Grounding of the Crude Oil Tanker

*Kyeema Spirit*

East of Isle Aegna

on 24 September 2012
The accident was investigated by Estonian Safety Investigation Bureau in accordance with Estonian Maritime Safety Act §70 and the IMO Code for the Investigation of Marine Casualties and Incidents. The sole purpose of the investigation was to determine the causes of the accident and make safety recommendations to avoid similar occurrences in future. The investigation report is not to be used for apportioning any blame or liability.

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Summary

On September 24, 2012, the Crude Oil Tanker *Kyeema Spirit* dragged her anchor in Estonian territorial waters East of Isle Aegna (Ulfsö) and subsequently ran aground while trying to leave the anchorage “I”. The weather conditions had been deteriorating since the vessel anchored in calm conditions on the previous day to near gale winds (14-17 m/s) and rough sea on the night of the accident.

The vessel sustained damage to her hull. There were no personal injuries and no damage to the environment. No other vessels were involved in the accident.

*Kyeema Spirit* arrived to Estonian territorial waters in ballast condition on 23rd September and anchored 8 nm from the harbour to await berth at Port of Muuga for cargo loading. The following night the wind speed increased and the vessel’s anchor started dragging. The Captain decided to leave the anchorage until the weather would improve. While manoeuvring to leave the anchorage area the vessel ran aground.

Estonian Safety Investigation Bureau opened a safety investigation to determine the causes of the serious maritime accident.

The casualty was caused by human erroneous action, usage of outdated navigational chart information and adverse weather conditions.
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Abbreviations

BA – British Admiralty
BMS – Baltic Marine Services
CET – Central European Time
ECDIS – Electronic Chart Display and Information System
ECS – Electronic Chart System
EET – Eastern European Time
ESIB – Estonian Safety Investigation Bureau
EMA – Estonian Maritime Administration
Ch – channel
GPS – Global Positioning System
h – hour
IMO – International Maritime Organization
HFO – Heavy Fuel Oil
JRCC – Joint Rescue Coordination Centre
kn – knots
LOA – Length Overall
m – meter
m/s – metres per second
NE – North East
NM – Admiralty Notices to Mariners
nm – nautical mile
no. – number
OSC – On Scene Coordinator
SMS – Safety Management System
SOLAS – Safety of Life at Sea
UKHO – United Kingdom Hydrographic Office
UTC – Coordinated Universal Time
VHF – Very High Frequency
VTS – Vessel Traffic Service
WBT – Water Ballast Tank

**Times:** All times used in this report are local (UTC+03:00, Eastern European Summer Time) unless otherwise stated.
2 FACTUAL INFORMATION

2.1 Ship particulars:

Name: KYEEMA SPIRIT
Flag: Bahamas
Port of Registry: Nassau
Type: Crude Oil Tanker
Official number: 732224
IMO no. 9171840
Builder: Samsung H.I. Koje S.Korea
Registered Owner: Kyeema Spirit Holdings L.L.C
Built: 1999
Classification Society: Det Norske Veritas
Construction: Steel
Length Overall: 249 m
Gross Tonnage: 62619
Engine Power and/or type: Samsung B&W; 18,400 BHP
Service Speed: 15 kn
Other relevant info: 1 fixed pitch propeller
Cargo: None, in ballast condition

2.2 Voyage Particulars

On 19 of September 2012 at 08:00 (UTC+02:00, CET) Kyeema Spirit departed Mongstad, Norway in ballast condition. On the following day she anchored at Skagen for bunkering from 13:00 to 18:30 (UTC+02:00, CET) whilst bound for Muuga.

On 23rd of September the vessel reached Tallinn anchorage „I“, at 14:06 (UTC+03:00). She was anchored 5 shackles in water at the depth of 38m.

The voyage was made in moderate weather conditions with variable winds Beaufort Force 3-8 winds (5-17 m/s).
24 crewmembers were on board during the accident. The crew consisted of Indian, Russian, Croatian, Georgian and Filipino nationalities. The crew did not exceed the rest and duty time restrictions.

### 2.3 Marine casualty information

The nature of the marine casualty: grounding

Time and date: 24 September 2012, 06:48 EET

Location of accident: Estonian territorial waters, East of the Isle of Aegna (in Tallinn Bay), Position (LAT 59°35,2’N; LON 024°47,4’E)

Injuries/Fatalities: None

Damage to the environment: None

#### 2.3.1 Other vessels in the anchorage area “I” during the accident

Name: **Genmar Spyridon**

Flag: Marshall Islands

Type: Crude Oil Tanker

Length Overall: 274m

Cargo: none, in ballast condition

Name: **Brovig Fjord**

Flag: Gibraltar

Type: Oil/Chemical Tanker

Length Overall: 114m

Cargo: none, in ballast condition

#### 2.3.2 Weather information

The weather conditions had been deteriorating since Kyeema Spirit’s anchoring from light breeze (2-3 m/s) to near gale winds (14-17 m/s) and rough sea (average wave height 2-3.5m). Estonian Meteorological and Hydrological Institute’s data of the actual weather conditions over the period of the incident is shown in Table 1.
Table 1: Extract from the weather data recorded by Estonian Meteorological and Hydrological Institute at Rohuneeme coast station.

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<th>Wind direction</th>
<th>Average wind speed (m/s)</th>
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<tr>
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<td>7.9</td>
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2.3.3 Consequences

Damage to the vessel

Multiple cracks and indents found on vessel flat bottom between frames 13 to 52 centre line, in the way off:

- Bilge Holding Tanks
- Engine Cofferdam
- HFO Overflow Tank
- Pump Room
- 4 DBWT PS

The damage included an indented rudder blade bottom plate, the flooded pump room and water entering the HFO Overflow Tank which contained 28.6 m³ of Heavy Fuel Oil. Due to the HFO’s increase of viscosity after coming in contact with cold water there was no leakage of HFO and no damage to the environment.

An underwater inspection of Kyeema Spirit was made by Smit Salvage specialists at the road of Muuga, Estonia, on 25 September 2012.

After the accident the tanker Kyeema Spirit was to proceed with single voyage to the repair facilities under own power under specific weather and technical requirements allowed by the vessels classification society Det Norske Veritas.

Figure 1: Left side view is showing indentation on bottom shell plating. Indent runs through the length of the Engine Room and Pump Room into WBT no. 4. Right side view is from the inside of the pump room showing bottom shell damage port forward outboard corner into frame 52.

Other Damages

There were no personal injuries and no damage to the environment.
2.4 Shore authority involvement and emergency response

JRCC Tallinn’s duty officer was monitoring the situation some minutes before the grounding. At 06:50 the Captain of *Kyeema Spirit* confirmed to JRCC that the vessel has run aground and there is a leakage to the pump room, at 07:01 the head of JRCC was notified of the situation, two rescue vessels and a helicopter watch were dispatched to the scene of the accident.

Communication between the vessel and JRCC was held on VHF Ch. 13 and 69 without problems.

The closest JRCC rescue vessel (at Muuga harbour, 8 nm) could not arrive to the scene due to the weather conditions. *PVL101*’s distance to the scene was 50 nm – ETA 4 hours. *PVL 101* arrived to the scene at 11:27 and was assigned as OSC by JRCC.

*PVL101* was a Fire Fighting Ship with oil recovery equipment, designed to service as a border patrol ship in the Baltic Sea for Estonian Police and Border Guard Board. JRCC Tallinn is a Rescue Coordination Centre operated by the Estonian Police and Border Guard Board.

2.5 Charts used for the area

The paper charts used on board *Kyeema Spirit* were UKHO BA Charts and were properly corrected according to the information available to the vessel’s crew by UKHO Notices to Mariners. Admiralty standard nautical charts comply with SOLAS regulations.

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Figure 2: UKHO BA charts of the Area of Muuga. The Anchorage area "I" locates in the borderlines of charts No 2227 and 222. Scale 1:27 500.

Figure 3: EMA charts of the area surrounding Muuga and Tallinn. The anchorage area "I" is clearly visible on the chart No 610. Scale 1:50 000.
2.5.1 Charts used on board Kyeema Spirit

To enter the Muuga harbour UKHO BA charts 2227 and 2225 are commonly used on foreign vessels. On these charts anchorage “I” is not fully visible (Figure 5) According to the Hydrography and Aids to Navigation Division of the Estonian Maritime Administration the common practice for UKHO is to use the local charts as basis for UKHO chart layouts. For the Muuga area UKHO BA charts have a very different layout as shown on the pictures below. The port of Muuga is constantly visited by foreign ships using mostly UKHO BA charts. On Figures 2 and 3 are shown the layouts of the EMA and UKHO charts surrounding the areas of Tallinn and Muuga, two of the most commonly visited ports in Estonia by foreign vessels. On figures 2 and 3 the green dot represents the location of Muuga harbour and blue dots the location of the anchorage area “I”.
Figure 6: EMA chart no 610 "Approaches to ports of Tallinn and Muuga", scale 1:50 000. The anchorage "I" and "K" have been pointed out with a red line.

Figure 7: EMA Notices to Mariners No. 1 - 2002. Distributed on 01.01.2002.

**Soome laht / Gulf of Finland**

No. 2

Tühistada Eest – Soome vahelised
veealused sidekaablid

ROHINEEME

läänpoolne / western
a) 59° 33,9’N 024° 48,2’E
b) 59° 34,7’ 024° 49,1’
c) 59° 45,0’ 024° 40,25’
d) 59° 51,2’ 024° 34,0’
e) 59° 57,8’ 024° 32,2’
f) 60° 00,4’ 024° 30,8’

idapoolne / eastern
a) 59° 33,8’N 024° 48,2’E
b) 59° 34,7’ 024° 46,5’
c) 59° 45,5’ 024° 42,3’
d) 59° 52,2’ 024° 37,4’
e) 59° 56,2’ 024° 36,9’
f) 60° 00,4’ 024° 30,9’

PORKKALANNEEMI

Kaart nr. 507 (1267), 610 Chart
EMA notices to mariners “TM No.1-2002” in 2002 included the deletion of submarine cable which located in the anchorage area “I” after it was removed from the sea bottom.

Although after publishing all EMA chart corrections are automatically sent to UKHO the deletion of the cable was added to UKHO chart corrections on week 48 2012 (9 weeks after the grounding of Kyeema Spirit) after an enquiry from the EMA concerning the deletion of the submarine cables.

The duty officers on board marked the anchoring position without a swing circle on the paper charts using only GPS position. The paper chart BA 2227 was not in use as the primary navigational system as the swing circle was marked and tracked only on the raster charts which were on board Kyeema Spirit for reference use only. A swing circle is marked on navigational charts to observe the movement of the vessel inside the designated swing radius around the anchoring position according to the vessel’s anchoring position, vessel’s length and anchor cable length. A position outside this circle is an indication that the anchor is probably dragging.

All the navigation equipment on board Kyeema Spirit was reported to be in working condition. Kyeema Spirit was not equipped with ECDIS, there was a working ECS with raster charts for reference use only.
Figure 9: Picture taken from the monitor of the raster chart used on board Kyeema Spirit with a swing circle clearly visible. “For reference only” is clearly marked at the bottom of the screen. According to the deck officers the swing circle on the figure No 10 has the same characteristics as the one used before the accident.
2.6 Crew’s actions

24 crewmembers were on board during the accident.

The results of alcohol tests done to all crewmembers 24 h after the accident were negative.

The Captain had been employed as a Captain in this company since 2007. He held all necessary licenses and certificates to be in command of Kyeema Spirit. He was well rested during the days before the accident and he didn’t consider tiredness a contributing factor even though he woke earlier than usually to perform the manoeuvring on the day of the accident.

There are no records of previous maritime accidents in which the Captain would have been involved with known to the ESIB.

The Captain had previously sailed Kyeema Spirit to Muuga at least on one occasion. In January 2012 when Kyeema Spirit visited Muuga the same Captain was in command. On that occasion had used the anchorage “K” which has compulsory pilotage and is partly covered from the Northernly winds by the Isle of Prangli.

The safety margin of the anchor swing circle was set to 2 cables from the initial anchoring position (59°35.7’N; 024°48.2’E). The Captain left clear orders to call him if any sign of anchor dragging and/or winds over 30 kn (15 m/s) or distance 0.5 nm of any danger. The Captain also stated both the existence of the submarine cable and the closeness of the shore in the orders and assigned watchman to check the cable weight and lead once per hour.

Duty officer called him 19:00 the previous evening due to wind increasing but during the time no anchor dragging was noticed.
As the weather deteriorated the 274 m Crude Oil Tanker *Genmar Spirydon* had repositioned due to her anchor dragging two times before the duty officer of *Kyeema Spirit* noticed her anchor dragging. This did not alert the duty officer of *Kyeema Spirit* of the dangerous situation although he noticed *Genmar Spirydon*'s movements and had received the weather forecast predicting near gale earlier.

Figure 10. *Kyeema Spirit*, *Genmar Spirydon* and Brovig Fjord at anchor 05:20 on 24th of September. The VTS had already received alerts “*KYEEMA SPIRIT:* drifts from anchor position”. This screenshot shows the view for VTS operator including the anchor positions.”

### 2.7 Choice of anchorage

Prior to arrival to Estonian waters the Captain was advised by the agent BMS to head for anchorage „I“. On previous visit with the same vessel the Captain used anchorage „K“ which is more covered from northerly winds but requires a pilot for entering.

Although the anchorage „I“ does not require pilotage for entering and avoids associated costs the Captain did not report any pressure by the company in choosing the anchorage locations in this kind of situations.

The Captain did not question the agent’s choice of anchorage nor did he see any reason at the time to do so. The Captain chose the anchoring position in the area “I”
according to the UKHO charts, which had a cable located in the middle of the anchorage area. Captain’s first plan was to anchor to the area where Genmar Spyridon was anchored. Whilst approaching and acknowledging the presence of Genmar Spyridon, he re-decided, and due to Brovig Fjords position did not see any alternative to the ultimately chosen location. The Captain took into account the location of the non-existing cable which was marked on the chart and weather forecast including the wind direction so in case of dragging anchor not to drag/break the cable.

There was no advice from VTS concerning the anchoring position, only a reminder was given to notify the VTS before dropping anchor.

During the time of the anchoring the Captain of Kyeema Spirit was not aware that the wind was due to increase later.

2.8 The length of anchor cable

The Teekay Shipping’s SMS manual’s “Use of Anchors Procedure” requires that for maximizing an anchor’s holding power, the scope of cable should be sufficient to ensure that, in calm weather, a length of cable would lie along the seabed and thus pull horizontally at the anchor shackle. When this occurs, the cable rises gently in a curve to the hawse-pipe. The curve (catenary) is necessary to ensure that the cable exerts a horizontal pull on the anchor shackle. This absorbs any shocks when forces on the ship due to wind, tide and current increase the pull on the cable. The length of cable is key in establishing a catenary. Most large ships (including the Kyeema Spirit) are fitted with about 12 shackles, approximately 330 m, of cable for each anchor.

The common formula for calculating the minimum number of shackles required for calm weather is:

\[
\text{Number of shackles of cable} = 1.5 \times \sqrt{\text{depth of water in metres}}
\]
3 NARRATIVE

3.1 Timeline

On 23 of September at 14:06 the crude oil tanker Kyeema Spirit anchored at anchorage “I” in about 40 m of water in calm weather conditions.

At 19:00 the duty officer informed the vessel’s Captain that the wind had increased. At the time there was no anchor dragging noticed and the duty officer had received the weather forecast giving near gale warning in the region.

In the same anchorage two other vessels were anchored at the time – crude oil tanker Genmar Spyridon and oil/chemical Tanker Brovig Fjord. During the following night, Genmar Spyridon repositioned 3 times due to her anchor dragging.

At 03:45 the duty officer of Kyeema Spirit called the Captain to notify him about the vessels stern passing the swing circle. According to the duty officers judgement the vessels anchor position had shifted 2 cables. The Captain arrived to the bridge at 03:48 and the duty officer reported that also the bow has passed the swing circle.

At 04:05 an anchor team of 3 crewmembers was sent forward to the anchor station and at 04:18 the vessels engines were ready for manoeuvring.

The Captain started trying to ease the anchor chain by using the vessels engine and rudder. Due to the weight of the cable it took about 30 minutes to heave 1 shackle back in. While manoeuvring, the vessel moved slowly astern.

05:45 the Captain informed the VTS of his intentions to weigh anchor with the intention to anchor again at about 4 cables NE of his present position.

At 06:02 the Captain informed the VTS about changing his plans: instead of changing the anchoring position the vessel would head to drift until the weather improves further away from the shoreline.

At 06:27 the anchor team notified the Captain that the anchor was almost up after struggling with what they first thought to be an old cable caught on the anchor.

From 06:42 the VTS started to give warnings about approaching shallow water. By this time the northerly wind had increased to gusts of 16-18 m/s.

At 06:47 the Captain gave the order to drop the anchor and at 06:48 the vessels run aground. After this he contacted the VTS and JRCC Tallinn to notify them of the grounding and at 06:52 the vessels general alarm was sounded.
4 ANALYSIS

4.1 Navigational charts

Before arriving to Estonian waters the Captain decided to anchor at the South East area of “I” anchorage in approximately 59°34,9’N; 024°50,0’E due to the disused submarine cable which was marked to the UKHO BA chart 2227. This position would have been about 1 nm from the 10 m contour of the Isle of Aegna. 1.5 h before arriving to the anchorage area, after the duty officer contacted the Estonian VTS, the Captain was notified about Genmar Spyridon laying at anchor in his chosen area. He re-assessed the anchoring options taking into account the disused cable on the chart and decided to anchor close to the Northern limit of the “I” anchorage which was already taken by Brovig Fjord. After having an overview of the situation he chose the anchoring position which he took as the safest possibility under the circumstances.

If the charts would have been updated according to the correction which EMA made public in 2002 it would have been most likely that the Captain would have chosen another anchoring location more East to keep well clear of the shoal contour.

On UKHO charts anchorage „I“ is not properly visible although the Estonian Chart 610 covers the whole entrance to port of Muuga. According to EMA UKHO commonly uses the layout of the national charts when updating its own charts of the area. This has not been done yet for the entrance of Muuga on UKHO BA charts although Muuga is a big port with daily heavy traffic.

4.2 Crew’s actions

The Captain’s previous experience according to his own words when manoeuvring Kyeema Spirit was that the vessel had always responded well which gave him a false sense of security about the vessel’s manoeuvrability. He did not take sufficiently into account the wind surface of the vessel, weather conditions and small surrounding area for navigation. The Captain of Kyeema Spirit was also aware of the Genmar Spyridon repositioning two times during the night and having similar wind surface and characteristics as Kyeema Spirit.

It was the Captain’s decision to remain at anchor off lee shore and in the vicinity of hazards in conditions exceeding their ability to get underway safely. Also when giving orders about the anchor chains length he probably did not make any calculations which resulted in the chain not being given out enough and ultimately starting to lift the anchor shank and losing holding power.

Although the anchorage area can be allocated by the agent, VTS, pilot, etc. – the safety of the vessel and decisions remain the Captain’s responsibility. Prior to arrival the Captain was advised by the agent BMS to head for anchorage „I“. On previous visit
with the same vessel the Captain used anchorage „K“, which is partly covered from the Northernly winds by the Isle of Prangli. During this voyage the local agent company referred the Captain to use anchorage “I” which can be entered without using a pilot and, respectively, without additional expenses.

On 23rd of September the vessel reached Tallinn anchorage „I“ and was anchored 5 shackles in water at the depth of 38 m at the Captains orders.

According to the common formula for calculating the minimum number of shackles required for calm weather. The scope of cable used by the Kyeema Spirit – 5 shackles in the water – was inadequate with Teekay Shipping’s SMS manual’s “Use of Anchors Procedure”. The depth of water was about 38 m (readings from echo sounder). Using the common formula for calculating the minimum number of shackles required for calm weather should be about 9.2 shackles. Deciding not to let out enough anchor chain resulted in lifting the anchor shank and losing holding power.

Using the correct scope is essential in the maximum holding power of the anchor, particularly in adverse weather conditions. If less cable is used, the effects of yawing caused by the wind and the effects of pitching caused by the swell, increase the risk that the cable will be lifted from the seabed.

The work and rest hours timetable for 96 h before the grounding indicate that fatigue was not a factor in this accident.

5 CONCLUSIONS

Estonian Safety Investigation Bureau’s investigation determined as the main cause of the accident failure of the crew to maintain safe ground-clearance during manoeuvring.

The Captain lost his situational awareness due to being overconfident in his skills based on previous experiences on the vessel.

Contributing factors:

- Near gale wind, rough sea.
- UKHO chart No 2227 varied from Estonian National chart and did not cover the entrance to Muuga including the anchorage area in a user friendly way.
- Usage of outdated navigational maps, caused by publisher’s delay in updating their charts according to the national corrections available to them. Captain’s decision to agree with the local agency’s recommendation to use anchorage „I“ which is off lee shore instead of anchorage „K“ which the Captain had used on a previous visit to Muuga and would be safer choice with Northerly winds and large wind surface due to vessel’s ballast condition.
6 ACTIONS TAKEN DURING THE INVESTIGATION

6.1 By the company
At the time of publishing the safety investigation report no indications of actions taken were known to ESIB.

6.2 By EMA
EMA took contact with UKHO after the grounding of Kyeema Spirit to inquire about the corrections on UKHO chart 2227.

6.3 By UKHO
After an enquiry from EMA, on week 48 of 2012 UKHO gave out a correction of chart No 2227 which included the deletion of the cable in the middle of anchorage “I”.

No alterations on the area’s charts layouts have been made at the time of publishing this safety investigation report.
7 SAFETY RECOMMENDATIONS

Estonian Maritime Administration

1. Estonian Maritime Administration is recommended to consider changing the rules for anchorage area “I”. For anchoring in the anchorage “I” the prevailing weather conditions and forecast should be taken into account to avoid similar accidents with large wind surface vessels anchoring windward of the shallow areas.

2. Estonian Maritime Administration is recommended to propose to the UKHO BA Office to review the layouts of the UKHO BA charts 2227 and 2225 surrounding Muuga harbour area including the anchorage “I” in order for the navigating officers to get a better overview of the area than currently possible.

Estonian Safety Investigation Bureau, 2014

/signature/
Jens Haug
Director