aibn
Accident
Investigation Board
Norway

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REPORT ON MARINE ACCIDENT MV FULL CITY GROUNDING AT SÅSTEIN 31 JULY 2009

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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.

Photo of ferry on the Norwegian west coast: Bente Amandussen

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NOTIFICATION OF THE ACCIDENT

The Accident Investigation Board Norway (AIBN) was notified of the accident by the Joint Rescue Coordination Centre (JRCC) at Sola at 00:44 on 31 July 2009. The Panama-registered cargo vessel *Full City* had run aground at Såstein off Langesund with 23 persons on board. The information was forwarded to the Panama Maritime Authority's (PMA) Marine Casualty Investigation Branch.

Figure 1: Full City's grounding at Såstein off Langesund on 31 July 2009. (Source: AIBN)

An investigation was instigated with Panama as the 'lead investigating State' in accordance with Panamanian and Norwegian legislation, the International Maritime Organization's (IMO) Code for the Investigation of Marine Casualties and Incidents[1] and the United Nations Convention on Law of the Sea (UNCLOS).

The AIBN arrived on the accident scene on 2 August 2009 with three marine casualty investigators, while the PMA arrived on 7 August with two marine casualty investigators. The PMA interviewed the vessel's crew, and the AIBN conducted interviews with personnel from Brevik VTS, the shipping agent and others (landowners).

SUMMARY

The Panama-registered cargo vessel *Full City* received the assignment to ship artificial fertilizer from Herøya in Porsgrunn to Guatemala on 23 July 2009. The vessel was berthed in Newport, England at the time. As early as one week before the vessel entered Norwegian waters, the local Norwegian agent referred the vessel to anchor at Såstein anchorage while awaiting clearance to

[1] IMO Resolution A.849 (20) with appendices.

birth at Herøya. The agent stuck to Såstein as the anchorage site, even though the weather forecasts increasingly indicated that the area would be exposed to strong winds and high waves.

Before the vessel entered Norwegian waters, contact was established between the vessel and the Norwegian authorities (Brevik VTS) in accordance with the international guidelines that apply to permission to enter a VTS centre's area of operation. In its communication with the vessel Brevik VTS did not make it clear that the anchorage referred to was outside its area of operation.

Just before midnight on 30 July 2009, *Full City* lost its anchor hold and started dragging[2] under the impact of strong south-easterly winds and high waves. Because it was dragging in a south-easterly direction quite close to the shore, there was little opportunity to regain control once the vessel had started dragging. The vessel ran aground at Såstein after dragging anchor for 35 minutes.

The AIBN believes that different role expectations contributed to the master's decision to let the vessel lie at anchor at Såstein in strong winds. The input from the agent and the VTS centre influenced the master's expectation that the vessel should lie at anchor. This did not tally with the expectations of the agent and the VTS centre that the master had to make his own independent assessments.

In the AIBN's view, the greatest potential for preventing similar incidents in Norwegian waters and for safeguarding Norwegian environmental protection interests can be found in the organisation and execution of the authorities' vessel traffic service. If this service is given a more active role, the AIBN believes that both agents and ships can be guided into making decisions that better ensure safety.

The Norwegian Coastal Administration (NCA) has initiated and implemented measures in this area. No safety recommendations are therefore submitted by the AIBN after this investigation.

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[2] Anchor dragging along the seabed

1. FACTUAL INFORMATION

1.1 Introduction

Panama, as flag state, and the AIBN entered into a cooperation agreement at an early stage. Under the agreement, Panama was to concentrate on matters relating to the vessel's safety management system and the shipping company, whereas the AIBN was to shed light on matters relating to Norway as the coastal state. Even though Panama, in its capacity as flag state, has also been lead investigating state, the AIBN resolved to carry out an independent investigation of the accident. The AIBN's investigation is presented in this report.

The investigation has been limited for the purpose of considering, in particular, where the greatest potential lies for preventing similar incidents in Norwegian waters in order to safeguard Norwegian environmental protection interests. The AIBN has not investigated matters relating to the vessel's owners. The investigation is also limited in that it does not include any evaluation of the salvage, rescue or oil-spill response operations.

The report specifically addresses issues relating to the Norwegian vessel traffic service (VTS service) and how it has acted in relation to foreign vessels entering Norwegian waters and calling at Norwegian ports. Details about the transport assignment, the vessel's movements, communication between the vessel and Norwegian authorities and explanations provided by those involved have been included as part of the investigation. Panama's report has not been published, but the AIBN has been granted access to the results of the PMA's investigation.

The AIBN has obtained documentation from the vessel, the shipping company, the shipping agent, the NCA, the classification society and others. Evidence provided by the vessel's crew is based on statements made to the police. Technical data consist of AIS[3] data, communication records, subsea data and other data. External expertise has been employed to inspect and analyse the vessel's anchor arrangement.

1.2 Details of the vessel and the accident

Time of accident:	At 00:25 on 31 July 2009 (local time, UTC +2)
Accident location:	Såstein, Bamble municipality Position N 58° 58,03’ Ø 9° 42,747’
Persons on board:	23 crew
Personal injuries/deaths:	None
Damage to the vessel:	Hull damage to approximately 1/3 of the vessel's bottom
Environmental damage:	Leakage of diesel and heavy fuel oil that caused damage to the flora and fauna along the Skagerrak coast from Vestfold county to Agder county.

[3] AIS: Automatic Identification System

Vessel details

Vessel's name and IMO No:	*Full City*, 9073672
Owner:	Roc. Maritime Inc., Hong Kong
Shipping company:	Cosco HK Shipping Co Ltd, Hong Kong
Company responsible for ISM:	Cosco Shipping
Home port:	Panama City
Flag state:	Panama
Class:	Class NK (Nippon Kaiji Kyokai), Tokyo
Transport type:	Bulk
Year/place built:	1995 Hakodate Dock Co. Ltd
Construction material:	Steel
Length overall:	160 m
Gross tonnage:	15 873 tonnes
Engine:	Mitsubishi – 6uec45la: 7200 hp at 158 RPM
Propulsion:	1 propeller shaft with fixed four-blade propeller
Service speed:	16 knots

Details about the cargo, bunkers, charterer and vessel's agent

Type and quantity of cargo:	Empty (in ballast condition)
Ballast:	Water-filled ballast tanks, empty forepeak tank
Amount of bunkers:	1154T
Vessel's draught:	3.31 m at the bow and 5.48 m at the stern
Charterer:	Oldendorff carriers
Vessel's local agent:	Høyergruppen AS

Figure 2: Full City aground east of Lille Såstein. (Photo: NCA/Scanpix).

Figure 3: Full City aground at Såstein. (Photo: the police).

1.3 Chain of events

1.3.1 Introduction

The chosen starting point for this investigation is the point at which the vessel received the transport assignment to Herøya and what happened from then onwards. The vessel's passage, anchorage, changes in position, grounding and important communication between the vessel and VTS will be successively described in the sections below. The figure overleaf shows where *Full City* dropped anchor, the direction in which it moved

and where it ran aground at Såstein. The map shows that the vessel was outside the area of operation of Brevik VTS (Grenland Vessel Traffic Service Area) throughout the course of events.

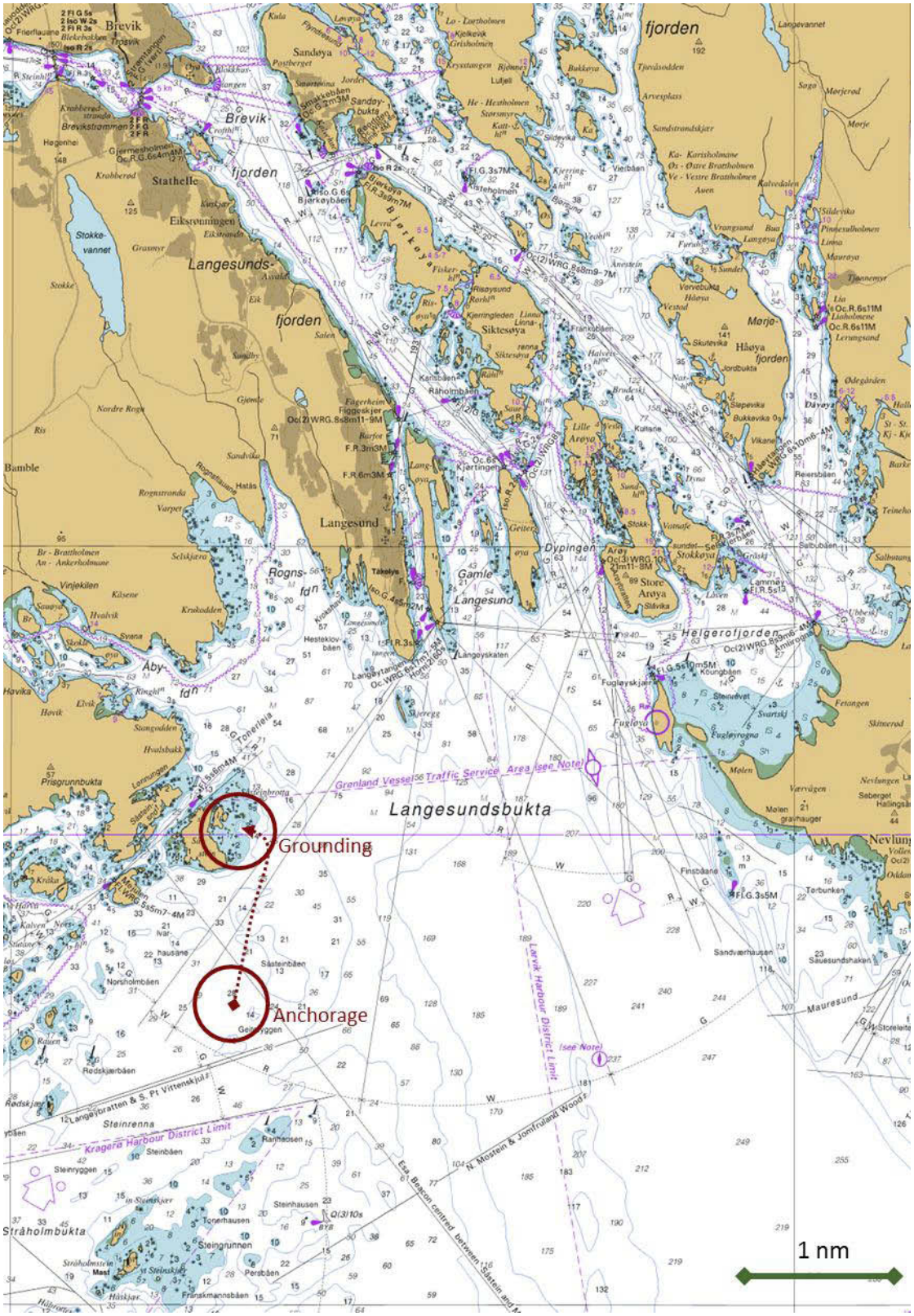


Figure 4: The position in which Full City dropped anchor, the direction in which it drifted and the place where the vessel ran aground. (Source: the Norwegian Mapping Authority/AIBN).

1.3.2 The assignment and early weather outlook

On 23 July, *MV Full City* was assigned to carry approximately 10 780 tonnes of mineral fertilizer from Yara at Herøya in Porsgrunn, Norway to Puerto Quetzal in Guatemala. The vessel was berthed in Newport, England at the time. On the same day, Høyergruppen AS in Porsgrunn was appointed local agent for Full City's call at Herøya.

The local agent saw to all communication with Yara at Herøya, Brevik VTS and others, for the purpose of obtaining information and arranging practical necessities. On 24 July, the master on *Full City* received an email with preliminary information from the local agent about the call at Herøya. The email informed the vessel that the estimated time of arrival at the quay at Herøya had been stated as the morning of 1 August, and that:

'Vessel has to anchor Saastein/off Langesund due to layday'

The vessel left Newport at 23:30 (local time) on 26 July, setting course for Skagen and subsequently Norwegian waters.

In another email sent by the agent to the charterer Oldendorff on 28 July, in which the master was among those copied in on the Cc line, it was repeated (in wording corresponding to that cited above) that the vessel was to anchor at Såstein. In that email, the estimated time of arrival at the quay was stated to be in the afternoon of 31 July. It was stated, however, that according to the forecast, there would be rain, which could cause some delay.

The AIBN has been informed by the agent that it considered Såstein to be the anchorage area normally given to vessels waiting to berth at Grenland. This would also be more economical for the vessel, in that it would only need pilotage once. In another email from the agent on 29 July, Såstein was repeated as the anchorage area, while stating the same estimated time of arrival at the quay as the previous day. The latter email included a link to the local weather forecast. The weather forecast indicated strong winds in Skagerrak from late at night on 30 July. The agent did not comment on the weather forecast in this email. The agent was aware of the severe weather forecast, but expected that decisions relating to anchoring would be a matter for the vessel.

The AIBN has been informed that problems with the vessel's computer equipment meant that the crew were unable to open email attachments or access the internet.

1.3.3 Bunkering in Skagen

Full City had planned to bunker in Skagen before taking cargo on board at Herøya, and it anchored to bunker diesel and heavy fuel oil at Skagen at 01:20 on 30 July. According to the master, it filled 385 tonnes of heavy fuel oil and 79 tonnes of diesel. In such case the vessel was carrying a total of 1 015 tonnes of heavy fuel oil and 121 tonnes of diesel.

That night, gale warnings for the next 24 hours were sent via Navtex and VHF radio, and these included the Skagerrak area. For more detailed information about the weather and sea conditions, see section 1.5.

1.3.4 The voyage across Skagerrak

The vessel set course for Langesund at 09:15 on 30 July, with full bunker tanks and in ballast condition. On 30 July, the agent reported to SafeSeaNet Norway the amount of

bunker fuel that the vessel carried, and contacted Brevik VTS requesting it to call *Full City* and instruct the vessel to anchor at Såstein on arrival that afternoon and inform the vessel that clearance to berth at Herøya to take aboard cargo would be given on 1 August.

A south-easterly breeze was blowing when the vessel crossed Skagerrak, and the previous night's gale warnings sent via Navtex and VHF were repeated several times during the day. During the same period, weather forecasts were also issued via the SafetyNet/Inmarsat C, which included place names both Norway (*Norwegian basin*) and Denmark (*Danmark Strait*). These were remote areas of no relevance to the vessel at the time. See section 1.5 for more information on this point.

1.3.5 The vessel's entry into Norwegian waters

At 13:33 on 30 July, the vessel called Brevik VTS on VHF channel 80 and notified that it was entering Norwegian waters. At that time, the vessel was approximately 12 nm from the pilot boarding point in Langesundsbukta bay, and it was sailing at a speed of approximately 15 kn. Brevik VTS answered as follows:

> *'Well understood Full City. You are going to anchor at Saastein anchorage … As I have from your agent approximately tomorrow sometime going for berth.'*

The three dots before the final sentence represent a pause of a few seconds in Brevik VTS's response to the vessel. *Full City* confirmed that it would anchor at Såstein, and that it would contact the VTS centre when it had anchored. In its contact with Brevik VTS, *Full City* was issued anchor point coordinates as Brevik VTS requested precision anchoring at Såstein anchorage. Precision anchoring was requested based on previous incidents of anchor dragging (described in more detail in section 1.10.1). When asked by the police, the bridge officers did not express that they were bound by a particular anchoring position at Såstein, however.

There were no instructions on board relating to wind restrictions on anchoring, with the exception that the anchoring position should be monitored and logged at wind forces of 7 or more.[4]

1.3.6 At anchor at Såstein

At 14:50, the master called Brevik VTS and reported that they had dropped the starboard anchor at Såstein with five shackles in the water (approximately 137 m of anchor chain) in position 58˚56.9’ N 009˚42.7’ E, which was the position requested by Brevik VTS. The main engine was then shut down. From the anchoring position, the nearest shore was 0.9 nm to the north. At this point the sea was approximately 20-22 m deep. According to weather observations from Jomfruland and Svenner, there was a moderate to strong south-easterly breeze (force 4–6) at the time when the vessel anchored. The wave heights in the area were 2–3 m.

Brevik VTS confirmed to *Full City* that it had received the information and told the vessel to berth at Herøya in two days' time. It requested that the vessel maintain a

[4] Wind forces and figures are stated with reference to the Beaufort wind force scale, see http://metlex.met.no/wiki/Beaufort

listening watch on VHF channel 80. *Full City* confirmed that it would remain on standby on channel 80. The vessel had also tuned its radio to channel 16.

1.3.6.1 *Såstein anchorage*

The sea area south of Såstein has been used as an anchorage for vessels waiting to berth for many years. Såstein anchorage was not marked as an anchorage area on the nautical charts. The anchorage also lay outside what was defined as the area of operation for Brevik VTS.

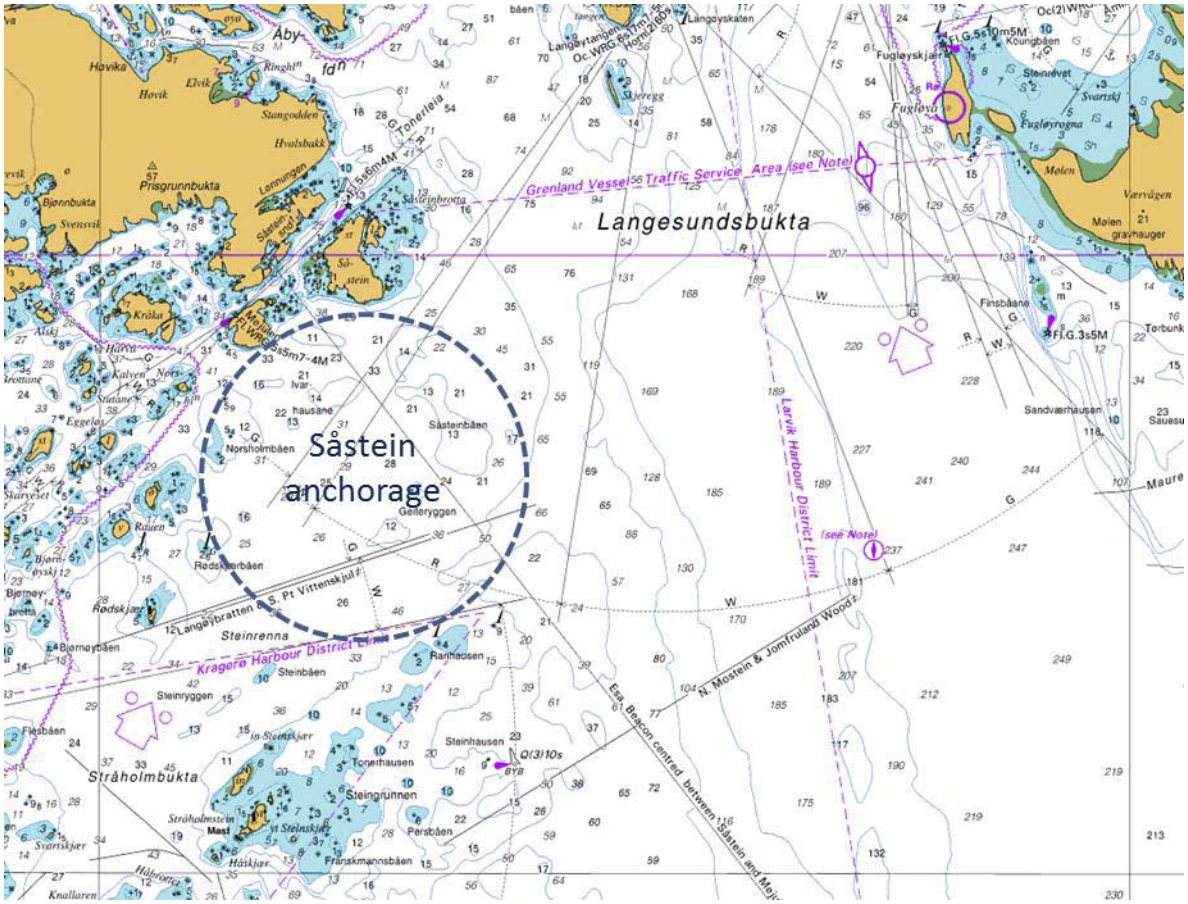


Figure 5: The ringed area shows Såstein anchorage. The area was not marked on the nautical charts. (Source: the NCA/AIBN).

1.3.6.2 *Understanding of the relationship with Brevik VTS*

In his statement, the master considered that the anchorage area appeared to be exposed to the wind, particularly when taking into account that the vessel was empty. He thought the distance to two other vessels that were anchored further to the north-east at Såstein anchorage was okay. The master understood Brevik VTS to be an official authority. When they had anchored at Såstein, it was his understanding that they were under the authority of Brevik VTS. Had the master deemed the weather conditions to be poor, he would have asked the VTS centre for permission to move or put further out to sea. He also expected that he would be notified by the VTS centre if there was a need for action on his part. He did not receive any such notification from the VTS centre, or from the shipping agent, charterer or other vessels.

However, Navtex printouts on board the vessel show that, around the time of arrival at Såstein anchorage, updated gale warnings were received and acknowledged, including for Skagerrak, which was the area closest to the vessel's position (weather forecast at 14:00 on 30 July).

1.3.6.3 *Other vessels*

Not long after *Full City* had anchored at Såstein, the gas tanker *MT Lady Margaux* left the area to move to a more sheltered anchorage in the Frierfjord. The master on *Full City* has explained that he understood the vessel to be moving because it had been given the green light to berth. The AIBN does not know on what grounds *Lady Margaux* decided to be under pilotage and move to sheltered waters.

The tanker *MT Vingatank* was also at anchor at Såstein awaiting orders for its subsequent voyage. *MT Vingatank* left the anchorage at 15:55 after being ordered to sail to Gothenburg to load.

1.3.6.4 *Preparations for the night*

The mate on the 8-12[5] watch noticed that a moderate to fresh breeze (force 4–5) was blowing when he came on watch. He has stated that he read the weather forecast which indicated that the wind would increase to fresh breeze and high winds (force 5-7). In his statement, the master said that he expected fresh to strong south-easterly breeze (force 5–6) during the night. He therefore chose to maintain a normal preparedness level in terms of crew. This meant that there were two persons on bridge watch and two in the engine room. He visually checked the horizon and sea surface late at night, and observed nothing out of the ordinary. The master ended his workday by writing in the night orders book at around 21–22. The instructions were worded as follows:

- The position of the anchor must be carefully monitored, that it remains in position
- If anything unexpected occurs, those on duty must take action
- Listen carefully to communications/VHF
- Should any problems arise, the master must be woken up

After this, the master left the bridge and went to bed. According to those who were on bridge watch, they used both GPS and radar as aids to monitor the vessel's position. They also checked visual landmarks as long as there was daylight. There was also an option of setting an alarm, so that they would be warned if the vessel moved. This option was not used.

1.3.6.5 *Gale Warning No 436*

A gale warning (No 436) from Rogaland radio was transmitted via VHF radio at 21:00. The same warning was also sent via Navtex at 21:06, 21:08 and 23:50.

Gale Warning No 436 was worded as follows:

[5] Bridge officer on watch, with cyclus 8-12 and 20-24..

'Gale warning; Class: 1; Gale warning no. 436 - Issued by Norwegian Meteorological Institute 30.07.2009 at 18:49 UTC[6]

Svenskegrensa[7] *– Jomfruland*

Late Thursday evening increasing southwest gale force 8, briefly strong gale force 9 in outer Oslofjord. Late Friday morning southwest near gale force 7, in the evening decreasing.

Jomfruland - Åna Sira

Late Thursday evening increasing southwest gale force 8, briefly strong gale force 9 in outer Oslofjord. Late Friday morning southwest near gale force 7, in the evening decreasing.

Karmøy - Slåtterøy

Friday morning increasing to west at times near gale force 7, decreasing Friday afternoon.

Inner Skagerrak

Late Thursday evening increasing southwest gale force 8, briefly strong gale force 9 in outer Oslofjord. Friday afternoon decreasing to force 6.'

Outer Skagerrak

Late Thursday evening increasing southwest gale force 8, briefly strong gale force 9 in outer Oslofjord. Friday afternoon decreasing to force 6.'

1.3.6.6 *Change in the weather*

After 21:00, there was a marked change in the weather. The wind changed from south-easterly to south-westerly and became stronger. This also affected the wave height. See section 1.5.2 for more information about weather observations.

1.3.6.7 *Change of watch at Brevik VTS*

The watch changed at Brevik VTS between 23:15 and 23:30. According to Brevik VTS, the first part of the watch is spent on studying which moves are scheduled to take place during the period immediately ahead. Hence priority would not be given to *Full City*, a vessel at anchor that, moreover, was located outside the VTS centre's area of operation during the early phase of the watch. As usual, the VTS was manned by two operators during the night.

1.3.7 The vessel starts drifting

The officer on the 8-12 watch lost visual references when it became dark around 22:00, but he observed increasing wind speeds on the anemometer. At approximately 23:00, he called the engine room and asked the engine crew to not leave the engine room as they would possibly have to act at short notice. At 23:45, the officer coming on watch arrived on the bridge. They now noticed that there was more movement in the vessel, and they discussed whether to also drop the port anchor. The officer leaving the watch noted down

[6] At 20:49 local time
[7] Translator's note: Svenskegrensa = the Swedish border

in the log book that the anchor position was 'ok', and entered the time 00:00. The port anchor was not deployed.

The officer coming on watch read the night orders book, and then started to check the vessel's position using GPS and radar. He thought the time was 23:56 when he got the first indication that the vessel might be adrift and heading for shore. He therefore checked again, and a change of position was again confirmed. At 00:02, he had a telephone conversation with the master, who had been woken by strong movements in the vessel. The master instructed the officer on watch to notify the engine room to prepare to start the engine, and arrived on the bridge in person a few minutes later. The master ascertained that the vessel was dragging and ordered the chief mate and a member of the deck crew to the bow to start heaving the anchor. The chief engineer was also ordered to go to the engine room. The rest of the crew were notified by the officer on watch by an announcement over the vessel's PA system some time between 00:10 and 00:15. An emergency situation was announced, and everybody was ordered to muster at their designated stations.

The master tried to get the vessel under control. He has stated that he turned the rudder hard to port, intending to attempt to move to deeper waters once the propulsion system came into operation. He also considered deploying the port anchor, but that would have impeded the chance of moving to open waters.

The vessel was now dragging sideways in a north-easterly direction and rolling strongly in the high seas. Weather observations show that a fresh to strong south-easterly gale was blowing across the area. According to the crew, the vessel's anemometer measured speeds of up to 50 knots (approximately 25 m/s) during the period in question. An attempt was now made to heave the starboard anchor. The anchor chain was tight, and they had difficulties heaving the anchor as the winch was not powerful enough.

According to AIS data, the vessel started drifting from its anchor position at 23:53. One anchor fluke was found on the seabed during a subsequent search. It was found near the position *Full City* was in at around 00:10, see Figure 5. Searcharea with finding is shown in apendix A. *Full City* was then moving across a shallow seabed at a speed of 2–3 knots in a north-easterly direction. The anchor fluke was brought ashore and examined. The results of this examination are described in section 1.8.

A pilot boat lay at the pilotage station in Langesund. The pilot boat's crew kept an eye on the vessel's movements on the AIS. They began to observe indications that *Full City* was dragging, and at 00:13, the pilot boat notified Brevik VTS. AIS data show that, at that time, *Full City* had moved almost 8 cables (i.e. 0.8 nautical miles or about 1 500 metres) and was 2 cables off the nearest land at Såstein. At 00:17, the VTS centre contacted the vessel over VHF radio for the first time and it monitored the vessel's further movements by radar and AIS.

Figure 5 shows the track from the AIS system for the phase during which *Full City* was dragging. Key communication events are shown in the figure, while the detailed communication between the vessel and the VTS centre during this phase is described in the following.

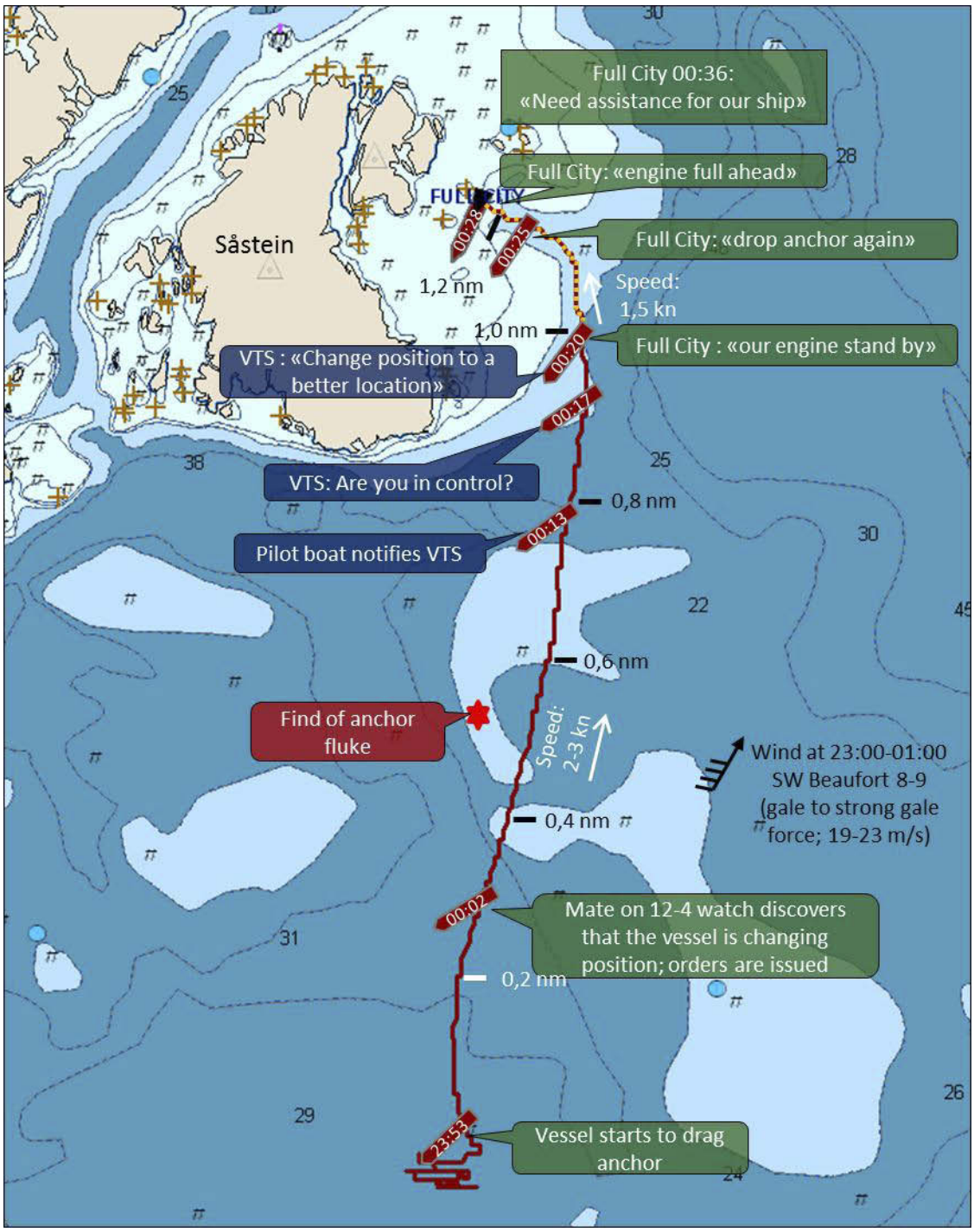


Figure 6: AIS tracking of Full City's anchor drag, including key information. (Source: AIBN).

The following is taken from a sound recording of the communication between the VTS centre and the vessel on channel 80 on 31 July 2009, and cited in the present tense:

> At 00:17: The VTS calls *Full City*. The officer on the 12-4 watch on *Full City* answers. The VTS asks if they are in control of the anchor position, whether they have initiated a move or are drifting. *Full City* does not respond.
>
> At 00:19: The VTS makes another call to *Full City*. *Full City* replies after 20 seconds. The VTS asks if they are in control. *Full City* replies *'Our engine stand by'*. The VTS states the following: *'You are drifting towards shallow area. Check your*

position and change your anchor position to a better location or…'. Full City interrupts and repeats that the engine is *'stand by'*. The VTS requests *Full City* to report back when they are in a secure position.

At 00:24: The VTS calls *Full City* without getting a reply. The VTS calls again a minute later. *Full City* replies: *'Drop anchor again, drop anchor again'*. The VTS responds: *'No, you cannot drop anchor there. Get away. You are drifting towards danger. You are just about one cable before you are grounding'*. Full City's reply is somewhat unclear, but the AIBN understands it to be *'Yes, I know I know I know'*. The VTS then orders *Full City* to move south and eastwards.

Full City had drifted 1.2 nm by that stage and was close to the shore.

1.3.8 The vessel runs aground

The order to start up the engine was issued at around 00:05, and the engine was up and running approximately 15-17 minutes after midnight. The engine speed was gradually increased. AIS data show that, from 00:17, the vessel changed its heading to a southerly direction at the same time as it took a westerly course across a shallow area. During this phase, the vessel's speed was reduced to about half the stable speed of 2-3 knots it had held for the past 20 minutes. The change in course brought the vessel in the direction of some shallows east of Lille Såstein. From around 00:26, the vessel's movement was erratic, and it stopped moving at about 00:28. The crew have stated that water flowed into the engine room and that the engine stopped shortly thereafter. They estimated that the engine had been running for approximately ten minutes before it stopped. Attempts were made to restart the engine, but failed. The crew could hear and feel that the vessel's bottom repeatedly struck the rocks. The master noted that water had entered cargo holds 2, 3 and 5, and that there was a hole in the hull between cargo holds 2 and 3.

The communication between Brevik VTS and the vessel from 00:28 and onwards was as follows:

At 00:28: The VTS calls *Full City*, repeating the call after another two minutes. *Full City* responds: *'My engine already full ahead'*. The VTS asks whether they have run aground and what is happening. According to the AIBN's interpretation, *Full City* responds as follows: *'No, no. No grounding'*. However, the pronunciation of the word *'no'* can also be interpreted as *'now'*. When he was subsequently interviewed by the police, the officer on watch stated that he did *not* think they had run aground at that point. The VTS requests *Full City* to repeat whether or not they have run aground. It is difficult to interpret *Full City's* reply, and the VTS centre repeats the question. *Full City* replies: *'No aground'*, or *'Now aground'*.

The VTS then asks whether they need tugboat assistance, to which *Full City* replies: *'Heave anchor, heave anchor. Will drop anchor again, again. No grounding, no grounding'*. VTS responds: *'According to the AIS you are aground. Can you confirm if you are aground or floating.'* The time is now 00:32. *Full City* does not respond.

At 00:36, *Full City* calls Brevik VTS. The VTS responds. *Full City* requests assistance. The VTS asks whether they have run aground and whether they are taking in water. *Full City* replies that the engine is out of control. The VTS acknowledges this and asks again whether they are at anchor or aground. *Full City* replies that they are at anchor. The VTS asks if they are securely anchored. *Full City* repeats that they

are in need of assistance and that they cannot use the engine. Voices can be heard in the background. The VTS says that assistance will be ordered and asks *Full City* to contact Tjøme Radio on channel 16 and remain on standby. The time is now 00:38.

At 00:37, *Full City* requests 'immediate assistance' on channel 16. During the next 30 minutes, *Full City* repeats this message five times.

At 00:39, *Full City* calls the VTS centre on channel 80 with the message: *'My ship is grounding, engine room flooding, main engine stopped, require assistance, urgent'*.

Brevik VTS has stated that, due to language problems, it was difficult to understand what was being said by *Full City* on the VHF channel. The VTS got the impression that the officer on watch thought the vessel was under control and that it seemed as if they might just run clear of Såstein. The VTS operator on duty has stated that he let some time pass between each call he made, as he did not want to unnecessarily add to the confusion in what he understood to be a hectic situation.

The crew on *Full City* had not been able to heave the anchor before the vessel ran aground. One shackle was still in the water when the AIBN examined the vessel.

1.3.9 The rescue operation

At 00:37, Brevik VTS informed Tjøme radio on channel 16 that the tugboat *Bruse*, which was moored just outside Brevik VTS, had been notified and made ready, and that the pilot boat was on its way. At 00:50, the pilot boat was seven cables from *Full City*. The pilot boat observed that Full City's deck lights were on, but that they went out just after 01:00. Tjøme radio called for an additional tugboat, *Balder*, which was scheduled to arrive the next morning. *KV Nornen*, which lay in Langesund, was notified and headed out at 00:42. At 01:04, *KV Nornen* reported that it was in place as on-scene coordinator (OSC). *Bruse* reached the grounded vessel at 01:36.

At 00:56, Brevik VTS notified the NCA's Department for Emergency Response. A rescue helicopter (Sea King Saver 60) arrived at 01:30 and informed the OSC that it carried emergency bilge pumps on board. At 01:54, the rescue helicopter had lowered a rescue worker onto the deck of *Full City*. At 01:55, the rescue worker from the SeaKing helicopter reported that he observed a lot of oil in the sea on the port side of *Full City*.

At 02:23, the rescue helicopter had picked up 12 crew and brought them ashore to the Command Centre (CO) at Brevik. The helicopter returned to *Full City* intending to pick up the remaining crew of 11. The master wanted to retain some crew in order to save the vessel and limit the damage, and was granted permission to retain a minimum crew on board consisting of the master, chief engineer, first mate and some members of the deck crew. At 02:47, 16 crew members had been evacuated, while 7 remained on board. The final seven crew members were evacuated the same morning (31 July).

In the course of the day (31 July), the NCA organised the deployment of booms. The shipping company contracted Smit Salvage from the Netherlands, and the salvage firm arrived at the grounded vessel late at night on 31 July.

1.4 Extent of damage

1.4.1 The vessel

The grounding resulted in extensive damage to the hull of *MV Full City*. This caused water ingress to a large part of the engine room. The AIBN observed that there had been water up to the top of the cylinders, approximately 6 metres above the keel. There was also extensive damage to four of the five cargo holds; see Figure 7, Figure 8 and Figure 9.

Figure 7: The keel at the stern. (Photo: AIBN).

Figure 8: Damage forward of midship on the starboard side of Full City; here seen in the dry dock near Gothenburg. (Photo: AIBN).

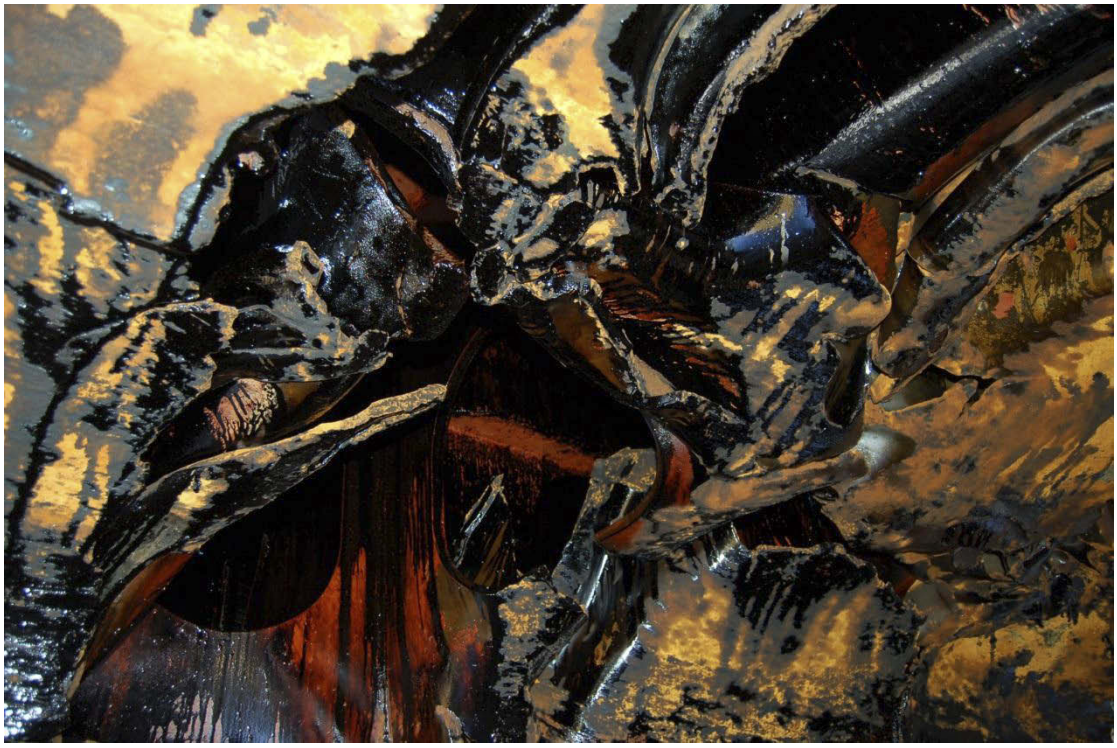


Figure 9: Hole in the bottom of Full City, with opening to the frame and tank top. (Photo: AIBN).

1.4.2 Oil spill

After the grounding, the NCA, together with local authorities and volunteers, carried out an extensive clean-up along the affected coastal area.

The NCA has conducted an analysis of the oil in the sea that shows how much oil can be linked to the remaining oil on board the vessel. Approximately 293 m^3 of oil leaked out from the vessel. This caused pollution along the coast from Larvik in the north-east to Grimstad in the south-west.

Calculations by the NCA show the following:

Table 1: Calculated amount of bunker fuel in the vessel and the environment

Total on board	1 154 m^3
Collected from the sea	28 m^3
Collected from rocks and beaches	74 m^3
Pumped from the vessel at Såstein	740 m^3
Pumped from the vessel while in dry dock in Gothenburg	120 m^3
Uncollected oil (remaining in the environment)	191 m^3

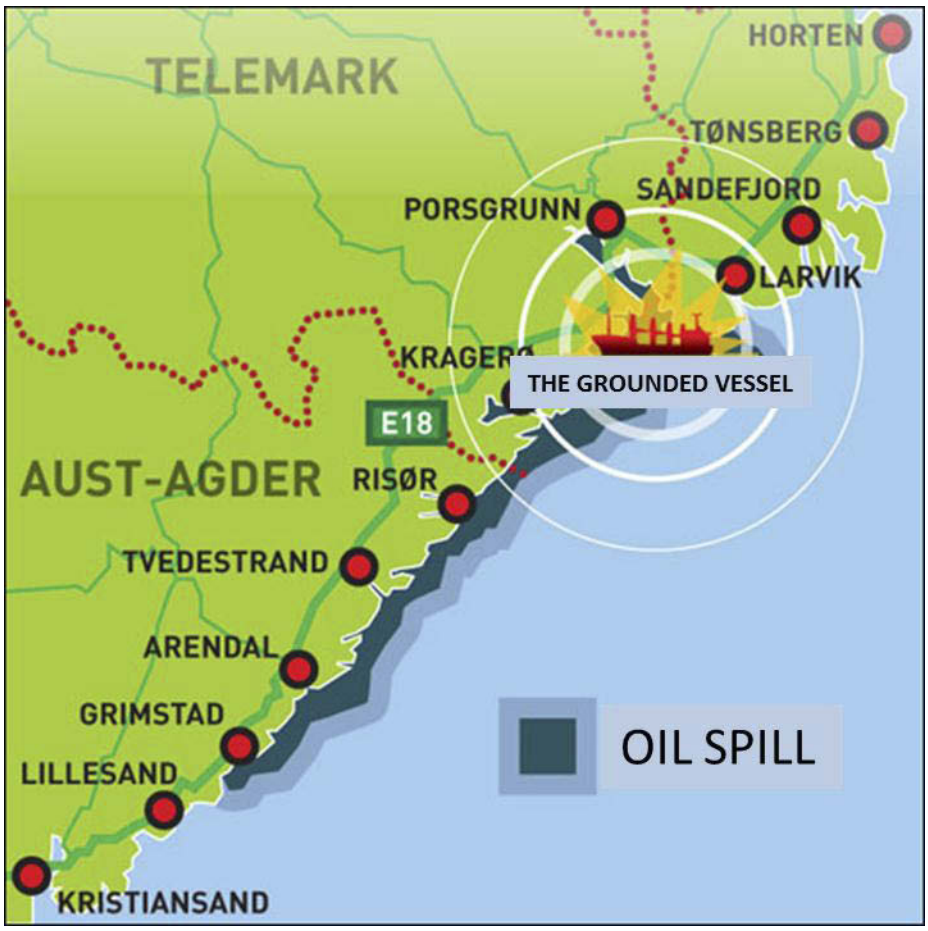


Figure 10: Illustration of the spread of the oil spill from Full City. (Source: NCA).

1.5 Weather and sea conditions

1.5.1 Weather forecasts

1.5.1.1 *Forecast at midnight on 29 July*

A printout from Navtex on board the vessel shows the confirmed receipt of a weather forecast that was broadcast late at night on 29 July or in the early hours of 30 July. The introduction was worded as follows:

> 'GALE OR STORM IS EXPECTED IN THE AREAS: SKAGERRAK, GERMAN BIGHT, DOGGER, FISHER, SOUTH UTSIRE, FORTIES, VIKING'

The forecast for the following 24 hours was as follows for Skagerrak:

> 'SE FORCE 4-5. SCATTERED SHOWERS. THURSDAY SE FORCE 6, FROM LATE IN THE MORNING OCCASIONALLY NEAR GALE FORCE 7. IN THE AFTERNOON SOUTHWEST GALE FORCE 8, POSSIBLY BRIEFLY STORM FORCE 10. RAIN SHOWERS, RISK OF THUNDER. MODERATE IN PRECIPITATION.'

The vessel was close to Skagen at the time.

Navtex is a system for radio and short-wave transmission of transcripts of maritime safety information, including weather forecasts. Skagerrak was covered by the Navtex system. Skagerrak was also a clearly visible place name on the vessel's chart.

1.5.1.2 *Gale Warning No 434*

The Norwegian Meteorological Institute issued a separate maritime gale warning to the coastal radio stations for broadcasting on area-specific VHF channels. Rogaland radio's coastal radio station broadcast Gale Warning No 434 by VHF radio at 05:20, 08:33 and 12:33 on 30 July. The same warning was also sent via Navtex at 05:28, 05:37, 07:50 and 08:08. The vessel was close to Skagen at the time.

The warning was worded as follows:

> *'GALE WARNING, CLASS 1. 'GALE WARNING NO. 434 ISSUED BY NORWEGIAN METEOROLOGICAL INSTITUTE 30.07.2009 AT 03:08 UTC*[8]
>
> *SVENSKEGRENSA*[9] *– ÅNA SIRA:*
>
> *TODAY THURSDAY LATE MORNING INCREASING TO SOUTHEAST NEAR GALE FORCE 7, IN THE EVENING SOUTHWEST GALE FORCE 8, PERHAPS STRONG GALE FORCE 9 OF SHORT DURATION.*
>
> *ÅNA SIRA – SLÅTTERØY:*
>
> *TODAY THURSDAY SOUTHEAST NEAR GALE FORCE 7, FORM THIS EVENING WEST GALE FORCE 8, AT TIMES STRONG GALE FORCE 9.*
>
> *SKAGERRAK*
>
> *TODAY THURSDAY LATE MORNING INCREASING TO SOUTHEAST NEAR GALE FORCE 7, IN THE EVENING SOUTHWEST GALE FORCE 8, PERHAPS STRONG GALE FORCE 9 OF SHORT DURATION.'*

The warnings were announced in English on channel 16, referring listeners to channel 01 for more comprehensive information.

1.5.1.3 *Gale Warning No 436*

A gale warning (No 436) from Rogaland radio was transmitted via VHF radio at 21:00 on 30 July 2009. The same warning was also sent via Navtex at 21:06, 21:08 and 23:50. The vessel was anchored at Såstein at the time. This was when the change in the weather occurred.

The forecast was worded as follows:

> *'GALE WARNING, CLASS: 1; Gale warning no. 436 - ISSUED BY NORWEGIAN METEOROLOGICAL INSTITUTE 30.07.2009 AT 18:49 UTC*[10]
>
> *Svenskegrensa*[9] *– Jomfruland*
>
> *LATE THURSDAY EVENING INCREASING SOUTHWEST GALE FORCE 8, BRIEFLY STRONG GALE FORCE 9 IN OUTER OSLOFJORD. LATE FRIDAY MORNING SOUTHWEST NEAR GALE FORCE 7, IN THE EVENING DECREASING.*
>
> *JOMFRULAND - ÅNA SIRA*
>
> *THURSDAY EVENING INCREASING SOUTHWEST GALE FORCE 8, POSSIBLY BRIEFLY STRONG GALE FORCE 9 BY LINDESNES. FRIDAY AFTERNOON WEST NEAR GALE FORCE 7, IN THE EVENING DECREASING.*

[8] At 05:08 local time.
[9] Translator's note: Svenskegrensa = the Swedish border
[10] At 20:49 local time

KARMØY - SLÅTTERØY

FRIDAY MORNING INCREASING TO WEST AT TIMES NEAR GALE FORCE 7, DECREASING FRIDAY AFTERNOON.

INNER SKAGERRAK

THURSDAY EVENING INCREASING SOUTHWEST STRONG GALE FORCE 9, POSSIBLY BRIEFLY STORM FORCE 10 IN SOUTH. FRIDAY AFTERNOON DECREASING TO NEAR GALE FORCE 7.

OUTER SKAGERRAK

THURSDAY EVENING INCREASING SOUTHWEST GALE FORCE 8, POSSIBLY BRIEFLY STRONG GALE FORCE 9. FRIDAY AFTERNOON DECREASING TO FORCE 6."

1.5.1.4 *Weather forecast via SafetyNet/Inmarsat C*

Sources of weather information on board the vessel included the global system Safetynet/Inmarsat C. Inmarsat C is divided into ocean regions (Metareas), and Metarea I covers the North Atlantic sea area. However, for the sea areas between England, Denmark and Norway, the *Admiralty list of radio signals vol. 5* (p. 225) refers to the Navtex service, as Inmarsat C does not include weather forecasts for Skagerrak.

At 11:26 local time, weather forecast arrived via the SafetyNet system on board the vessel, which at that time was en route across Skagerrak. The forecast included placenames as *Norwegian basin* and *Danmark Strait*. The message was signed and contained gale warnings for eight designated sea areas. The two above-mentioned areas were not among them. The AIBN has indications that the crew may have interpreted this to mean that their area was not under threat of strong winds. The Denmark Strait and the Norwegian basin are defined sea areas of no relevance to Skagerrak.

The weather forecast also includes a hydrographic chart showing areas of high and low pressure. The master and one of the mates noted that there were low pressures down to 1 005 mb on the chart and that this could generate strong local winds. The chart showed 1 005 mb approximately in the middle of the North Sea. Hydrographic chart dated 30.7.2013 at 11:00 (local time) is shown in appendix C.

1.5.1.5 *Concerning receipt of weather forecasts on board the vessel*

Two of the officers have explained that both the Inmarsat C and the Navtex receivers were working as normal, but that they had not recognised local place names in the area they were in. The receivers provided a lot of information about the weather, but neither the deck officers nor the master read the messages carefully. Several of them explained that they had expected 'Herøya' to be specified as the local weather area. The master and all the deck officers have explained that at no time did they register any particularly poor weather forecasts for the area in which they lay at anchor.

1.5.2 Meteorological observations

1.5.2.1 *Wind*

The Norwegian Meteorological Institute was assigned by the AIBN to produce a weather report relating to the accident. The following is a summary of the institute's analysis.

On 28 July, a low pressure system was building in the North Atlantic. The low pressure intensified and moved across the British Isles, reaching the North Sea on 30 July. The

low-pressure centre continued to move in the direction of the Hardangerfjord. The area of low pressure produced increasing wind in Skagerrak and along the Skagerrak coast on 30 July.

During the night leading up to 30 July, southerly light winds and a gentle breeze (force 2–3) were recorded at the metering stations closest to Langesund (Jomfruland and Svenner). During the course of the day on 30 July, the wind increased from the south-east and reached moderate gale force at Svenner in the early afternoon.

Observations from these two stations show that the wind increased to moderate to fresh breeze, changing direction from easterly to south-easterly and briefly reaching moderate gale force 6. During the same period, south-westerly fresh to strong gale (force 8–9) was developing in Skagerrak. As the night progressed on 30 July, the strong south-westerly wind gradually approached the coast. Between 21:00 and 22:00, the wind turned south-westerly along the coast of Telemark and Vestfold, increasing to fresh gale (force 8) at Svenner and moderate gale (force 7) at Jomfruland. The strong south-westerly wind continued through the night, varying in force and reaching its peak between 00:00 and 01:00 on 31 July. A strong gale (force 9 – 22.5 m/s) was measured at Svenner, and a fresh gale (force 8 – 19.3 m/s) was measured at Jomfruland. The strongest wind gusts were measured between 23 and midnight, reaching 27.0 m/s at Svenner and 24.3 m/s at Jomfruland.

NMI 2009	30 July 12:00-15:00	30 July 15:00-18:00	30 July 18:00-21:00	30 July 21:00-24:00	31 July 00:00-03:00	31 July 03:00-06:00	Maximum wind speed 23:00-24:00
Jomfruland	12	8	9	19	20	19	24 m/s
Svenner	13	12	16	23	22	22	27 m/s

Figure 11: Meteorological observations at the closest weather stations around the time of the accident. The figures and wind arrows show ten-minute maximum mean wind speeds (in m/s) and wind directions for three-hour periods (Source: NMI/AIBN).

The AIBN has also received more detailed hour-by-hour wind data from the Norwegian Meteorological Institute. The figure below shows how the wind developed around the time of the accident.

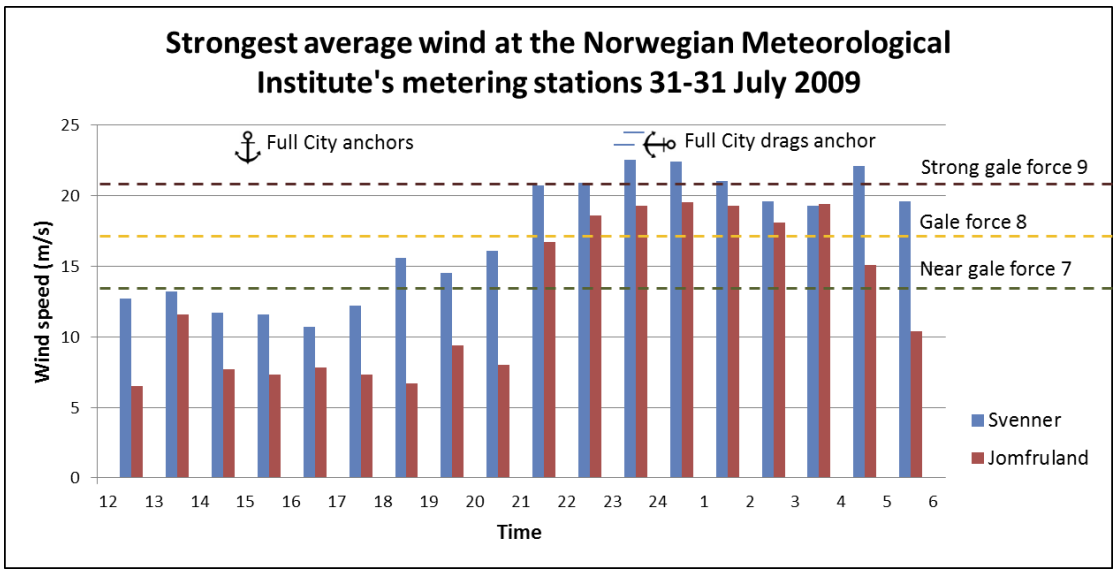


Figure 12: Observations of ten-minute maximum mean wind speeds at hourly intervals (Source: NMI/AIBN).

1.5.2.2 *Waves*

No wave height measurements are available, but model calculations by the Norwegian Meteorological Institute of significant wave heights (average of the highest third of the waves) in open waters result in the following figures:

On 30 July at 22:00, the waves were south-easterly with a significant wave height of 2.5–3 m

On 30 July at 23:00, the waves were southerly with a significant wave height of 2.5–3 m

On 30 July at 00:00, the waves were south-westerly with significant wave height 4.5 m

On 31 July at 01:00, the waves were south-westerly with significant wave height 4.5 m

The estimated maximum wave height was between 6 and 9 metres in open waters.[11]

[11] The relationship between maximum wave height and significant wave height varies according to the number of wave passages and the form of the wave aspect. In extreme cases, individual waves can be double the significant wave height, but the relationship is usually between 1.6 and 1.8.

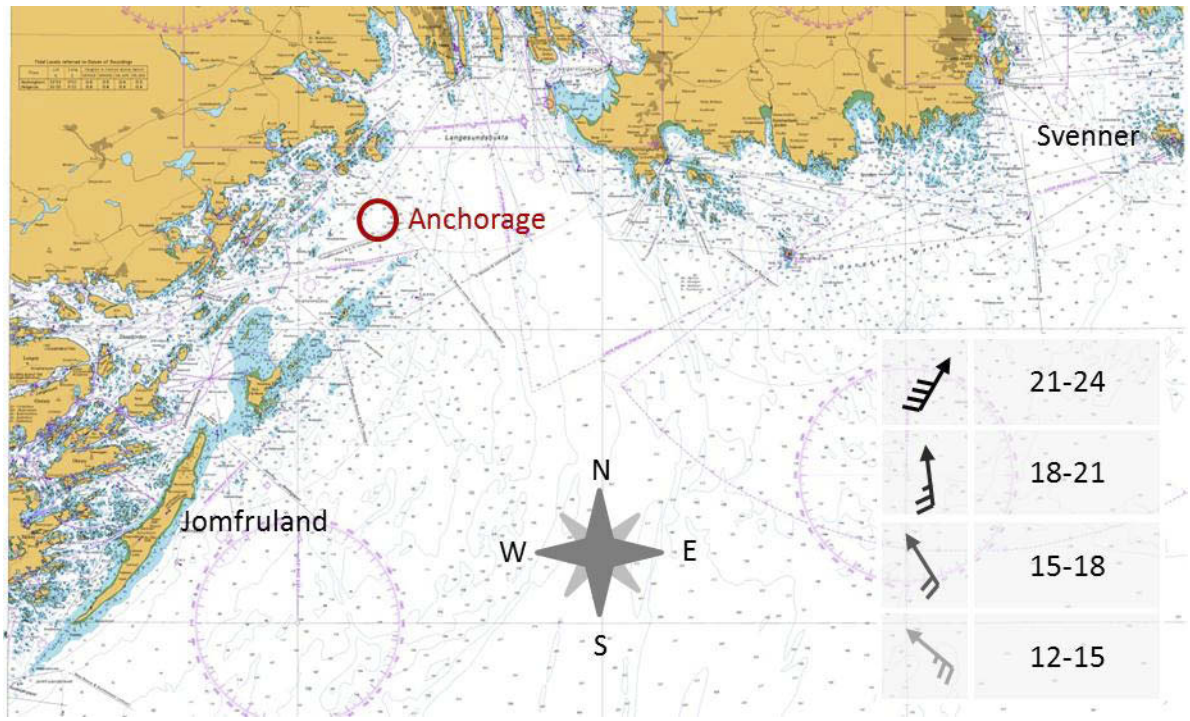


Figure 13: The anchorage's protection from the sea. The wind arrows are based on measurements at the Jomfruland and Svenner weather stations on 30 July 2009. (Source: the Norwegian Mapping Authority/AIBN).

1.5.2.3 *Visibility*

According to Norwegian Metorological Institute weather prediction for Thursday 30. July, it would be rain with moderate to poor visibility. The weather stations reported visibility of 4–9 km during periods of precipitation, and otherwise 10 km.

1.6 The shipping agent

The shipping agent, Høyergruppen AS, has its registered address in Porsgrunn and offers practical services to vessels with assignments for ports and terminals in the Grenland region. Local knowledge and broad experience are emphasised as advantages on the agent's own website. In the present case, the agent's role was to act as a link between Oldendorff as charterer and Yara as cargo owner. The agent also handled requests for pilotage and other formalities prior to berthing of the vessel.

1.7 The Norwegian Coastal Administration (NCA) and the VTS centres

The NCA is a public agency that reports to the Ministry of Fisheries and Coastal Affairs. Its main objective is to ensure safe and efficient navigation in the fairways along the Norwegian coast and to/from Norwegian ports. The NCA exercises authority pursuant to several acts of law, including the Harbour and Fairway Act. The following are stated to be among its most important tasks: development and maintenance of fairways, aids to navigation services, vessel traffic services, pilot services, reporting services and navigational warnings.

The NCA operates five VTS centres that regulate and monitor vessel traffic in defined geographical areas along the Norwegian coast. In addition to Brevik VTS, there are VTS centres covering local areas in Hordaland (Fedje VTS), Rogaland (Kvitsøy VTS) and the

Oslofjord (Horten VTS/Oslo Port VTS). Vardø VTS centre monitors traffic in the northern areas and is responsible for monitoring all tankers and other hazardous traffic along the entire coast with the exception of the areas covered by the other four local VTS centres.

The VTS centres offer three types of services based on national regulations and international recommendations: information services (INS), navigation assistance services (NAS) and traffic organisation (TOS). The NCA has defined the service types as follows:

Information services
This service shall provide important information at the right time to support nautical decision-making processes on board. A vessel may request information, and the traffic control service may provide unsolicited information and request clarification from the vessel as required. The information that the NCA offers to provide, notably includes meteorological and hydrographic information.

Navigation assistance
Navigation assistance is established either on the request of the vessel or when the traffic controller observes irregular navigation and deems it necessary to intervene. This service entails close assistance to the vessel in question. It mentions situations like difficult meteorological conditions and the risk of grounding or collision.

Traffic organisation
This service seeks to prevent hazardous situations from developing and to ensure safe and efficient navigation through the VTS area. The traffic control centre provides information, advice and instructions to vessels. Vessels report before sailing into the VTS area and when leaving an anchorage site or quay, among other things to avoid critical situations as a result of traffic density.

1.7.1 Brevik VTS

1.7.1.1 *General*

Brevik VTS centre is located at Brevikstrømmen in Porsgrunn municipality and covers the approaches to the major industrial area in Grenland. This is the NCA's oldest VTS centre, established in 1978 in the wake of the petrochemical industry development at Rafnes. According to the NCA, gas tankers and other vessels carrying dangerous cargo represent a major part of the vessel traffic in the area. At the time *Full City* ran aground, Brevik VTS's area of operation was limited to: *'the waters limited by straight lines drawn from the northernmost point on Mølen via the northernmost point on Såstein to the easternmost point on Halvorodden'*. This means that Såstein anchorage was outside Brevik VTS's area of responsibility; see Figure 22.

World VTS guide is a coordinated web-based service based on input from several international organisations. The website specifies what services are offered by the local VTS centres. According to World VTS guide, Brevik VTS provides the following services[12]: Information services with 24-hour service availability, including traffic image generation based on closed circuit television (CCTV), radar, VHF radio position

[12] http:www.worldvtsguide.org/Norway/Brevik

reporting and visual observations. According to World VTS guide, Brevik VTS does not provide navigation assistance (NAS) or traffic organisation (TOS).

1.7.1.2 *Relevant factors*

Brevik VTS had set up an anemometer on Fugløya island, but it was not working when the *Full City* accident occurred. Hence, the VTS centre did not have any real-time information about relevant winds and wind directions in the sea area during the night and early morning in question. According to Brevik VTS, the anemometer equipment was sometimes out of order.

Brevik VTS lacked procedures for conveying weather information to vessels, regardless of whether they were outside or inside the VTS area. Nor had the VTS centre defined any criteria for the use of anchorage areas within its area of operation. Such assessments were left to the vessels' masters.

The AIBN has been told that, as the anchorage was outside Brevik VTS's area of operation, the VTS centre did not have any authority in the area, and could not order vessels to put to sea or stop them from anchoring at Såstein. However, it was established practice at Brevik VTS to demand precision anchoring on anchoring at Såstein, as there had been several previous incidents of anchor dragging (see section 1.10).

Furthermore, Brevik VTS believed that the vessel had many opportunities to obtain updated weather forecasts, and assumed that the crew on *Full City* would listen to the forecasts, assess the conditions and take action on their own initiative without being issued with information, advice and orders from the VTS centre.

1.8 Examination of the anchor arrangement

1.8.1 Material examination

Both flukes were missing from the starboard anchor on board *Full City* after the vessel had run aground at Såstein. One of the flukes was found on the seabed near the vessel's line of drift. The fracture surfaces of both the anchor and fluke were cut out for mechanical examination at the Norwegian Defence Research Establishment (FFI) at Kjeller, and isotope photography (radiographic examination) at Nammo in Raufoss. None of the examinations carried out at FFI and Nammo detected any anomalies in the strength or quality of the damaged anchor.

1.8.2 Function tests

The anchor winch and chain were examined by Det Norske Veritas (DNV) following the accident and the tests were summarised as follows:

> *'The starboard anchor winch and brakes were functional during the test. The starboard anchor chain has withstood the loads to which it was exposed and did not break. The starboard anchor dragged and both anchor flukes broke off.'*

Even though only the starboard anchor was deployed when the vessel lay at anchor, DNV also tested the port anchor system. The test demonstrated that the port anchor system worked as intended.

Figure 14: Starboard anchor without flukes. (Photo: AIBN).

Figure 15: Intact port anchor. (Photo: AIBN).

1.9 Regulations and guidelines

1.9.1 Introduction

Shipping is regulated by international conventions, codes and classifications. The International Maritime Organization (IMO) is the United Nation's specialised agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. IMO has a number of specialised committees charged with developing international laws and regulations. Norway, Panama and China are among the 170 member states that, through ratification of the IMO Convention, are committed to following the rules.

1.9.2 Design of anchor arrangement

The International Association of Classification Societies Ltd. (IACS) is an umbrella organisation for classification societies, of which Class NK is also a member. The IACS issues specific requirements and limitations relating to the design and construction of anchor arrangements.

The following is cited from *IACS Req. 2007: Requirements concerning mooring, anchoring and towing*:

> *'A1.1.1 The anchoring equipment required herewith is intended for temporary mooring of a vessel within a harbour or sheltered area when the vessel is awaiting berth, tide etc.*
>
> *A1.1.2 The equipment is therefore not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship which is moving or drifting. In this condition the loads on the anchoring equipment increase to such a degree that its*

components may be damaged or lost owing to the high energy forces generated, particularly in large ships.'

The regulations are based on the assumption that the seabed provides a good holding ground for the anchor (A1.1.3), and that, under normal circumstances, a vessel will use only one bow anchor and chain (A1.1.5). The design criteria are based on an assumed current speed of 2.5 m/sec, wind speed of 25 m/sec and that the payed out length of anchor chain is between 6 and 10 times the water depth (A1.1.4). A table of parameters is set out below:

Table 2: Prevailing conditions when Full City started dragging

Wind speed	19-23 m/sec
Peak gusts	24–27 m/s
Wave height	4–5* m
Current	unknown
Sea depth	20–22 m
Length of anchor cable	137 m
Cable/depth ratio	6.5

*Calculated by the Norwegian Meteorological Institute for open waters in Langesundsbukta

1.9.3 Territorial waters

The Act of 27 June 2003 No 57 relating to Norway's territorial waters and contiguous zone (Ministry of Foreign Affairs), defines Norwegian territorial waters, consisting of the territorial sea and internal waters. The baseline forms the outer limit of the internal waters and is defined in the Regulations of 14 June 2002 No 625 relating to the baselines for the territorial sea around mainland Norway. The outer limit of the territorial sea is a line that runs 12 nm from the baseline.

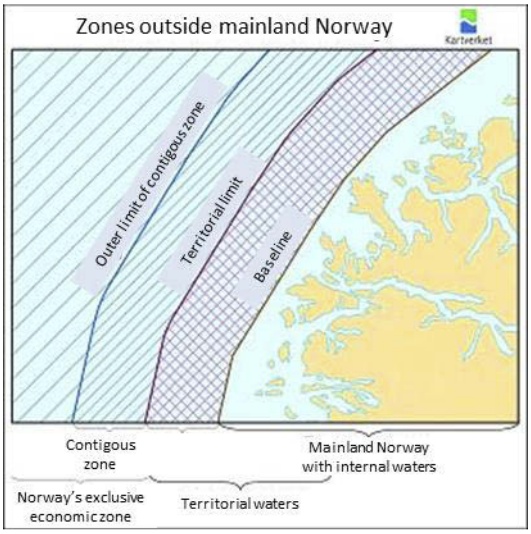


Figure 16: Maritime zones outside mainland Norway. (Source: the Norwegian Mapping Authority)

The Regulations of 23 December 1994 No 1130 relating to entry into and passage through Norwegian territorial waters in peacetime of foreign, non-military vessels (the 'Non-Military Vessels Regulations' – Ministry of Defence), describe rules for calling at ports and passing through Norwegian internal waters, and the obligation to notify prior to entry. Large vessels are obliged to notify Norwegian authorities at least 24 hours in advance of entry into internal waters, see Section 17. Section 16 of the Regulations state that anchorage in internal waters is only permitted when it is incidental to normal navigation.

1.9.4 Use of fairways

The Ministry of Fisheries and Coastal Affairs administers the Act of 17 April 2009 No 19 relating to ports and fairways (the 'Ports and Fairways Act'). The purpose of the Act is to facilitate good navigability, the safety of maritime traffic and acceptable use and management of Norwegian territorial waters and internal waters, see Sections 1 and 2. The Act entitles the ministries to issue regulations relating to navigation rules and the use of specific fairways or waters, see Section 13. This includes making decisions to prevent entry to specific parts of the fairway when this is necessary for safety reasons, see Section 15. The Ministry can also order the implementation of measures to prevent situations of distress should a vessel threaten the safety of navigation in a fairway, see Section 38.

1.9.5 Traffic organisation

Section 17 of the Ports and Fairways Act states the following about vessel traffic services:

> *'The ministry can establish traffic service centres for monitoring and control of vessel traffic and other traffic, including for enforcement of the Rules of the Sea, other traffic organisation and safety and emergency response actions. The traffic service centres shall also provide mariners with navigation assistance and other nautical information as required.*
>
> *The ministry can issue regulations relating to the tasks, activities and authority of the traffic service centres.'*

On behalf of the Ministry, the NCA has supervisory authority and administrative responsibility for facilities and installations designed to aid navigation or regulate traffic, see Section 19 of the Ports and Fairways Act and delegation of authority to the Coastal Administration pursuant to the same act. Among other things, this also involves issuing provisions on technical requirements for the equipment used, see Section 20.

The Regulations of 15 December 2009 No 1684 relating to maritime traffic in certain waters (the Maritime Traffic Regulations) are intended to reduce the risk of marine accidents in Norwegian waters. The Regulations are designed to keep maritime traffic moving in an efficient manner within the VTS centres' areas of operation, see Section 1.

Specific rules concerning use of the fairways in the Grenland area in Telemark county, which is part of Brevik VTS's area of operation, are described in Chapter 4 of the regulations. The delimitation of the area of operation was changed by the Regulations of 21 December 2011 No 1464, which entered into force on 1 January 2012. As a result of that change, Såstein anchorage became part of Brevik VTS's area of operation (see section 1.11.1).

Within a VTS centre's area of operation, all communication shall be by VHF radiophone, and vessels are obliged to listen to the VTS centre's working channel. It is a requirement that those in charge on the bridge are able to communicate in a Scandinavian language or in English, see Section 14.

Pursuant to Sections 2 and 15, *Full City* belonged to a category of vessels that is required to request permission from the VTS centre when:

1) the vessel enters the VTS centre's area of operation;

2) the vessel initiates a move within the VTS centre's area of operation;

3) the vessel intends to deviate from the voyage plan decided by or agreed with the VTS centre. This also applies to any stops en route; and

4) the vessel drops anchor.

Applications for permission as mentioned in (1) and (2) above must be received by the NCA no later than one hour prior to the vessel entering the VTS centre's area of operation, or departing from a quay or anchorage in the same fairway.

If it becomes necessary to interrupt the voyage or change the voyage plan for safety reasons, permission is not required for the actions mentioned in (3) and (4) above. In such case, the VTS centre must be notified.

Neither the Maritime Traffic Regulations nor the Non-military Vessels Regulations require that vessels seek permission to anchor in areas outside the VTS centre's area of operation.

1.9.6 Vessel Traffic Services

A vessel traffic service (VTS) is a service implemented by a Competent Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area. Resolution A.857(20) of 27 November 1997; *Guidelines for vessel traffic services (VTS)* sets out international guidelines for the organisation of vessel traffic services.

Paragraph 1.1.9 in Res. A.857(20) states that a VTS should comprise at least an information service providing a navigation assistance service or a traffic organization service, defined as follows:

- An information service is a service to ensure that essential information becomes available in time for on-board navigational decision-making (1.1.9.1).

- A navigational assistance service is a service to assist on-board navigational decision-making and to monitor its effects (1.1.9.2).

- A traffic organization service is a service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessel traffic within the VTS area (1.1.9.3).

Res. A.857(20) also states that an information service should include the following (2.3.1):

> *'The information service is provided by broadcasting information at fixed times and intervals or when deemed necessary by the VTS or at the request of a vessel, and may include for example reports on the position, identity and intentions of other traffic; waterway conditions; weather; hazards; or any other factors that may influence the vessel's transit.'*

1.9.6.1 *VTS areas and equipment*

According to Res. A.857(20), a clear distinction has to be made between a port or harbour VTS and a coastal VTS. A port VTS is mainly concerned with the above-mentioned functions, while a coastal VTS usually only provides an information service. Both services can be offered by one and the same VTS centre (2.1.2). In formal terms, the coastal VTS in Vardø was the overriding supervisory authority for maritime traffic outside Brevik VTS's area of operation.

Concerning the establishment and delineation of VTS areas, the Resolution states that a VTS area may be divided into sectors, but these should be kept to a minimum number. Furthermore (2.3.5):

> *'Area and sector boundaries should not be located where vessels alter course or manoeuvre or where they are approaching areas of convergence, route junctions or where there is crossing traffic'.*

When planning and establishing a VTS centre, the competent authority must ensure that the VTS area is provided with the equipment and facilities necessary to accomplish its tasks (2.1.7). Paragraph 2.5.1 states that consideration should also be given to the need to establish any back-up facilities to sustain and maintain the desired level of reliability and availability.

1.9.6.2 *Communication between the VTS centre and vessels*

Resolution A.857(20) refers to Resolution A.918(22) *'IMO standard marine communication phrases'*, and states that the phraseology used in the communication between the VTS centre and the vessel should clarify the message content and prevent misunderstandings. In any VTS message directed to a vessel, it should be made clear whether the message contains (1) *Information*, (2) *Advice*, (3) *Warning* or 4) *Instruction* (2.4.2).

1.9.7 Sources of information for port calls

The publication *Admiralty List of Radio Signals vol. 6 (2)* is published by the United Kingdom Hydrographic Office (UKHO). In addition to information about port authorities and the pilotage service, it contains information about VTS centres. Brevik VTS area is listed, with information about when to report, what to report, and what VHF channel vessels are obliged to keep a listening watch on when inside the area covered by the VTS centre.

According to the procedure for clearance on approaching the Grenland area, vessels shall be cleared at least one hour before entering the area or departing from a quay or anchorage. Chapter 5 in the procedure states the following concerning anchorage:

'Vessels should also obtain permission from Brevik VTS before anchoring, and may be directed by the centre to a suitable anchorage.'

1.9.8 National VTS procedures

At the time of the accident, the NCA had established 17 national VTS procedures. Three are cited below.

- Procedure for vessels dragging anchor (P-VTS-08/00556-2). This procedure is intended to '*ensure that vessels anchored in compulsory pilotage waters in the VTS centre's area of operation are prioritised as regards pilotage and other necessary assistance in connection with anchor drag.'* This is to be accomplished in that: '*The traffic controller shall inform the pilot service of prioritised pilotage assignments as soon as possible when anchored vessels subject to compulsory pilotage report anchor drag or dragging is detected by the traffic controller.'* Furthermore: *'The traffic controller shall also notify and initiate mobilisation of other resources, if necessary, in accordance with the NCA's emergency response plan.'*

  In formal terms, this procedure did not apply in the present case, as *Full City* lay at anchor outside Brevik VTS's area of operation.

- Procedure for communication (P-VTS-08/01304). This procedure is intended to: *'Ensure that the VTS centre uses correct terminology for communication in order to avoid misunderstandings .'* The following is stated in section 3.1: '*As a rule, the VTS centre shall ensure that the terminology described in "IMO Standard Marine Communication Phrases" is used for communication on maritime VHF channels.'*

- Procedure for vessels seeking pilotage services (P-VTS-08/01302). This procedure is intended to: *'Ensure that vessels seeking pilotage are not placed in near-shore situations that constitute a hazard to navigation or obstruct other traffic.'* Furthermore: *'Ensure good communication and a safe approach for vessels within the VTS centre's area of operation until the pilot has boarded.'* This is to be accomplished, *inter alia*, in that: *'The traffic controller shall ensure that vessels awaiting pilotage do so outside the baseline and, insofar as it is possible, outside the VTS area.'*

1.9.9 Transport of dangerous or polluting cargo

Pursuant to the Regulations of 17 December 2009 No 1633 relating to the duty to report for vessels of more than 300 gross tonnage and vessels carrying dangerous or polluting cargo, such vessels are obliged to report to the Norwegian authorities on approaching and departing from Norwegian ports. The Regulations replace the Regulations of 16 June 1999 No 727 on requirements for notification and completion of checklists for vessels carrying dangerous or polluting cargo. It sets out provisions corresponding to those that are cited here. Reporting is to take place via the web portal SafeSeaNet Norway, established by the NCA in 2005.

The Regulations apply to vessels with a gross tonnage of 300 tonnes or more transporting dangerous or polluting cargo in bulk or packaged goods. Pursuant to these regulations, vessels with a gross tonnage of 1 000 or more, carrying bunker fuel or lube oil for their

own use are deemed to be vessels carrying dangerous or polluting cargo. There are certain exceptions, but under the Regulations, *Full City* of 15 000 gross tonnage is deemed to be a vessel carrying dangerous or polluting cargo.

The Regulations are, *inter alia*, intended to meet the requirements of IMO MARPOL,[13] which are intended to prevent operational pollution of the marine environment by oil and other harmful substances and to minimise accidental discharges of such substances.

1.9.10 Responsibility for and authority of the vessel

In accordance with the ISM Code chapters 3 and 5, the shipping company is obliged to have a safety management system in place. The system is intended to ensure safe practice in the operation of vessels, a safe working environment, protection against identified risks and continual improvement of the skills of the shipping company's personnel.

In the safety management system, the shipping company shall specify that the master has the overriding authority and responsibility for making decisions related to safety and pollution prevention and for requesting assistance from the company as necessary.

1.10 Previous incidents

1.10.1 *Dulcinea*, Såstein anchorage 2007

Figure 17: Dulcinea (Source: SeaWeb)

In the morning of 20 January 2007, the cargo vessel *Dulcinea* lay at anchor at Såstein anchorage. Brevik VTS has described that, according to the anemometer on Fugløya island, there was a strong south-easterly wind of between 20 and 30 m/s, and the sea was rough when *Dulcinea* was found to be dragging anchor at 11:30. The master confirmed that the vessel was in difficulty, and the tugboat *Bruse* was sent to assist the vessel at 11:45. *Bruse* arrived at *Dulcinea* at 12:30.

The tugboat *Bukken* was sent out to assist *Bruse*. It departed at 12:25 and was in position at 13:00. At 12:55, *Dulcinea* was connected to *Bruse* by a short towline, but the line broke as soon as it came under strain. At 13:30, *Dulcinea* was fastened to *Bruse* by a longer tow line, and the situation was brought under control. *Dulcinea* began to heave

[13] MARPOL = the International Convention for the Prevention of Pollution from Ships (1973) and the 1978 Protocol.

anchor at 13:40, and at 14:21, the anchor was aboard. The vessel received clearance to be brought to Helgerobukta bay under tow by *Bruse*, with *Bukken* on standby astern. *Dulcinea* with escorts were cleared to pass through Kalven and anchored again at Frier at 16:31.

The above description shows that *Dulcinea* was not sheltered from the south-easterly wind when it dragged anchor. Persisting wind speeds in the stated range correspond to a fresh to strong gale. The tugboats took 35–45 minutes to reach *Dulcinea* and only gained control of the situation two hours after the dragging was discovered. Had the towline not broken, the situation could have been under control after approximately 1.5 hours. The vessel had not run aground. It was towed to safety and was able to anchor again in the Frierfjord without assistance.

Brevik VTS prepared a nonconformity report following the incident. The report concluded that alertness, rapid response time and the presence of tugboat resources in the vicinity prevented the incident from developing into a serious accident. The reason for the dragging was deemed to be a poor choice of anchoring position, given the prevailing weather conditions, and that the chosen anchoring position was outside the recommended anchorage area as the seabed provided a poor holding ground for the anchor and there had been several cases of dragging in the past.

To avoid similar incidents in the future, the nonconformity report proposed the following corrective measures:

- On a vessel's request for anchoring, the anchoring position shall be designated by the traffic controller at Brevik VTS. This also applies to vessels with a pilot on board.

- The anchoring position shall be specified with a high degree of accuracy, stating degrees and arc minutes to one decimal point, so that the vessels understand that precision anchoring rather than random anchoring is required.

- Locally designated, recognised anchorage areas should be incorporated into the Norwegian Hydrographic Service's maps.

The points mentioned in the nonconformity report had not been incorporated into the written procedure for Brevik VTS at the time *Full City* ran aground.

1.10.2 *Yamaska*, Nesnaflaket 2009

Figure 18: Yamaska being pointed into the wind and pushed seawards by the tugboat Boa Hårek off Nesna in 2009. (Photo: NRK/Lena Kristin Vollen).

On 9 September 2009, *MV Yamaska* (BT 16 623) lay at anchor at Nesnaflaket in Nordland county together with two other ships. The vessel was in ballast condition and had approximately 220 m^3 of bunker fuel on board. According to the NCA, there was a south-westerly gale at 07:45 when the tugboat *Boa Hårek* overheard one of the other two vessels at anchor calling *Yamaska* on the VHF channel, notifying it of a danger of collision. *Boa Hårek* notified Vardø VTS of the situation at 07:50, and Vardø VTS gave *Boa Hårek* orders to proceed to the position in question and remain on standby, as the risk of the vessel drifting ashore was considered to be high.

The master of Yamaska notified the VTS centre via Bodø radio at 08:09 that it was dragging anchor and needed assistance. When *Boa Hårek* reached *Yamaska* at 08:20, the vessel was still adrift but had managed to heave anchor. From approximately 08:40 to 09:10, *Boa Hårek* managed to point *Yamaska* into the wind and push it seawards, allowing the master on Yamaska to establish enough speed to head out from the fjord. *Boa Hårek* reported a south-westerly fresh gale during this phase.

At 09:10, *Yamaska* was moving, and the situation was described as under control so far. The pilot boarded at 09:20. *Yamaska* turned out to have problems with its main engine, so an additional tugboat was used to assist in towing the vessel to quay in Mo i Rana. The Norwegian Maritime Directorate followed up the incident with a Port State Control.

The navigation officer in charge on *Boa Hårek* has estimated that, at the closest point, *Yamaska* was approximately 280 metres from the nearest shore and approximately 90 metres from the 5-metre contour.

1.10.3 *Pasha Bulker*, Australia 2007

Figure 19: Pasha Bulker grounded near Nobbys Beach in Australia. (Source: masterok.livejournal.com).

On 23 May 2007, the Panama-registered bulk carrier *Pasha Bulker* (LOA 225 m, 76 741 dwt) dropped anchor off Newcastle on the east coast of Australia, 2.4 nm from the shore and in good weather ballast condition. It was expected to berth and start loading coal three weeks later.

At midday on 7 July, the master payed out more anchor chain as a consequence of a gale warning. The local VTS centre provided navigational assistance for anchoring in this area. In their guidelines for anchoring, the conditions were defined as 'difficult' if a gale warning had been issued and/or wave heights exceeded 4.5 m. Monitoring was to be increased in such situations. The VTS centre did not provide information about the

weather conditions, however, as it expected the ships to obtain such information from meteorological sources.

The wind was south-easterly and increased to fresh gale after midnight, and at 05:00, the wind increased to strong gale (force 9) with wave heights of 4–6 metres. At 06:25, the vessel started dragging. The master managed to heave the anchor when the vessel was 1.2 nm from shore, but the attempt to turn the vessel into the wind failed, and it grounded on the lee shore at 09:51 (see Figure 19). The hull was holed, but the grounding caused no pollution.

The Australian Transport Safety Bureau (ATSB) (Marine Occurrence Investigation Report No. 243), which investigated the incident, believed that several unfortunate decisions on board in the attempt to get out of the situation contributed to the vessel running aground. A survey that was conducted found that most masters, including the one on *Pasha Bulker*, expected clearer guidance from the VTS centre as to when it was no longer safe to remain at anchor.

1.10.4 *Young Lady*, England 2007

Figure 20: Young Lady. (Source: MAIB report No 3/2008).

On 24 June 2007, the Isle of Man-registered oil tanker *Young Lady* (LOA 239 m, 105 000 dwt) sailed towards Tees Bay off the north-east coast of England. The vessel was in ballast condition and was heading to shore to load crude oil. Delays at the quay meant that it had to wait for berthing. The VTS authority advised the master to find a safe anchorage, and in dialogue with VTS staff, he was advised to keep clear of a gas pipeline on the seabed. The designated VTS authority accepted the master's chosen anchoring position, and one anchor was dropped at 22:00 on 24 June, approximately 1.5 nm north of the pipeline.

A fresh breeze (force 5) was blowing the first night the vessel lay at anchor. Twelve hours before the vessel dropped anchor, a weather forecast was received that contained a warning of strong winds during the next 24 hours. Late at night, the weather forecast reported a north-easterly fresh gale (force 8) for a nearby area. The instructions for anchoring at Tees Bay (Admiralty sailing direction, NP 57) advised against anchoring in easterly or northerly winds of gale force 8 (fresh gale) or more.

On 25 June, the master was informed that berthing would be further delayed and prepared to stay another night. The vessel kept anchor watches, with instructions to keep the engine ready and pay extra attention if the wind increased to moderate gale (force 7) or more. When the wind increased to moderate gale (force 7) at midday on 25 June, the master decided to pay out one more shackle of the anchor chain.

After 20:00, the wind increased to fresh gale (force 8) from the north-northwest. The vessel was now rolling and pitching heavily and the wave height exceeded 5 metres. The weather forecast issued at 22:00 the same night contained a warning of strong gale from north-west. The officer on watch monitored the anchor position closely, and at 22:00, he received the first indication that the vessel was dragging anchor. The crew were mobilised, and when the engine was ready for use at 22:16, the vessel had dragged anchor 0.8 nm southwards at a speed of 3 knots. The wind had now reached strong gale (force 9). An attempt was made to heave the anchor, and the engine was set to slow ahead in order to reduce the load on the anchor arrangement.

Three shackles were still out at 22:40 when the anchor found a hold on the seabed. The vessel now lay still, at a distance of 0.2 nm from the gas pipeline. When the crew were about to switch the winch mechanism to neutral and apply the brakes to lock the anchor, the cast iron in the windlass ruptured, and all 12 shackles payed out. The vessel was now drifting rapidly towards the pipeline, and at 23:00, the anchor fluke snagged onto the gas pipeline, where it was stuck for a few minutes before coming loose. The pipeline was damaged, but no gas leakage occurred.

The Marine Accident Investigation Branch (MAIB report No 3/2008) stated that the master, who was familiar with the anchoring instructions and the forecast wind, should have left the anchorage and moved out to sea before the adverse weather began. The MAIB also pointed to the fact that the design limitations of the anchor arrangement should have been more easily accessible as decision-making support for the master. The investigation also pointed out that the incident had the potential to cause serious environmental impacts and could have put the country's energy supply at risk.

1.10.5 *Astral*, England 2008

Figure 21: *Astral.* (Source: commons.wikipedia.org).

On 7 March 2008, the Swedish-registered oil tanker *Astral* (LOA 130 m) dropped anchor at Nab anchorage 0.9 nm south of the nearest shore on the east side of the Isle of Wight in the south of England. The vessel carried 9 800 tonnes of diesel to be offloaded at a refinery in Southampton. A gale warning was issued on 9 March. The anchorage was not sheltered against winds from the south. The local VTS centre monitored the vessels on the radar and provided them with updated weather reports. Because of the forecast severe weather, the crews on board the vessels were advised to keep the engines ready so that they could leave the anchorage at short notice.

Early in the morning of 10 March, the wind increased to storm (force 10) from the south, and at 06:50, *Astral* started dragging anchor to the north. The VTS centre suspected this

and contacted the vessel at 07:05 to receive confirmation, but was unsuccessful. At 07:10, the officer on watch on board the vessel notified the master that the vessel was possibly dragging anchor and, at 07:21 – 31 minutes after the vessel started dragging – the propulsion system came into operation. The vessel came into contact with the seabed and suffered damage to the rudder arrangement at around 07:25–07:26, but no leakage or pollution occurred. The vessel was successfully towed to safety.

The joint investigation of the Swedish Accident Investigation Authority and the MAIB (Report No 4/2009, January 2009) addressed the fact that language problems in relation to crew from the Philippines meant that important time was lost before effective measures were introduced. The investigation also found that many foreign mariners expect clear, unambiguous wording in communications from the VTS centre, to ensure the desired response and shorter response times.

1.11 Implemented measures

1.11.1 Expansion of the VTS centre's area of operation

The NCA had plans to review Brevik VTS's area of operation. The review was brought forward as a result of the *Full City* incident. From 1 January 2010, Brevik VTS's area of operation was expanded to include Langesundsbukta bay (cf. the Maritime Traffic Regulations; see also Figure 22). In the NCA's grounds for the expansion were based on the following arguments:

- Unlike other VTS centres, Brevik VTS's area of operation did not previously cover the approaches to the narrow fairways: Brevik VTS did not therefore have the same ability to oversee and coordinate vessel traffic before it passed into narrow navigational waters.

- There is heavy traffic in the area, and much of it consists of gas and chemical tankers, which in total means that the general risk in the area is regarded as high. Crossing ships often meet in the pilot boarding field. Such situations entail a special risk.

- In several incidents involving incorrect navigation in Langesundsbukta in recent years, the VTS centre has had to notify vessels and request a change of course.

The NCA states that an expansion of Brevik VTS's area of operations means that vessels will be required to ask for permission pursuant to Section 15 of the Maritime Traffic Regulations before sailing into or anchoring in Langesundsbukta. The expansion also means that the VTS centre will have the authority to stipulate conditions for sailing in Langesundsbukta and for the use of, for example, the anchorage at Såstein. And finally, the expansion also means that the VTS centre will be able to establish information, traffic organisation and navigation assistance services in Langesundsbukta.

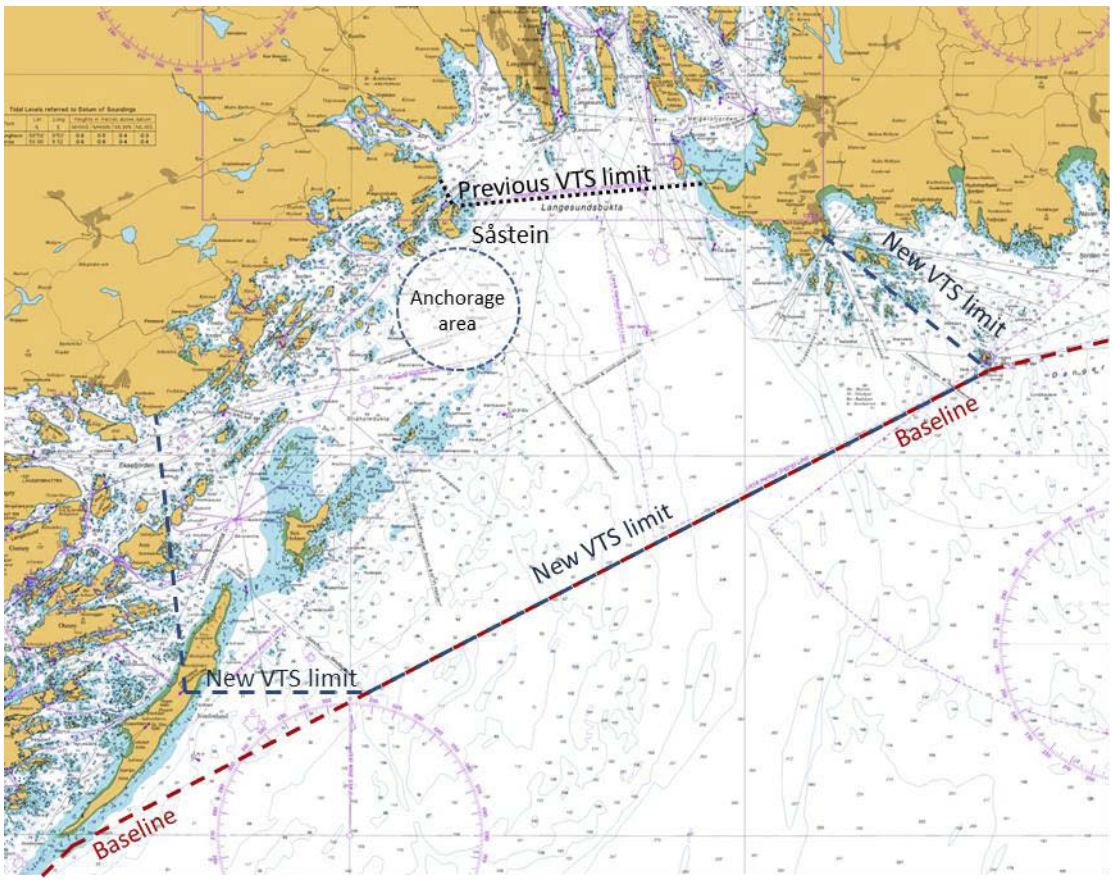


Figure 22: Expansion of Brevik VTS's area of operation, applicable from 1 January 2010. (Source: NMA/AIBN).

1.11.2 Anchoring project

According to information AIBN have received, the NCA has established a project for the purpose of drawing up procedures and criteria for the use of the anchorage areas along the coast. The NCA gave DNV the task of preparing a report, which states that sediment surveys must be carried out in the various anchorage areas before holding forces can be calculated and more detailed criteria set for use of anchorages in these areas. The status as of April 2012 was that work was under way on obtaining information about the sediment conditions, and that this was expected to be completed in 2013. In parallel with this work, and as the sediment information gradually becomes available, procedures will be prepared for anchoring in relevant anchoring positions, and for following up vessels at anchor.

The NCA has prepared instructions for traffic regulation of Brevik VTS's area of operation that are valid from 19 February 2013.

The instructions state the following about anchoring at Såstein:

'Såstein anchorage is limited by the following criteria:

- *Anchoring shall take place in pre-defined anchoring positions.*
- *The total number of vessels at anchor shall not exceed three.*
- *Anchoring shall not take place if the forecast wind for the expected anchoring period exceeds 12 m/s.*

Vessels at anchor at Såstein anchorage shall be ordered to weigh anchor if:

- *the forecast wind exceeds 15 m/s; or*
- *the surveillance radar in the area is out of operation; or*
- *the anemometer in the area is out of operation; or*
- *the AIS coverage in the area is unstable.'*

2. ANALYSIS

2.1 Introduction

The analysis starts with an assessment in order to clarify what caused *Full City* to run aground near Såstein in the early hours of 31 July 2009, so that parts of the Skagerrak coast was contaminated by oil.

Furthermore, assessments are made of what possibilities there were of preventing the vessel from running aground. Particular focus will be given to the time aspect and the role of the VTS centre. The analysis concludes by pointing to areas in which the AIBN believes there is most to gain from implementing safety improvement measures to safeguard Norwegian environmental protection interests.

2.2 Assessment of the chain of events

The AIBN's understanding of the accident is based on the following:

Full City, with a gross tonnage of 15 000 tonnes, was given the assignment to ship artificial fertiliser from Herøya to Guatemala while it was berthed in England about a week before the grounding. On approaching Norwegian waters and the Grenland area, the vessel filled 464 tonnes of fuel in Skagen. The agent reported the arrival of the vessel in SafeSeaNet, where the amount of bunker fuel was specified. Upon its arrival in Norwegian waters on 30 July, the vessel had approximately 1 154 tonnes of bunker fuel on board. The agent asked the vessel to anchor at Såstein off Langesund while awaiting clearance to berth at Herøya on the morning of 1 August in accordance with the passage plan.

The following sections describe the assessments made in seeking to clarify and elaborate on how the chain of events was perceived.

2.2.1 Understanding of weather forecasts

The vessel had two available systems in operation that regularly printed out weather forecasts: Inmarsat C and Navtex. The printouts were signed as confirmation that they had been read. The forecasts contained a lot of information and were not read carefully. The coast radio stations announced gale warnings, referring listeners to another channel for more detailed information. Computer problems on board prevented access to the internet, so local weather forecasts etc. could not be obtained from that source.

The weather forecasts for these areas did not give the crew any indication that there were special challenges involved. On the hydrographic chart included with the Inmarsat forecast, a low pressure area was identified in the North Sea. In the AIBN's opinion, in order to interpret the meaning of such charts, several charts must be studied to identify developments in the weather situation.

The officers did not recognise any of the place names in the local Navtex messages, despite the fact that Skagerrak was specifically placed under a gale warning. Nor were the forecasts transmitted by VHF radio, the contents of which corresponded to the Navtex

forecasts, perceived as being of importance to the vessel. No other information or weather forecasts were received from Brevik VTS or other vessels.

The adverse weather that arrived on the night of 30 July corresponded well with the forecasts issued during the past 36 hours.

The AIBN understands that the crew paid attention to the weather, but failed to make sure that the forecast severe weather would not affect them. Contact had been established with Brevik VTS, and the vessel's master expected to be notified by the VTS if any action was required. The AIBN believes that a lack of information from Brevik VTS and the agent regarding the weather was part of the reason why a more thorough check of the weather forecasts was not carried out on board.

2.2.2 Dragging confirmed after 10 minutes

GPS and radar were used as aids to check the anchor position from the bridge, in addition to visual inspections of sea conditions and the horizon. After the onset of darkness at about 21:00–22:00, the wind changed direction and force. In connection with the watch change on the bridge before midnight, the vessel's anemometer showed an increasing trend, and the movements in the vessel were notable. Whether to also deploy the port anchor was discussed. Shortly after, the officer coming on watch received indication that the vessel had changed position. A new check confirmed this, and the vessel's crew were notified accordingly. There was an option of setting an anchor alarm on the GPS and radar, but this was not done. It took about 10 minutes from the vessel started drifting until any action was initiated from the bridge. The master was quick to arrive on the bridge and his intention was to heave the anchor and move the vessel to deeper waters.

The bridge crew did not identify possible consequences of the increasing wind soon enough to be able to take necessary actions on board. The lack of visual references and absence of an anchor alarm may have contributed to why it took nearly 10 minutes before it was confirmed that the vessel was adrift.

2.2.3 The vessel dragged anchor and drifted ashore in the course of 35 minutes

According to AIS data, the vessel started moving across a shallow area in a north-north-easterly direction at 23:53 on 30 July 2009, and ended up close to the shore east of Lille Såstein at 00:28 on 31 July 2009. The vessel had dropped its starboard anchor and had five shackles out when the north-north-easterly movements started. Following a call from the pilot boat, the VTS centre was informed about the situation 20 minutes after the vessel had come adrift. Fifteen minutes later, the vessel ran aground east of Lille Såstein.

A vessel in ballast condition is normally lighter in the bow, which means that it will tend to turn its stern into the wind. The wind came from the south-west. During the vessel's north-north-easterly movements, the vessel pointed in a west-south-westerly direction (see Figure 6). In the AIBN's opinion, the vessel's movements are compatible with the vessel being pushed by the wind and dragging anchor along the seabed.

In the final 8–10 minutes before it ran aground, the vessel's bow turned southwards. *Full City* changed course and headed west across a shallow area. At the same time, the speed was halved to approximately 1.5 knots. The AIBN believes that the vessel's change of course and speed from approximately 00:17 are indications that the propeller was running during the final 10 minutes before the vessel ran aground (shown by the yellow/red

dotted line in Figure 6). This tallies with the master's explanation that they had propulsion during the final minutes.

It appears that, had the propeller not been in operation during this phase, the vessel might just have steered clear of Såstein, which corresponds with the assessment of the operator on duty at Brevik VTS. However, when the engine started running, the vessel was so close to the shore that there was not enough room forward to change course and head towards the open waters to the south and east. The vessel's engine power thus brought it even closer to the shore.

2.2.4 The anchor broke while it was being dragged

Technical examinations found no fault in the anchor steel or in the anchor arrangement in general. In the following, an assessment is made of forces to which the anchor arrangement may have been exposed, in relation to the classification society's design criteria for anchor arrangements. The discussion forms the basis for the conclusion that the anchor most likely broke while it was being dragged by the vessel.

2.2.4.1 *Wave forces*

Following the increasing wind from around 21:00, the Norwegian Meteorological Institute's calculations show that, around midnight, the wave height had increased to 4–5 metres in open waters. Closer to the shore, the swell of the water increases the wave height. At the same time, Jomfruland, Stråholmen and other islets and rocks will have a sheltering effect on the anchorage area in relation to winds from the southwest (see Figure 13**Feil! Fant ikke referansekilden.**). A change of wind direction from south-easterly earlier in the night to south-westerly would stir up the sea and potentially increase the size of individual waves. Without carrying out more detailed analyses and calculations, there is no basis for saying whether the wave height during the period the vessel was dragging anchor was higher or lower than the Meteorological Institute's calculations for open waters.

2.2.4.2 *Wind force*

The greatest wind forces on the night of 30 July and the early hours of 31 July were measured around midnight. The highest mean wind speed was about 20 m/s, corresponding to fresh to strong gale. The vessel measured winds of 25 m/s while the anchor was being dragged, which is compatible with the Meteorological Institute's observations of maximum wind forces during the same period. The empty vessel was light in the bow and rode high in the water. The push of the wind against the foreship caused the vessel to drift sideways, which is also evidenced by the AIS data in Figure 6.

2.2.4.3 *Current conditions*

The current conditions at the time were another force acting on the vessel. The AIBN has not considered this contribution. The current factor may have reinforced or counteracted the wind and wave forces. The current conditions contribute to the sum of forces acting on the vessel, but the AIBN considers this to have had little impact on the present incident.

2.2.4.4 *Find of anchor fluke*

Both anchor flukes on the starboard anchor were missing when the vessel was examined. DNV concluded that they had broken off during the accident. One of the anchor flukes was later found after a search of the seabed. It was found 10–30 m west of the place where the bow must have passed at around 00:10. The chart shows a seabed formation slanting towards the north-east in this area. Dragging the anchor into this formation would push the anchor upwards and westward from the vessel, which tallies with where it was found. In an underwater slope, there is assumed to be solid ground. The vessel dragged anchor at a speed of approximately 3 knots across this area. When a vessel is adrift and the anchor is dragged upwards and out of the vessel's course, the establishment of a new anchor hold will impose a far greater load on the anchor arrangement than keeping the vessel still. It is possible that the anchor winch was also being operated at this point in time, which would further increase the load on the anchor.

2.2.4.5 *Forces imposed in relation to the anchor's design criteria*

In accordance with the classification society's rules for the anchor arrangement, the vessel was exposed to wind forces bordering on the limits of what an anchor arrangement is designed for. In addition, the vessel was exposed to great wave forces that, intermittently, must have imposed extra loads on the anchor arrangement. Extra loads can be reduced by using a long anchor chain. A total of 137 metres payed-out anchor chain at a water depth of around 20 metres is just within the range recommended by the classification society.

2.2.4.6 *Overloading of the anchor*

The find of an anchor fluke in an area in which *Full City* had been dragging makes it highly likely that the anchor flukes on the starboard anchor broke as a result of the vessel's motion energy after it started dragging. This tallies with the classification society's rules according to which the anchor arrangement is not designed to stop large ships that have come adrift.

2.2.5 The anchor lost its hold

In light of what has been discussed above, the AIBN believes that the vessel started moving north-eastwards from 23:53 because the anchor lost its hold on the seabed as a result of up to gale-force winds, combined with dynamic loads from high, uneven wave formations.

2.2.6 Communication between the vessel and the VTS centre

The crew did not contact Brevik VTS after the vessel came adrift. Brevik VTS did not pay attention to *Full City*, because the vessel had not planned to move and was anyway outside the VTS centre's area of operation. The vessel had dragged anchor for more than half the period it took before the grounding occurred, before Brevik VTS was made aware of the situation. The AIBN understands the situation on board the vessel to have been hectic and unclear when it was confirmed that it was adrift, just after midnight. The deck officer who communicated with Brevik VTS seemed to be focusing on establishing a new anchor hold. The master decided at an early stage that they had to move to open waters, however, and wait for the engine to deliver the required thrust. Brevik VTS may only have become aware that *Full City* needed assistance after it had run aground.

2.2.7 Little time to get out of the anchor dragging situation

Whether it was possible to avoid grounding once the vessel was adrift is discussed in the following.

2.2.7.1 *Regaining control*

It took 35 minutes from the vessel came adrift until it ran aground at Såstein. The first nine minutes were spent on confirming that the vessel was dragging. The following minutes were spent on raising the alarm and on starting the machiery for propulsion. When the main engine started, the vessel was only 10 minutes from grounding. The AIBN believes there is a certain possibility that the vessel would have been able to deal with the situation had the crew discovered earlier that the vessel dragged anchor, and if the main engine had been ready to start immediately. It would have taken time to turn the vessel into the wind, and the rough sea combined with a light vessel could have caused propeller cavitation problems. AIBN do not have substantially premise to have an oppinion whether the master could have backed the vessel out of the situation and in to deeper waters when engine power for propulsion became available.

2.2.7.2 *Assistance of tugboat*

The *Dulcinea* incident at Såstein anchorage in 2007 (section 1.10.1) showed that assistance by the use of tugboats saved the vessel from running aground. In that case, however, there was more time available after the vessel came adrift. One hour passed from the anchor dragging was discovered to the first tugboat arrived. Arranging towing hawsers between the vessels also takes time. In the AIBN's opinion, during *Full City's* anchor-dragging period of 35 minutes, tugboat assistance would only have been possible if the tugboat had already been standby in the vicinity of the vessel. The possibility of providing effective assistance would naturally have increased had the vessel steered clear of Såstein.

2.2.8 Summary of the chain of events

The accident shows that time was scarce from when the vessel started dragging anchor until it ran aground at Såstein. Other incidents cited in this report also show that large vessels may find it difficult to deal with anchor dragging in rough weather, even if they have more time available. The adverse weather that developed during the night and in the early hours of 31 July 2009 had been forecast for several days. The AIBN believes that grounding is best avoided by assessing the conditions in advance. When the vessel entered Norwegian waters on 30 July, the plan was to berth at Herøya on the morning of 1 August. The vessel had to wait for almost two days, and no alternative to Såstein anchorage was considered, despite of the anchorage being exposed to the forecast weather.

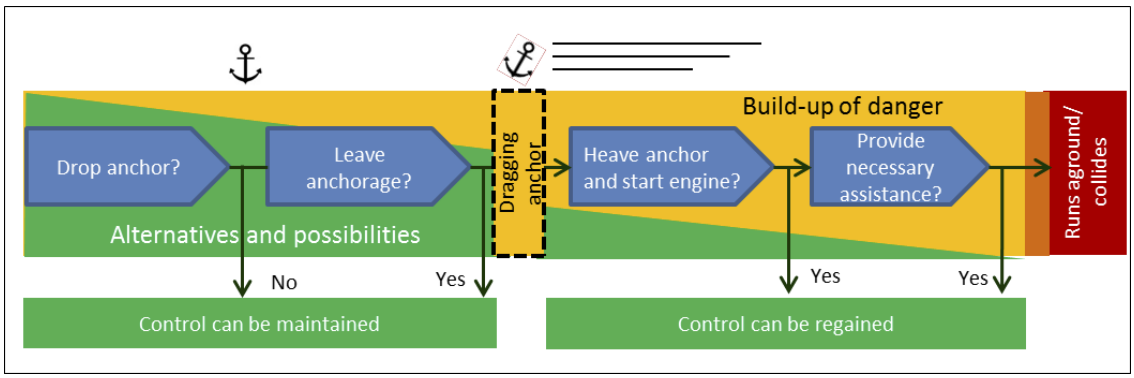


Figure 23: Timeline illustrating that the possibility of avoiding grounding as a result of dragging anchor is greatest during the early phase, before a vessel starts dragging. (Source: AIBN)

2.3 The decision to anchor at Såstein

Great wind and wave forces caused *Full City* to lose its anchor hold, drag anchor and run aground at Såstein. The AIBN's assessments of the chain of events show that the greatest potential for safety improvements relates to the decision to anchor. The investigation has shown that three parties mainly influenced this decision.

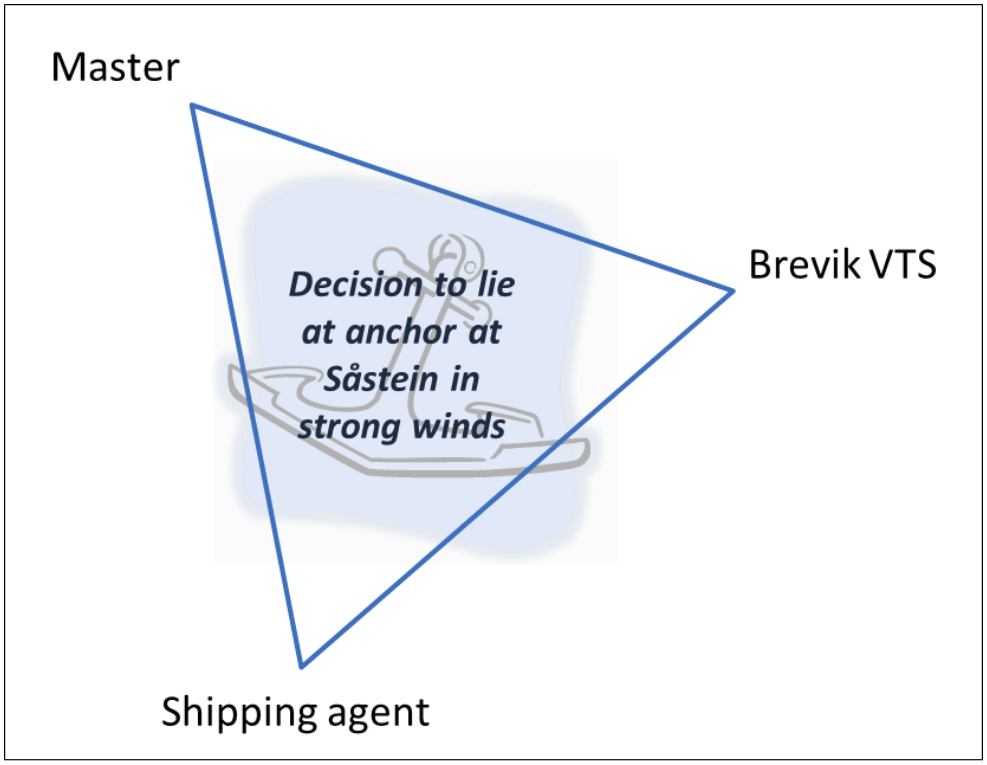


Figure 24: The decision to anchor as the result of interaction between three parties. (Source: AIBN)

2.3.1 The vessel and the crew

The investigation indicates that the crew were unable to identify relevant place names mentioned in the weather forecasts. They were not aware that the Inmarsat C weather transcripts did not provide information about Skagerrak, so that remote sea areas with better weather forecasts were seen as relevant in relation to their own position. Local place names were not recognised in gale warnings received via VHF radio and Navtex

transcripts. In the AIBN's opinion, there is every reason to expect that Skagerrak will be recognised in such warnings.

The written forecasts must be read in order to identify weather conditions that can put a vessel at risk. The AIBN is also of the opinion that the master should have made sure that the gale warnings were checked more carefully to clarify whether they might be relevant. The weather during the day and early evening provided no indication of a rapid change of weather later that night. The AIBN believes that the crew failed to realise that the wind could increase so much as many of the forecasts predicted.

Problems with the vessel's computer equipment prevented connection to the internet, but the AIBN is unable to say whether the crew would have attempted to do so had they had such access. The AIBN believes that the link to a local online weather forecast provided by the agent could have been an effective tool had the vessel's computer equipment been working.

2.3.2 The shipping agent

The local agent referred the vessel to anchor at Såstein nearly a week before it entered Norwegian waters. According to the agent, it is normal practice to recommend anchorage at Såstein while awaiting berth at Grenland. The AIBN assumes that the weather conditions were not assessed that far in advance. At such an early stage, it would also be natural to take account of uncertainties in relation to arrival time and clearance for berthing at the quay.

Further emails from the agent during the following days confirmed Såstein as the anchorage site while awaiting berth. The agent's link to a local online weather forecast was included in an email of 29 July. At this point in time, the poor weather forecast was known, and the agent knew that adverse weather was on its way. The agent nonetheless continued to provide information about Såstein as the relevant anchorage.

In the AIBN's opinion, the clear and repeated request from the agent that [the vessel] *'has to anchor at Saastein'* without giving any alternatives influenced the decisions that were made on board. In the AIBN's view, by insisting on only one option, the agent assumed an extended role in the master's decision-making basis. The AIBN believes that this was a problem in that assessments of the weather conditions were at the same time left fully up to the vessel.

In the AIBN's view, the vessel had other options than anchoring at Såstein: Like *Lady Margaux*, it could have moved to more sheltered waters, or it could have moved further out to sea to ride out the storm. The AIBN believes that a foreign vessel and crew should be able to expect a local shipping agent to provide the necessary information about local conditions and possible alternatives, in order to give the crew the best possible basis for making decisions.

2.3.3 Brevik VTS

The contact between the vessel and Brevik VTS was upheld in accordance with the international guidelines that apply to permission to enter a VTS centre's area of operation. Brevik VTS confirmed the information from the agent that the vessel was to anchor at Såstein. However, the phraseology used by Brevik VTS in its response did not make it clear whether anchoring at Såstein was an instruction or a message conveyed from the

agent ...*'you are going to anchor at Saastein anchorage'*. Moreover, the anchorage was assigned using coordinates. The approaching ship can perceive such formulations as instructions, which thereby leaves little room for own assessments.

The master believed he was subject to instructions from Norwegian authorities when the vessel was at anchor and that he expected to receive a message should anything threaten the vessel's safety. Since Såstein anchorage was outside the area of operation for Brevik VTS, the VTS centre did not have the role of providing the vessel with information services. Brevik VTS did not inform the vessel that it was outside its area of operation and in practice left to its own devices.

The AIBN believes that Brevik VTS's style of communication reinforced the crew's misconception that they were subject to instructions from Norwegian authorities.

2.3.4 Failed interaction

The three parties – the vessel, the agent and the VTS centre – all had different perceptions of their respective roles and of the situation. In the AIBN's view, the agent's one-sided request for the vessel to anchor at Såstein, which was perceived as an instruction from Brevik VTS, made it difficult for the master to overrule the request at his own discretion. The AIBN believes that the fact that the same request for anchoring was issued by two different parties and the fact that no warnings were issued about the forecast weather conditions may have affected the crew's decision not to study the received gale warnings in more detail. There was also plenty of time to reverse the decision after the vessel had anchored at 14:50.

2.4 Weaknesses in the vessel traffic service

In the AIBN's view, the greatest potential for preventing similar incidents in Norwegian waters and safeguarding Norwegian environmental protection interests can be found in the organisation and execution of the authorities' vessel traffic service. If this service is given a more active role, the AIBN believes that both agents and ships can be guided into making better decisions that promote safety.

The NCA has implemented several measures after the incident. This chapter contains an assessment of underlying factors relating to the vessel traffic service, including comments on subsequently implemented changes.

2.4.1 Delimitation of the area of operation

Såstein anchorage was outside the VTS centre's area of operation when *Full City* ran aground in 2009. In the AIBN's opinion, it is a problem that mandatory contact was scheduled between the vessel and Brevik VTS in accordance with international guidelines, without the VTS centre being given the authority to regulate traffic in the anchorage area. The accident shows that this contributed to misunderstandings as regards role expectations between the vessel and the VTS centre.

The NCA's attitude was that ships were preferably to wait outside the baseline and the VTS centre's area of operation, as described in one of its procedures. In the AIBN's view, the location and function of the anchorage area in relation to the ports in the Grenland area mean that it is natural to include it in Brevik VTS's area of operation. This is also in line with international guidelines for vessel traffic services.

The AIBN therefore takes a positive view of the fact that the VTS centre's area of operation in 2010 was extended to the baseline and now includes Såstein.

2.4.2 Criteria for anchoring

Såstein anchorage was not marked on charts or regulated by the authorities at the time of the accident, despite the fact that the area was within the baseline and subject to national regulations. The investigation has shown that the safety of a ship at anchor is subject to physical limitations. Wind and wave forces will challenge both the vessel's anchor arrangement and the hold of the anchor. There appears to be similarities with other incidents involving anchor dragging described in this report in that the ships were not in sheltered waters and were exposed to waves and wind forces of a magnitude expected in connection with gale warnings.

Both national and international regulations allow the authorities to introduce restrictions on the use of fairways in order to promote safety. After the incident, the NCA has initiated work to map the seabed conditions with a view to defining criteria for the use of anchorage areas. The instructions of 19 February 2013 also include criteria for the use of anchorage areas within Brevik VTS's area of operation, including Såstein.

The AIBN takes a positive view of the fact that criteria for the use of anchorage areas are being established and believes that such criteria should be based on risk assessments. The assessments should describe which parameters are included, as well as uncertainties, margins and any other factors that should be taken into account. In the AIBN's opinion, the assessments should include an assessment of the consequences of incidents. Particular attention should be paid to ships that carry dangerous and polluting cargo.

2.4.3 Execution of the vessel traffic service

2.4.3.1 *Weather forecasting*

At the time of the accident, VTS procedures did not include procedures for weather reporting to vessels. In the AIBN's view, this may have to do with the absence of criteria for the use of anchorage areas. In a situation in which criteria for anchoring have been established, it would be natural, in the AIBN's opinion, for the VTS centre to be assigned a clear and active role in communicating and providing information about weather and wave conditions. This also requires reliable and appropriate instruments for observation of weather and sea conditions. Having equipment for measuring the weather and communicating weather warnings to ships are also in line with national and international guidelines.

The investigation of the *Full City* incident and several of the other incidents mentioned in this report have shown that vessels clearly expect that the vessel traffic service should play an active role in connection with decisions made on board. The AIBN therefore finds it reasonable that the vessel traffic services should assume such a role.

2.4.3.2 *Use of correct phraseology*

National procedures prescribe the use of IMO’s standard marine communication phrases. Recognisable message markers are intended to help the recipient gain an understanding of the authority exercised by the VTS centre, i.e. to distinguish between messages containing information, advice, warning and instruction. *Full City* was outside Brevik

VTS's area of operation. The phases used by Brevik VTS may have further contributed to the misunderstanding on board concerning the authority exercised by the VTS centre. In order to clarify potential misunderstandings on board vessels, the VTS centre may in some cases be required to state its mandate. The AIBN expects the NCA to emphasise the use of correct phraseology in recruitment, training, procedures and in the day-to-day work of the VTS centres.

3. CONCLUSIONS

3.1 Operative and techincal factors

3.1.1 The vessel prepares to anchor at Såstein

a) The local agent referred *Full City* to anchor at Såstein while awaiting a free berth at Herøya. At no time did the agent mention alternatives to Såstein anchorage, despite the fact that poorer weather was forecast.

b) Brevik VTS told *Full City* to anchor at Såstein, but did not make it clear that this was a message from the agent and not an instruction from the authorities.

c) *Full City* dropped its starboard anchor at Såstein at 14:50 on 30 July and shut down the engine.

d) The master was under the impression that he was under the authority of Brevik VTS when the vessel lay at anchor at Såstein.

e) A strong south-westerly gale was forecast from late at night. The warning had been communicated via VHF radio and Navtex repeatedly from at least a day and a half beforehand.

f) *Full City's* weather information receivers were operational and provided a lot of information.

g) Due to computer problems on board the vessel, the crew were unable to access local weather forecasts on the internet.

h) The bridge crew on *Full City* did not read the weather reports carefully and failed to identify the correct local place names in the weather reports.

i) The crew on *Full City* understood that winds approaching gale force were forecast and maintained regular watch duty in the early hours of 31 July.

3.1.2 The vessel drags anchor

a) The wind force approached strong gale and the significant wave height in the area was 4–5 m when the vessel's anchor lost its hold and started dragging in a north-easterly direction at 23:53 on 30 July.

b) The distance to the nearest shore in the direction in which the vessel was dragging was one nautical mile.

c) The crew confirmed that the vessel was dragging anchor after approximately 9 minutes. The master gave orders to start up the engine and heave the anchor.

d) Brevik VTS was not monitoring the vessel, and received a message from the pilot boat that *Full City* was dragging anchor 20 minutes after the vessel started drifting.

e) The propulsion system probably came into operation 22–24 minutes after the vessel started dragging.

f) The propulsion system may have contributed to the vessel changing course to the west in the direction of Lille Såstein.

g) Once the vessel had started dragging, there were few opportunities to regain control of the vessel.

3.1.3 The vessel runs aground

a) The vessel ran aground east of Lille Såstein at 00:28.

b) Brevik VTS did not receive confirmation from *Full City* that the vessel was experiencing problems until several minutes after it had run aground.

c) The vessel remained aground and was pounded against the rock, creating a hole in the hull below the waterline.

d) Approximately 293 m^3 of bunker fuel from the vessel leaked out into the environment.

3.2 Important investigation results

Already a week in advance, the local agent referred *Full City* to anchor at Såstein while awaiting a free berth for loading at Herøya. The agent maintained this, although the weather forecast gradually indicated that the area would be exposed to strong winds.

The contact between the vessel and Brevik VTS was upheld in accordance with the international guidelines that apply to permission to enter a VTS centre's area of operation. Såstein anchorage was outside the area of operation for Brevik VTS, however, but the VTS centre did not make this clear to the vessel. This meant that the master thought he was under the authority of Brevik VTS when the vessel lay at anchor at Såstein.

Full City lost its anchor hold and started dragging under the impact of strong south-westerly winds and high waves. Because it was dragging in a south-easterly direction quite close to the shore, there was little opportunity to regain control once the vessel had started dragging.

The AIBN believes that different role expectations contributed to the master's decision to let the vessel lie at anchor at Såstein in strong winds. The input from the agent and the VTS centre influenced the master's expectation that the vessel was to lay at anchor. This did not tally with the expectations of the agent and the VTS centre that the master had to make his own independent assessments.

4. SAFETY RECOMMENDATIONS

The AIBN has chosen not to issue any safety recommendations following this marine accident. In the AIBN's view, the greatest potential for preventing similar incidents in Norwegian waters and safeguarding Norwegian environmental protection interests can be found in the organisation and execution of the authorities' vessel traffic services.

The NCA has initiated and completed several measures after the accident. This includes establishing criteria for anchoring, so that the VTS centre is given a more active role. It is also in line with national and international guidelines and gives Norwegian authorities a more independent role in improving marine safety in Norwegian waters.

The decision not to issue any safety recommendations is based on the expectation that the measures that are being implemented by the NCA will improve safety and be able to prevent similar incidents. This entails an assessment of whether these measures are relevant in relation to other VTS areas.

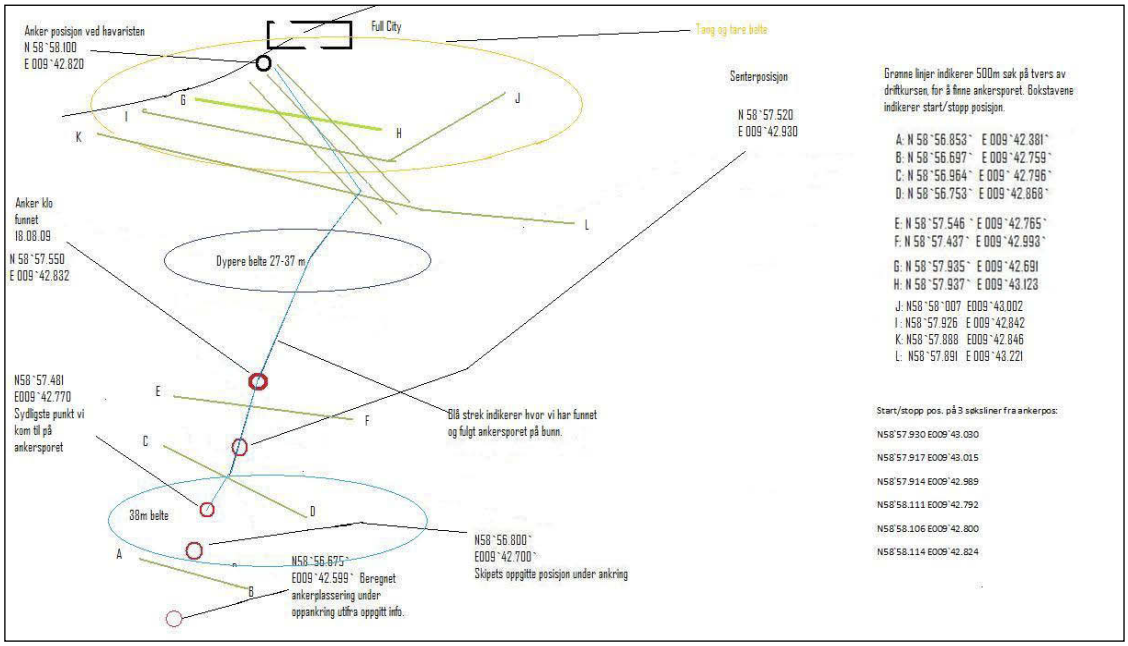
Accident Investigation Board Norway

Lillestrøm, 3. September 2013

APPENDICES

Appendix A: Searcharea on the seabed and determination of findings
Appendix B: Areachart for SafetyNet NAV/METAREA I
Appendix C: Hydrographic chart of Europa fra 30.7.2009 kl. 0900 UTC

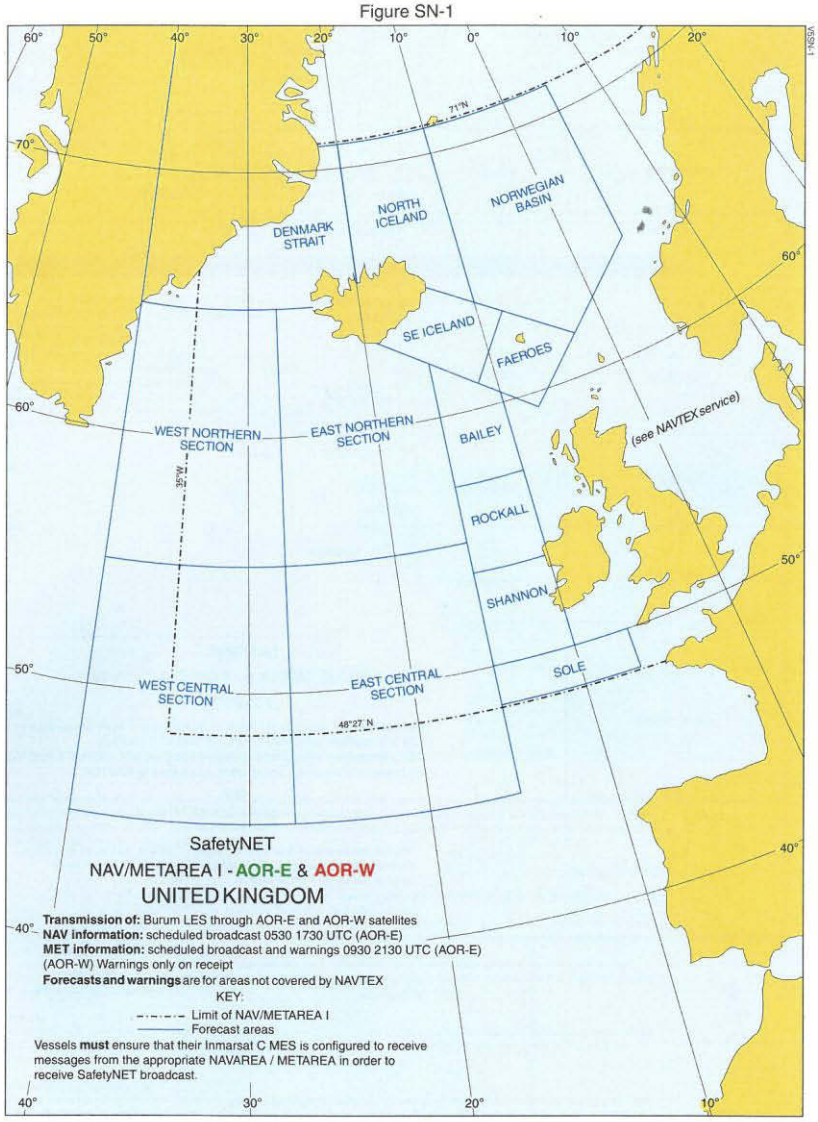
Appendix A



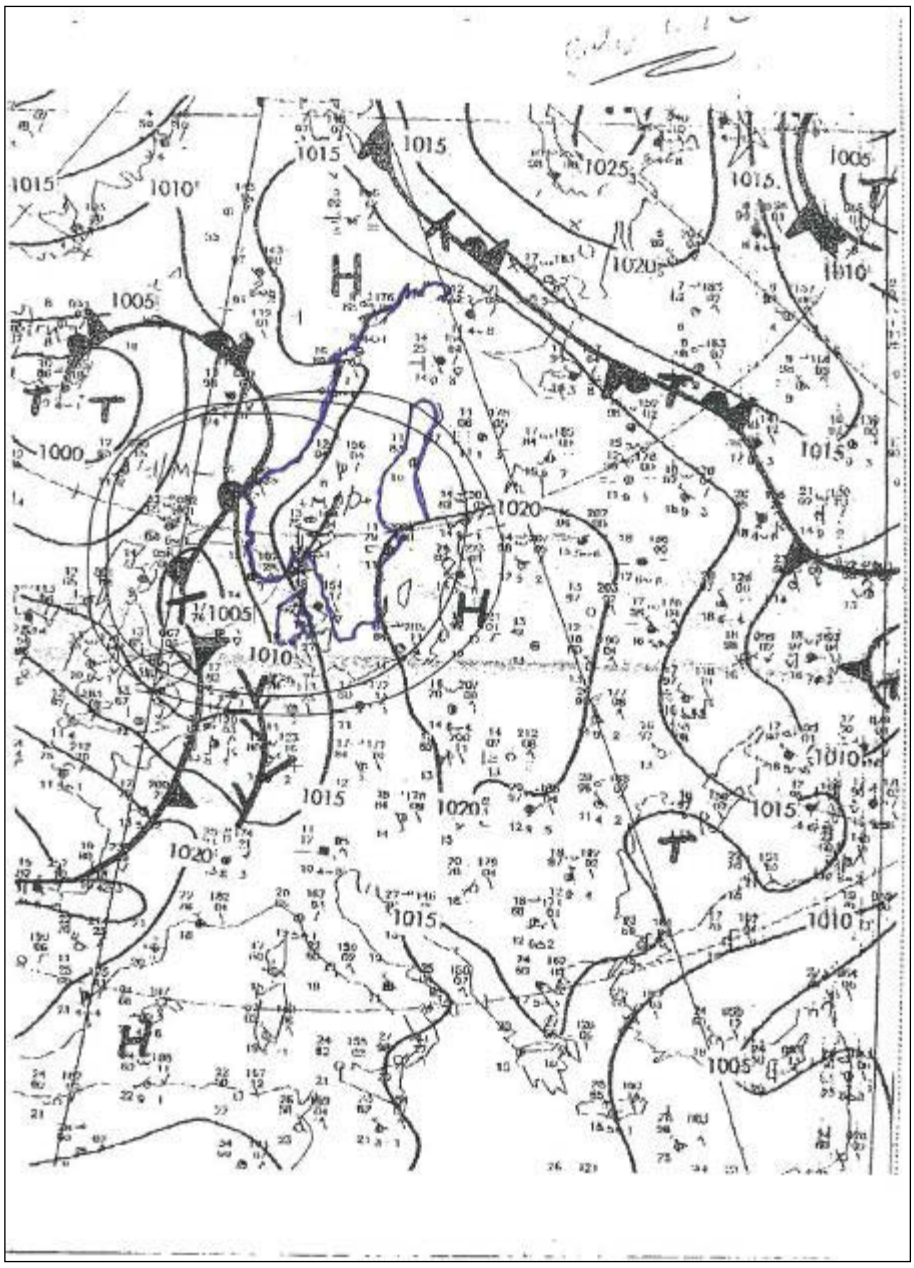
Searcharea on the seabed and determination of findings (source: Norwegian navy divers)

Appendix B

Figure SN-1



Appendix C



Hydrographic chart or Europe of 30. July 2009 at 0900UTC (source: Detcher Wetterdienst)