control and therefore did not react in time to regain control over the situation. This is understood by the lack of a functioning bridge team, resulting in a situation where there was no one on the bridge who was navigating the ship.

If each of the steps 1-4 is viewed independently, the execution on the part of the ship's bridge crew and the pilot was regarded as normal practice, and this entailed that they did not observe the gradually increasing loss of control over navigation.

Normal practice in this context means the way tasks are done and which is perceived as an ordinary way of doing these tasks. The practice may have developed over a period of time and is based on interaction between the parties. It may consist of several different ways of carrying out the tasks, depending on the interaction, and without this being perceived as impairing control over the situation. The normal practice is not necessarily the approved practice or what is stated in procedures and instructions.

2.3 Cooperation between bridge crew and pilot

Figure 13: View from the bridge. Photo taken when the ship was aground.

Based on the course of events and the actual conditions described earlier, the investigation shows that the practice carried out on the bridge was not as laid down in the STCW code and the ship management company's own procedures. The main purpose of the piloting service is to *strengthen* navigational safety in coastal waters by providing the ships' crews with necessary knowledge of local waters.

In practice, there was just one person, the pilot, who performed active navigation, and no one checked the voyage after Grip. The analysis below therefore attempts to understand why there was no well-functioning bridge team after the ship's arrival at Grip.

Our analysis is based on theories on bridge resource management (BRM). Navigation includes the actual performance of steering the vessel and control of this performance[45]. BRM is a concept adapted for maritime activity, although based on the aviation industry's concept of Crew Resource Management (CRM). BRM is used to describe important principles and the optimal use of available resources, people and technology, which provide for a safe voyage. Key principles deal with cooperation, communication, leadership and decision-making, allocation of resources and how tasks are carried out and affected by factors such as stress, attitudes and the understanding of risk. Principles in BRM consider preparation and planning of the voyage, the voyage itself, as well as an evaluation of the voyage upon arrival at the destination[46].

The main purpose of a well-functioning bridge team is to ensure that undesirable or deficient actions by individual persons are recognised by the team, and that necessary measures are taken to maintain control of the ship. This way, the risk of

[45] Encyclopaedia Britannica defines navigation as the 'science of directing a craft by determining its position, course, and distance travelled". The concept of navigation and the verb to navigate may be understood in several ways.

[46] *Bridge Team Management, a practical guide*. Capt. A J Swift, 2nd Ed. 2004, Nautical Institute. *Shipboard Bridge Resource Management*, Michael R Adams, 2003, Nor'easter Press.

exposing the ship and its crew to danger is reduced. AIBN is of the opinion that to fulfil the objective of strengthening safety *during navigation in coastal waters, it is necessary to have a well-functioning bridge team which also includes the pilot.*

The following analysis discusses why the bridge team did not function as assumed. Finally, challenges with BRM in practice, both for the ship management company and the piloting service, will be discussed.

2.3.1 How the ship's bridge crew functioned as a bridge team

By comparing the bridge crew's performance with the requirements stipulated in the STCW code, part 3, which are also reflected in the ship management's safety management system, the following conclusions can be drawn.

When the ship arrived at the pilot boarding place, the ship's bridge crew did not have the necessary navigational charts, and they had no passage plan prepared. The result of this was that they did not have the necessary prerequisites for performing safe navigation.

The bridge crew never established a passage plan from the pilot boarding place at Grip to the quay. This was not even done after they received the necessary navigational charts on board. It was the second officer's task to establish this plan. The master did not check whether this had been done, but presumed it was in order.

No review was carried out with the bridge crew and the pilot together, as stipulated in the ship's procedure. There was no communication between the master and the pilot regarding the passage plan.

The master did not ask for the pilot's passage plan and the pilot did not present any such plan. Given that the bridge crew had not studied the passage route earlier and the master was aware of this, even greater efforts should have been made to review the passage plan.

The chief officer was the navigator on duty from 0400 hours. After Grip, and before the pilot came on board, the responsibilities and tasks of the navigation watch were not carried out in a satisfactory manner according to the ship's internal procedures and the STCW code. The chief officer did not have access to any voyage plan and was thus unable check whether the ship was sailing according to the plan. The chief officer was therefore unable to provide sufficient information and instructions to the rest of the bridge crew. When the cadet was released from his duty as lookout, no one was dedicated to take over his task. Even though the chief officer observed that the ship was approaching land, this did not make him monitor the navigation more closely. This was at a time when the ship was heading for the beacon at Skarvbergneset with a speed of 13 knots and a distance of approximately 1.7-2.3 nautical miles (7-10 minutes before the ship ran aground). Even though the chief officer was unsure what the pilot intended to do, he did not try to find out. Nor did he try to find this out from the master. The chief officer was standing in the back of the chart table without ensuring that this was safe and that sufficient lookout had been organised.

The master was the one communicating with the pilot when the pilot entered the bridge. He also gave some of the engine orders, but the distribution of duties between him and the chief officer had not been clarified as demanded in the procedure.

An unintended consequence of this was that the chief officer was thus largely sidelined by the master with regard to his duties, but without this having been expressly stated between them. To some extent, this may explain the chief officer's passive approach when land was observed ahead, without this being followed up or communicated further. The chief officer was also concerned with some ballast matters.

When the captain perceived that it was important to get the AIS working, he involved himself in this task and his attention was diverted from navigation.[47]. The attention of the chief officer was also diverted from navigation, because the master involved him in checking whether the AIS worked as it should.

The matters described above may explain why the ship's bridge crew did not function as a bridge team from the pilot boarding place onwards.

2.3.2 Coinciding and mutual expectation among the ship's bridge crew and the pilot that it was unnecessary to work together as a bridge team

The AIBN observes that neither the pilot nor the master initiated a joint review of the passage plan. There was also no clarification of roles, tasks and communication routines, as laid down in the ship management company's safety management system.

Through conversations with the bridge crew and the management of the ship management company, the AIBN has gained an understanding of what expectations they have to the piloting service. Similarly, the AIBN has gained an understanding of what expectations pilots may have to the bridge crew.

The bridge crew expects the pilot to have the necessary knowledge of the local waters and that he will sail the route he has already decided on. Furthermore, they expect to be informed by the pilot as to how the voyage will be carried out. They also expect to be informed of weather conditions, conditions at the quay facility and other information that is important for a safe voyage. The ship management company management shares these expectations.

The AIBN believes that these expectations from the ship's bridge crew and the ship management company contribute to making the ship's bridge crew consider it is not quite so important to be prepared for this part of the voyage, since the pilot will look after that. In the case of the grounding of the Federal Kivalina, this was expressed in that the bridge crew and the ship management company accepted that in this case it was not possible to plan the last part of the voyage, in any case not until the navigational charts came on board the pilot boarding place.

[47] As the AIS was out of order, the pilot was unable to connect to it and therefore unable to use his own PC as a navigational aid. The AIBN believes, however, that the absence of this navigational aid does not constitute a contributory safety factor of significance as the pilot knew the local area well and was aware of the ship's position. The ship had sufficient navigational aids.

Even after the bridge crew had the navigational charts available on board, no passage plan was made. The second officer explained this by saying that he was waiting for the pilot to tell him the passage route, and when the pilot did not do this (during the first 20-30 minutes) he gave up establishing a passage plan.

This may also be viewed in the context of the long passage across the Atlantic, the poor weather they had had over the last few days, and that the bridge crew is used to the distance from the pilot boarding place to the quay being much shorter (relatively speaking) than in this case. The AIBN notes, through the audio recordings, that the bridge crew's attention to the navigation of the ship is considerably reduced once the pilot has entered the bridge.

The ship's bridge crew handed the Pilot Card to the pilot. The pilot put the card aside and did not sign it, as required in the ship's procedure. According to the ship management company, the ship's bridge crew often sees this as an indication that the pilot is not interested in receiving the necessary information.

On the other hand, the pilots say they know from experience that the ship's bridge crew rarely is well enough prepared for the voyage from the pilot boarding place to the quay. Once the pilot enters the bridge, the ship's bridge crew mostly tends to leave the voyage to the pilot. Therefore the pilot does not expect much from the bridge crew with regard to their planning and knowledge of local conditions. The way the pilots see it, they have to take care of the navigation.

The Service Instructions for State Pilots[48] do not require cooperation to be established between the pilot and the ship's bridge crew before the piloting commences, except that 'the state pilot must not take over the navigation or manoeuvring of the vessel before relevant information has been exchanged with the duty officer, such as a) the vessel's position b) course c) speed" [49]. In other words, the Service Instructions do not support the objective of the pilot duty in that the pilot shall *provide the ship's bridge crew* with necessary information of local waters.

The AIBN observes that the ship's bridge crew and the pilot expect the pilot to do most of the navigating while the bridge crew withdraws. There is, in other words, a coinciding and mutual expectation that it is not necessary for the pilot and the ship's bridge crew to work together as one bridge team. However, this expectation is not in line with the STCW code, the ship management company's own procedures or the objective of the piloting service in Norway.

BRM literature describes the establishment of a well-functioning bridge team in terms of conducting a 'team brief' when the pilot has arrived on the bridge. The purpose of a team brief is to review the passage route, exchange important information about the characteristics of the ship and local conditions, clarify expectations and arrive at a joint understanding of who is in charge of what tasks, and how communication will be conducted. It is important to include the pilot in

[48] 7.8 Tjenesteinstruks for statsloser (Service Instructions for State Pilots) and 7.12 Losenes oppgaver og plikter i forbindelse med losoppdraget, (The pilots' tasks and duties in connection with a piloting assignment), The Norwegian Coastal Administration.
[49] 7.12 Losenes oppgaver og plikter i forbindelse med losoppdraget <The pilots' tasks and duties in connection with a piloting assignment>, Item.3. The Norwegian Coastal Administration.

the bridge team, not least to ensure that everyone has the same understanding of what the passage plan entails. This forms the basis for achieving the objective of a well-functioning bridge team.

2.3.3 Pilot boarding place, practice for boarding and the order for full speed

The fact that the pilot and the ship's bridge crew had coinciding and mutual expectations that it was unnecessary to establish an efficient bridge team is also reflected when master and the pilot agree to order full speed ahead immediately after the pilot has entered the bridge.

The position for the current pilot boarding place lies open to all wind directions and the sea, and by current personnel safety standards, is only usable in good weather. In bad weather and/or heavy seas it is not safe to board the ship at the pilot boarding place.

The AIBN observes that one consequence of this practice is that when the pilot boards the ship, it is located nearer the coast, with the associated complex navigational conditions and more ship traffic. This necessitates a stronger focus on navigation as soon as the pilot enters the bridge.

We understand from conversations with pilots that it is normal to set the ship at full speed ahead as soon as the pilot is on board.

The AIBN wants to point out that the combination of boarding closer to the shore and ordering full speed ahead just after the pilot has entered the bridge – are some of difficulties that may prevent establishing a well-functioning bridge team where the pilot is a part of the team.

2.3.4 Implement BRM in practice – the ship management company and the piloting service

Based on conversations with pilots and bridge crews, the AIBN believes that lack of an effective bridge team is not unique to this accident.

Although both the ship's officers and the pilot have attended BRM courses, this appears not to have been sufficient to introduce a practice where the ship's bridge crew and the pilot together form a well-functioning bridge team. Both ship management companies and the pilot service are still lagging behind in establishing how to introduce the BRM principles in practice.

Subsequent to the grounding and based on the internal investigation, the ship management company has decided to send the Federal Kivalina's navigators on another BRM course. The ship management company has also distributed a message to all the ships in their fleet about the importance of establishing a passage plan, monitoring it and using lookouts, BRM and procedures for navigation with a pilot on board. The AIBN sees that these measures might further improve safety for the fleet operated by this company, but it will require close follow-up by the ship management company so that a good and efficient performance is introduced in practice, ensuring that everyone included in the bridge crew, including the pilot, work together. A safety recommendation is issued in this connection.

One approach to establishing a bridge team which has been pointed out in BRM literature, and which the Brisbane Marine Pilots in Australia[50] have introduced already, is that the piloting service forward the planned passage route to the ship prior to the piloting assignment. That way the bridge crew can study the pilot's planned route and adjust their own plan if necessary.

Brisbane Marine Pilots have also introduced requirements regarding a review of the passage plan in their procedures[51]. When boarding, the pilot must ask for the ship's passage plan and then take the bridge crew through his own plan. If there are differences between the two plans, the differences must be discussed and a decision must be made on which option to choose. The pilot will not carry out the assignment before the courses on the ship's navigational charts and the pilot's passage plan are identical. Any correction must also be corrected in other navigational aids, such as electronic charts and the radar. The pilot must also encourage the navigator on duty to confirm to him any changes in the course and how they relate to the passage plan. For this to take place, good communication must have been established between the pilot and the navigator on duty.

The Service Instructions for State Pilots do not express clearly enough the importance of the pilot being a part of the bridge team. Nor do the instructions provide a practical approach for how the pilot can become a part of the bridge team. The BRM training which pilots undergo in the Coastal Administration is not specifically tailored to the role and tasks of the pilot. A safety recommendation is issued in this connection.

The prerequisites for establishing a well-functioning bridge team on board the Federal Kivalina were not in place. For navigational safety to be further strengthened when the pilot comes on board, it is necessary that the piloting service makes sure prerequisites on the part of the ship's bridge crew are in place. Based on the information that most ships which are delivering similar cargo in Sunndalsøra are presented with the navigational charts at the pilot boarding place, there may be more ships which are not carrying out the necessary passage planning for the voyage. It is not clearly expressed in the Service Instructions for State Pilots or other instructions from the Norwegian Coastal Administration, which prerequisites must be satisfied in order for piloting to be carried out. Nor does it say what the pilot or others in the piloting service should do if these important prerequisite are not in place. A safety recommendation is issued in this connection.

2.4 Voyage preparation

The deck officers were not prepared for the approach to Sunndalsøra, since necessary navigational charts (paper) were not handed over until after the pilot boarding place at Grip. Planning of a coastal voyage is different than planning a sea voyage. The Norwegian coast is different from many other coasts due to the long approach in the fjords and which require more preparation.

[50] http://www.brisbanepilots.com.au/
[51] The pilotage paradox – Cosco Busan, By Capt. Paul Drouin MNI, Senior Investigator TSB of Canada. September 2008, Seaways

2.4.1 Access to navigational charts and competence

The dates for when the deck officers established passage plans (18 September) and when they were notified of a change in the port of discharge (22 September) are understood as they:

- on 18 September were aware that the possible port of discharge would be either Karmøy or Sunndal,
- or they established the passage plan for Sunndalsøra after 22 September.

The AIBN is of the opinion that it is of less significance in this case whether the deck officers knew that the first port of discharge would be Sunndalsøra *before* they left the loading port or whether they were informed of this a few days later since the charts were not available at loading port[52].

The AIBN have been informed that it may be normal practice to *plan* a voyage in other chart systems – paper charts as well as raster charts and other electronic charts – and then transfer the planned voyage to the approved charts.

Planning with the aid of electronic charts presumes that it is technically feasible to install new charts in the chart machine, and that the deck officers have the necessary know-how in using the chart machine, including downloading of new charts.

AIBN has not received clarification as to why the crew did not get ENC installed in the chart machine after 23 September. There may have been an error in the transfer of the licence keys. It is also possible that the necessary CD(s) containing the maps of Norway and the most recent updates, was/were not on board. It is also possible that the deck officers had not received sufficient training and user support to install new ENC(s).

AIBN has no indications of faults in the chart machine itself. ARCS for the relevant portion of the Norwegian coast were installed at some time after the ship received the necessary codes on 24 September[53]. One of the ship management company representatives got the ENC charts installed a few days after the grounding.

When the ship management company relies on the ships to plan a voyage with the aid of electronic charts, this presupposes that the charts are available, the deck officers have sufficient training and user support for installation of new charts.

2.4.2 Facilitation by the ship management company

It is not unusual that the port of discharge is changed. It is therefore necessary that the bridge officers and ship management company take this into account.

[52] Reminder to the reader: the ship left Vila Do Conde on 20 September. According to the ship management company the ship was not notified that the port of discharge would be Sunndalsøra until two days later. But according to Cargo Manifest No.716/08, signed prior to departure, there is the option that the cargo is to be delivered at a number of ports in Norway. On 23 September, ENCs are ordered for the relevant part of the Norwegian coast. The ship arrived at Grip in the morning of 6 October.

[53] ARCS only provides an overview chart which does not specify the necessary degree of detail to enable complete planning of the voyage for the Norwegian coast.

According to the ship management company there was no access to approved paper charts for the Norwegian coast in the loading port in Brazil before the ship left the loading port. The issue is therefore not just related to the change of the port of discharge while under way, but also how the bridge crew is to conduct prudent planning of the voyage prior to departure when paper charts are not available.

Planning of the coastal voyage is time-consuming, and it is expected that the pilot possesses this local knowledge. The deck officers will perceive the preparations as a waste of time if the pilot chooses another passage route than the one they have planned. This is substantiated by the fact that the passage plan for the original port of discharge, the Hydro quay at Karmøy, also lacks passage details after the pilot boarding place. This is a port the ship had offloaded at previously and for which it had the necessary paper charts. It has also been substantiated that even after the ship had the necessary navigational charts, no plan was established.

The ship management company had the option of implementing measures to ensure satisfactory planning and providing the necessary support to enable installation of ENCs in the chart machine, purchasing other electronic chart systems (TX-97), and other measures to ensure that the ship had paper charts on board well in advance of the pilot boarding place.

The AIBN is therefore of the opinion that the deficient planning before the pilot meeting place may be attributed to the fact that normal practice on board is not always to plan the voyage in detail from the pilot boarding place to the quay. This is also accepted by the ship management company under given circumstances. In this connection we issue a safety recommendation.

2.5 Preparations for the approach and pilot assignment

The quay operator and terminal representative (who is also the ship's agent) in Sunndalsøra were aware that the ship had too much draught and had planned for tugboats so that the ship could be kept away from the quay. The ship's bridge crew had been informed about this. Based on previous experience, the pilot also expected that the ship would have too much draught.

The pilot's attention to clarifying the question of whether it would be safe to come alongside the quay conflicted with the focus on navigating during the last 15 minutes prior to the grounding. Such clarification was particularly necessary due to the ship's draught and north-westerly wind. Both the pilot and the ship's agent knew from experience that going alongside the quay could be unsafe in the event of strong wind from the northwest, taking the ship's draught into account.

Thirty per cent of the ships that deliver aluminium oxide in Sunndal have first lain at anchor in Freifjorden[54]. Some of the ships have been waiting on better weather at the Hydro quay. The ship's bridge crew and the pilot must therefore regularly consider whether it is safe to go alongside the quay or lay at anchor.

The following analysis of the preparations for the approach and pilot assignment will deal with two factors; facilitation of the pilot assignment and the approach to

[54] This is based on the figures for calls at Sunndal in the first 10 months of 2008.

the quay facility, criteria for when it is safe for a cargo ship to go alongside the quay facility.

2.5.1 Facilitation of the pilot assignment and the approach to the quay facility

Information on the weather conditions at the quay facility was not obtained until the pilot did so during the voyage. Obtaining this information took a relatively long time and conflicted with the focus on navigation. This priority of performing the tasks was due to the following:

- As weather conditions constantly change, it was necessary to obtain weather information as late as possible in the process, so that the decision of whether to go alongside the quay was based on the best possible information about the weather and weather prospects. The voyage is relatively long, five hours, and the weather can therefore change under way.

- At the same time, it was necessary to clarify at an early stage whether laying at anchor was necessary, as there is only one anchorage in Freifjorden, about one hour's sailing from the pilot boarding place. Based on experience that this is a relatively large and heavy vessel, the pilot did not wish to end up in a situation where they would have to come about further in.

Why the pilot spent such a long time obtaining information on the weather conditions at the quay facility can first of all be explained by the fact that the quay operator gave inaccurate and contradictory information about the weather conditions. The quay operator did not report the wind force displayed on the quay facility's own anemometer. Criteria for when it would be safe to go alongside the quay and weather forecast were not given. This caused the pilot to be uncertain. According to the regulations relating to safe loading and unloading of bulk carriers, the terminals shall only accept those ships that can go alongside the quay facility in a safe manner.

Secondly, the terminal representative (who is also the ship's agent) did not inform the ship or piloting service about the weather conditions and weather forecast. According to the regulations relating to safe loading and unloading of bulk carriers, the terminal representative shall inform the master of special features of the quay berth "that the master may have a need to know about".

Nor was this information obtained by the piloting service, which thus did not have this information to communicate to the pilot. In accordance with the Norwegian Coastal Administration's instructions for the piloting service, the piloting service shall obtain relevant information about the ship and the pilot assignment and communicate this to the pilot.

On the basis of conversations with pilots, the Norwegian Coastal Administration, the quay operator and terminal representative, the AIBN is of the opinion that these deficiencies in the preparations for the voyage and pilot assignment are not unique to this accident and are regarded as being within normal practice.

The AIBN has obtained information of the pilot's sleeping and working hours in order to assess whether the pilot had had sufficient sleep and rest prior to the

grounding. These work circumstances may have contributed to the pilot's performance capability and alertness being reduced, and may have affected his ability to deal with several tasks at the same time – in this case, telephone calls and navigation. This substantiates the importance of optimally facilitating the pilot assignment for the pilot and the ship's deck officers so that they are not unnecessarily distracted from navigating.

The quay operator, the terminal representative (who is also the ship's agent) and the piloting service did not sufficiently facilitate the assignment for the pilot and the ship's deck officers with regard to obtaining and exchanging information on weather conditions, weather prospects and criteria for when it is safe to go alongside the quay. A safety recommendation is issued in this respect. The coordination task is issued to the Norwegian Coastal Administration to ensure that the improvement measures are coordinated among the players involved.

This presupposes that criteria be established for *when* it is safe to go alongside a quay, which is discussed in the next chapter.

2.5.2 Criteria for when it is safe for cargo ships to go alongside the quay facility

It is the AIBN's understanding that the long clarification period and the pilot's associated distraction from control of the voyage in the last 15 minutes prior to the grounding, are partly due to no delineation being established for *when* it is safe to go alongside the quay.

Ships with aluminium oxide usually have a greater draught than the quay facility, as Hydro Aluminium AS usually books ships with a dead weight of 30 000 – 40 000 tonnes. The change of unloading site may be decided by Hydro Aluminium AS during loading or when the ship is under way across the Atlantic, without regard to restrictions in conditions at the quay facility.

Hydro Aluminium AS' own restriction for the quay facility is that ships shall have a maximum draught of 9.3 metres. With the Federal Kivalina's draught of about 10.70 m, and its breadth, the ship's agent estimated that the ship had to be held four metres from the quay. This information was given a few days after departure from Vila Do Condo. The quay facility accepts bulk carriers with greater draughts than 9.3 metres, provided that the vessel is held out from the quay with the aid of two tugboats. The practice has become that the restrictions on what ships can go alongside the quay are based on the restrictions of the unloading equipment. I.e., the ships must have a draught and breadth no greater than that they are held no more than 6-7 metres from the quay.

The owner of the quay facility therefore accepts that ships with greater draughts than the maximum permitted depth can go alongside the quay. But the reason why this is permitted does not include an analysis of whether this is a safe operation for the ship. No weather restrictions have been stipulated for when a ship may go alongside, not even when a ship has too great a draught. Hydro Aluminium AS considers it the ship's responsibility to determine this.

Practice and the regular frequency of ships with too great a draught arriving at the quay have led to the quay operator and the ship's agent perceiving this as a normal

operation. It is also perceived as a safe operation, as neither the employees at the quay facility nor the ship's agent can remember any damage having been sustained during such an operation. Nor does the Norwegian Maritime Directorate's database contain any accidents of this type.

The ship management company, which operates ships all over the world, does not accept instructions from the charterer to berth when the draught of the ship exceeds the official depth at the quay. The ship management company describes such a situation as a problem, where the ship can be vulnerable to damage. Nevertheless, it was accepted that the bulk ship would go to Sunndalsøra even though the ship early on received information that the safe depth at the quay was significantly less than the ship's expected draught.

Pilots that the AIBN has been in contact with also perceive such situations as a potential problem for the ship's safety, but they have no clear perception of whether or not this is a normal situation.

The quay operator chose to use tugboats to hold the ship from the quay. When the ships are positioned, they must be far enough from the quay at all times to avoid touching ground. The danger of damage to the ships during this operation may entail impairment of the hull strength, puncturing of the shell plating and associated water-filling and/or oil discharges and damage to the rudder and propeller.

As the ship's deck officers often have no knowledge of the local area, this will in practice mean that such an assessment will be left to one person - the pilot. In cases of doubt this entails an individual assessment, which makes a decision vulnerable to influence from others with a motivation other than the safety of the ship.

The ship and the quay facility do not necessarily have the same interests. The quay facility's motivation is mainly based on the right cargo at the right time, flexibility to deliver cargo to Hydro Aluminium AS' various plants, reducing freight costs as much as possible and ensuring that the ship calls do not conflict with each other. This has resulted in restrictions as to which ships can go alongside the quay being based on the limitations of the quay facility's unloading equipment.

The conflict of interest between the quay facility and the ship is not necessarily apparent in very poor or very good weather conditions, but in borderline cases. When clear criteria are *not* stipulated for the suitability of the quay facility and the ships (where the ship's safety is included in the stipulation of the criteria), other interests may entail that the boundary for what is safe (for the ship) is stretched.

The regulations[55] related to the Harbour and Fairways Act and the Ship Safety Act stipulate functional requirements for the operator of the quay facility and the master of the ship. This includes the operator of the quay facility assessing the suitability of the quay facility and the ships. The operator of the quay facility is responsible for ensuring that only those bulk carriers that can go alongside the loading or unloading facility in a safe manner are allowed to do so.

55 FOR 2003-08-29 nr 1114: Regulations relating to safe loading and unloading of bulk carriers

The AIBN is therefore of the opinion that the quay operator has not made sufficient assessments of which ships can go alongside the quay, particularly in view of the substantial draught and during adverse weather conditions.

As part of the quay operator's assessment of the suitability of the quay facility and the ships, the AIBN is of the opinion that a risk analysis is necessary to conduct so that criteria for when it is safe to go alongside the quay are established. This will contribute to the owner of the quay ensuring that the port facility is operated and maintained so that the users' need for port services and transport services in the port is covered in a safe and efficient manner. A safety recommendation is issued in this connection.

Compared with the arrangement in Sweden, the AIBN observes that the Norwegian Coastal Administration's scope for determination of criteria for when it is safe to pilot vessels varies from area to area, and is not systematic. For example, no criteria for the approach to Sunndalsøra have been set.

3. CONCLUSION

3.1 Increasing loss of control

The ship's bridge crew and pilot did not identify indications on increasing loss of control.

The loss of control was gradual and the AIBN is of the opinion that the following circumstances contributed to this:

- The loss of control in connection with navigation began as early as from the pilot boarding place at Grip, before the pilot came aboard, since the ship's bridge crew did not have the necessary navigational charts and sailing plan.

- The bridge crew did not familiarise themselves with the passage route after the pilot boarding place, even after the necessary navigational charts had come on board.

- When the pilot came on board, no satisfactory exchange of information took place between the pilot and the bridge crew concerning the passage route and the ship's characteristics.

- The ship's bridge crew did not participate in navigation once the pilot was on the bridge. The result of this was that the only person involved in navigation was the pilot.

- Once the course had been set towards the beacon at Skarvbergneset, Årsundøya, the pilot was occupied with clarifying the wind conditions at the quay facility. Since the ship's draught was 10.7 meters and maximum safe depth at quay was 9.3 meters, it was important to clarify whether the wind was too strong to safely go alongside the quay. It was necessary for the pilot to decide whether the ship would have to lay at anchor pending better weather, as the only safe anchorage was in Freifjorden. This turned the pilot's attention away from navigating in the last 15 minutes prior to the grounding.

The result was that the ship stayed a steady course towards Skarvbergneset. The ship's bridge crew did not react until the ship was about 300 metres – 1 ½ ship's length – from land. This was not early enough to complete a successful evasive manoeuvre and the ship ran aground at a speed of 12 knots.

If the stages that led to a gradually increasing loss of control are viewed separately, they were considered by the ship's bridge crew and the pilot to be within normal practice. This resulted in no one recognizing indications of increasing loss of control, which may be understood by the fact that the bridge team did not function satisfactorily.

An analysis of the course of events identifies several underlying safety factors:

3.2 Insufficient voyage preparation

The ship's bridge crew was not sufficiently prepared for the 5-hour-long voyage from the pilot boarding place to the quay since the voyage plan did not include this leg.

The bridge crew and the ship management company had ample time to ensure that the entire voyage was planned satisfactorily.

The deficient planning may in part be attributed to the fact that the ship management company accepts this in certain circumstances.

An important prerequisite for establishing a well-functioning bridge team and strengthening navigation safety was therefore not fulfilled. A safety recommendation is issued in this connection.

3.3 Deficient bridge team

After the ship arrived at pilot boarding place at Grip there was not a well-functioning bridge team among the ship's bridge crew. An important prerequisite for strengthening safety in coastal waters was therefore not fulfilled.

When the ship sailed towards Sunndalsøra the persons on the bridge did not function together as a team.

The purpose of the ship management's safety management system and the Norwegian pilot duty is to strengthen navigation safety in coastal waters in that the pilot provides the bridge crew with the necessary knowledge of the local waters.

There were partially coinciding and mutual expectations among the ship's bridge crew and the pilot that it was not necessary to work together as a bridge team.

The piloting service in Norway does not to a sufficient extent include requirements in their procedures for the prerequisites for piloting being fulfilled by the ship's bridge crew before the actual piloting begins. Sufficient requirements have not been stipulated so that the pilot ensures that the ship's bridge team has prepared the necessary passage plan.

The piloting service in Norway does not stipulate sufficient requirements so that piloting shall be based on the pilot being part of the bridge team.

Three safety recommendations are issued in this connection.

3.4 Insufficient criteria for when it is safe to go alongside the quay

Criteria for when it is safe to go alongside the Hydro quay in Sunndalsøra are currently relegated to an individual assessment on board the vessel.

This has entailed vulnerability in terms of the ship's safety, as the decisions are reduced to individual assessments, without objective information and in jeopardy of being subjected to undue pressure from interests other than that of the ship's safety.

The quay operator has not sufficiently assessed the suitability of the quay facility and the ships. The Norwegian Coastal Administration's scope for determination of criteria for when it is safe to pilot the vessel varies from area to area, and is not systematic.

One safety recommendations is issued in this connection.

3.5 Insufficient facilitation of the assignment for the pilot and ship's bridge crew

The quay operator, the ship's agent/terminal representative and the piloting service did not sufficiently facilitate the assignment for the pilot and ship's bridge crew.

Information on the weather conditions at the quay facility was obtained after the pilot boarding place. This took a relatively long time and conflicted with the focus on navigation.

The insufficient facilitation includes obtaining and exchanging information on weather conditions, weather prospects and criteria for when it is safe to go alongside the quay, and associated organisation. A safety recommendation is issued in this connection.

4. SAFETY RECOMMENDATIONS

The investigation into this maritime accident revealed six areas where the AIBN finds it necessary to make safety recommendations for the purpose of improving maritime safety[56].

Maritime Safety Recommendation No. 2010/01T

The last part of the voyage plan from the pilot boarding place and in to Sunndalsøra had not been established by the ship's bridge crew. An important prerequisite for establishing a well-functioning bridge team and strengthening navigational safety was therefore not fulfilled.

The AIBN recommends that the ship management company introduce measures that ensure good and timely planning of the entire voyage.

Maritime Safety Recommendation No. 2010/02T

The ship's bridge crew did not function satisfactorily as a bridge team after the pilot boarding place at Grip. There were partially coinciding and mutual expectations among the ship's bridge crew and the pilot that it was not necessary to work together as a bridge team. An important prerequisite for strengthening navigational safety after the pilot boarding place was therefore not fulfilled.

The AIBN recommends that the ship management company implement measures that ensure that the bridge crew work together as a well-functioning bridge team when there is a pilot on board.

Maritime Safety Recommendation No. 2010/03T

The pilot was not aware that the ship's bridge crew was not sufficiently prepared for the final leg of the voyage from Grip to Sunndalsøra. The piloting service in Norway does not to a sufficient extent include requirements in their procedures for the prerequisites for piloting being fulfilled by the ship's bridge crew *before* the actual piloting commences.

The AIBN recommends that the Norwegian Coastal Administration conduct a review of the procedures to ensure that the prerequisites for piloting are fulfilled by the ship's bridge crew prior to commencement of piloting. This should also include measures that should be implemented by the pilot when crucial prerequisites have not been fulfilled by the ship's bridge crew.

Maritime Safety Recommendation No. 2010/04T

The piloting service in Norway does not stipulate sufficient requirements so that the pilot is part of the bridge team. There were partially coinciding and mutual expectations among the ship's bridge crew and the pilot that it was not necessary to work together as a bridge team. An important prerequisite for strengthening navigational safety after the pilot boarding place was therefore not fulfilled.

[56] The investigation report will be submitted to the Ministry of Trade and Industry, which will implement the necessary measures to ensure that the safety recommendations are taken into due consideration.

The AIBN recommends that the Norwegian Coastal Administration consider changes in the training of pilots and procedures, along with other measures, so that the pilots can more efficiently be part of a well-functioning bridge team.

Maritime Safety Recommendation No. 2010/05T

Deficient criteria for when it is safe to go alongside the quay have entailed vulnerability in terms of the safety of the ship when the decisions are relegated to individual assessment without objective information and in jeopardy of being subjected to undue pressure from interests other than those of the ship's safety. The quay operator of the Hydro quay at Sunndalsøra has not made sufficient assessments of the suitability of the quay facility and ships.

The AIBN recommends that the quay operator carry out risk management of the quay facility and ships, and establish and evaluate criteria for when it is safe to go alongside the quay.

Maritime Safety Recommendation No. 2010/06T

Procurement of information about weather condition took a relatively long time and conflicted with focus on navigation. The quay operator, terminal representative, and piloting service did not sufficiently facilitate the assignment for the pilot and the ship's bridge crew.

The AIBN recommends that the Norwegian Coastal Authority, in cooperation with the operator of the quay facility and the terminal representative, introduce measures to improve organisation and retrieval of necessary information in order to improve conditions for the pilot and the bridge crew.

Accident Investigation Board of Norway

Lillestrøm, 4 January 2010