Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Bundesoberbehörde im Geschäftsbereich des Bundesministeriums
für Verkehr, Bau und Stadtentwicklung

Investigation Report 465/05

15 October 2006

Serious marine casualty

Grounding of MV ILKA on 14 November 2005 over a Submarine Pipeline on the River Tay off Perth (UK)

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 16 June 2002.

According to this the sole objective of the investigation is to prevent future accidents and malfunctions. The investigation does not serve to ascertain fault, liability or claims.

The German text shall prevail in the interpretation of the Investigation Report.

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1 Summary of the marine casualty

On the voyage from Rostock to Perth in the United Kingdom, MV ILKA carrying a cargo of 1640 t wheat grounded twice on the River Tay. On 12 November 2005 at 11.20 h UTC[1] the laden vessel reached the inner anchorage of Buddon Ness on even keel with a read draft of 3.95 m. The voyage was continued the next day under pilot advice. At about 13.00 h the vessel grounded for the first time approx. 2 cables east of the submarine pipelines marked in the chart at Seggieden and was only able to continue the voyage with the next high tide in the night of 14 November 2005. The vessel managed to come free under her own power again, until shortly afterwards it grounded again on the eastern submarine pipeline at 01:36 h. After this the crew, apart from the Captain, were evacuated by way of precaution until it was certain that the accident did not involve any danger. With the assistance of a tug it was possible to pull ILKA free with the noon high tide and with a calculated under keel clearance of 0.25 m. ILKA was then able to continue her voyage with tug escort and arrived at her berth in Perth at 14.45 h.

[1] UTC Universal Time Coordinated. The times stated in the report all refer to UTC.

2 Scene of the accident

Nature of the incident:	Serious marine casualty
Date/time:	14.11.2005, 01:36 h
Location:	Seggieden
Latitude/longitude:	φ 56°22.5'N, λ 003°20.8'W

Excerpt from chart edition 228 2005, Federal Maritime and Hydrographic Agency

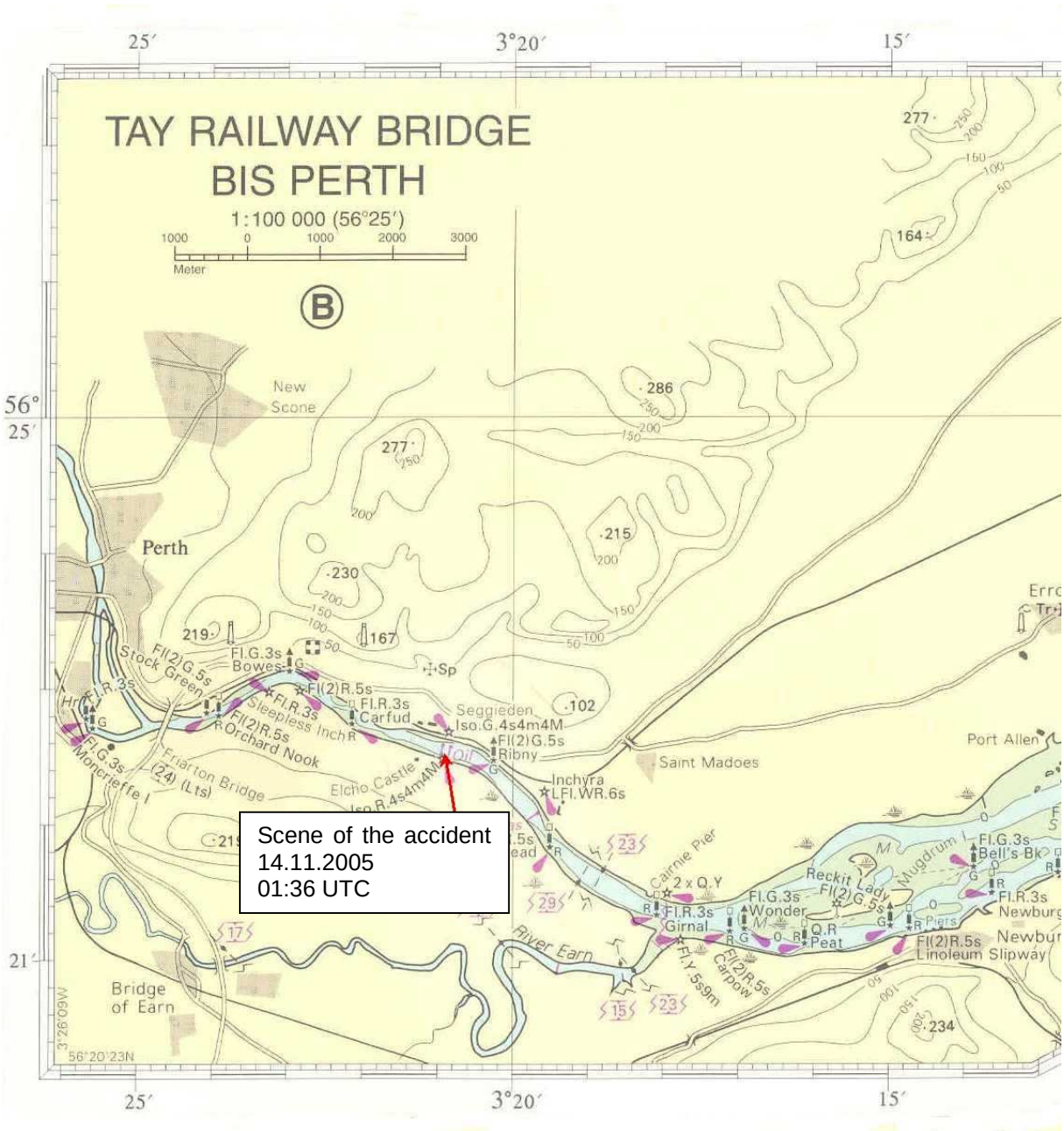


Figure 1: Chart

3 Vessel particulars

3.1 Photo

Figure 2: Photo of vessel

3.2 Particulars

Name of vessel:	ILKA
Type of vessel:	General cargo vessel
Nationality/flag:	Germany
Port of registry:	Husum
IMO number:	8504947
Call sign:	DIZZ
Vessel operator:	Thordsen MS ILKA GmbH & Co. KG
Year built:	1985
Building yard/building number:	Husumer Schiffswerft, 1498
Classification society:	Germanischer Lloyd
Length overall:	71.94 m
Width overall:	11.30 m
Gross tonnage:	1366
Deadweight:	1300 t
Draft at the time of the incident:	3.95 m
Engine rating:	588 kW
Main engine:	427 FOTK Aabenraa Motorfabrik
Speed:	10.00 kn
Hull material:	Steel
Hull design:	Double-bottom
Number of crew:	5

4 Course of the accident

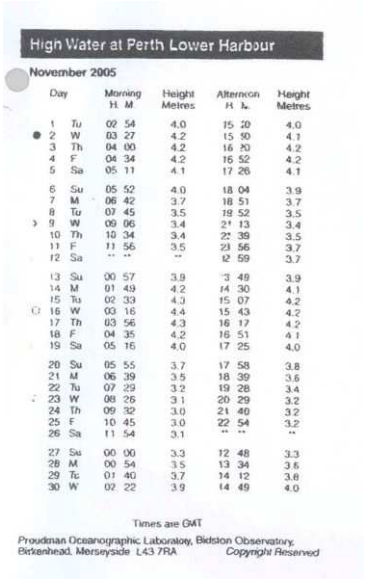
On 12 November 2005 at 11.20 h the vessel fully laden to the winter draft mark with a cargo of 1640 t wheat reached the inner anchorage of Buddon Ness on the River Tay and anchored. The draft read off at low water and at even keel was 3.95 m.

The vessel was expecting the pilot for the next day. According to the tide table from Proudman Oceanographic Laboratory (see Figure 3) used by the crew, high water for Perth was stated with 3.9 m at 13.49 h on 13 November 2005. At 10.25 h ILKA continued her voyage under pilot advice. The pilot changed off Dundee at 11.25 h. A port pilot with 30 years of professional experience took over the wheel and steered the vessel up-river. According to the statement by the pilot, there was an under keel clearance of approx. 0.25 m.

At about 13.00 h the vessel grounded for the first time approx. 2 cables east of the submarine pipeline shown in the chart at position 56°22.497'N 003°20.497'W. Repeated attempts to free the vessel under its own power were unsuccessful. The pilot thereupon left the vessel. According to the tide table, the next high water was predicted with 4.2 m for 01.49 h on 14. November 2005.

At 00.25 h on 14 November 2005 the pilot was back on board. The wind was blowing from a westerly direction with a force of 4-5 Bft and the air pressure read off was 1031 hPa. At 00.55 h the vessel succeeded in freeing itself under its own power. At about 01.36 h the vessel grounded again off Seggieden (see Figure 2) and was lying on the easterly submarine pipeline that runs 3 m below the sea bottom. In response to instructions by the port authorities of Perth, the vessel's crew then had to be evacuated, apart from the Captain.

After no evident damage was found to the vessel and the submarine pipeline, the crew and pilot were able to return on board at about 12.45 h. At 13.00 h the tug COLLIT arrived. It had been ordered by the P&I Club. After it was not possible for the vessel to get afloat under its own power, the tug made fast aft at 13.37 h and towed the vessel. After this ILKA came free and was able to continue her voyage to Perth with tug escort, arriving at her berth there at 14.45 h on 14 November 2005 with a read draft of 3.96 m (even keel).



High Water at Perth Lower Harbour

November 2005

Day		Morning H. M.	Height Metres	Afternoon H. M.	Height Metres
1	Tu	02 54	4.0	15 28	4.0
2	W	03 27	4.2	15 50	4.1
3	Th	04 00	4.2	16 20	4.2
4	F	04 34	4.2	16 52	4.2
5	Sa	05 11	4.1	17 26	4.1
6	Su	05 52	4.0	18 04	3.9
7	M	06 42	3.7	18 51	3.7
8	Tu	07 45	3.5	19 52	3.5
9	W	09 06	3.4	21 13	3.4
10	Th	10 34	3.4	22 39	3.5
11	F	11 56	3.5	23 56	3.7
12	Sa	** **	**	12 59	3.7
13	Su	00 57	3.9	13 49	3.9
14	M	01 49	4.2	14 30	4.1
15	Tu	02 33	4.3	15 07	4.2
16	W	03 16	4.4	15 43	4.2
17	Th	03 56	4.3	16 17	4.2
18	F	04 35	4.2	16 51	4.1
19	Sa	05 16	4.0	17 25	4.0
20	Su	05 55	3.7	17 58	3.8
21	M	06 39	3.5	18 39	3.6
22	Tu	07 29	3.2	19 28	3.4
23	W	08 26	3.1	20 29	3.2
24	Th	09 32	3.0	21 40	3.2
25	F	10 45	3.0	22 54	3.2
26	Sa	11 54	3.1	** **	**
27	Su	00 00	3.3	12 48	3.3
28	M	00 54	3.5	13 34	3.6
29	Tu	01 40	3.7	14 12	3.8
30	W	02 22	3.9	14 49	4.0

Times are GMT

Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA

Figure 3: Tide table Proudman Oceanographic Laboratory

4.1 Survey by MCA (Maritime and Coastguard Agency) and GL (Germanischer Lloyd)

MCA came on board in Perth and conducted a Port State Control. The MCA did not ascertain any visible damage to the vessel structure or any deficiencies in the equipment. MCA simply referred to buckets of paint wrongly stowed in the cable tier and to a freezer chest stowed wrongly. A GL surveyor ascertained that the echo sounder was defective. Otherwise there was no apparent damage. After completing discharge work ILKA was able to leave the port again on 17 November 2005 without any conditions being imposed.

4.2 Pilot's report

During the river passage from Dundee to Perth on 13 November 2005 the gauges were read off and transmitted to ILKA every 15 minutes. At 13.15 h the gauge was 3.9 m. This reading should have led to an under keel clearance of 0.25 m and allowed the vessel to pass the submarine pipeline. Despite this, ILKA grounded for the first time approx. 2 cables east of the submarine pipeline in the fairway and was not able to get afloat under her own power. About 15 minutes after high water the manoeuvring attempts were discontinued. At 00.55 h the next day ILKA was able to get afloat again at a gauge of 3.90 m and continued her voyage up to the easterly submarine pipeline, where the vessel grounded again at a gauge of 3.92 m. The gauge then reached a maximum level of 3.94 m. At this gauge a. water depth of 4.20 m should have been expected.

4.3 Nautical publications

According to the sailing direction of BSH (Shb.), vessels up to 90 m length and 4.2 m draft can reach Perth at spring tide[2]. No maximum water depth for Perth is stated in the sailing direction. Water depth data in the sailing direction refer to the chart datum of the chart which in this case is the LAT[3] (BA 1481 Plan B).

The measurement in this area is based on a commercial survey conducted between 1986 and 1990, as can be seen from the source diagram. The chart signature shows a water depth range between 0 and 5 m near the submarine pipelines at Seggieden. The maximum draft stated under maximum vessel dimensions in the North Sea sailing direction, Western Part, BSH No. 2008, Edition 2003, Section C 2.1.5 relates to the publication of the United Kingdom Hydrographic Office NP 54, Sixth Edition 2003, Paragraph 3. This information was confirmed by telephone on 15.06.2006 and does not necessarily mean that a water depth justifying a draft of 4.2 m is maintained on the estuary up to the berth. It is to be interpreted to mean that these maximum dimensions depend on the local features prevailing at the time the vessel is proceeding along the estuary. When running into Perth as a river port, substantial attention is to be paid to the problems of sanding, sediment transport and surface water.

The fairway runs between extensive sand banks. The wide estuary of the River Tay ends 2 nm beyond Newburgh, where the River Earn opens. From there the partially winding course of the river can be navigated up to Perth. The water depths change and currently valid information should be obtained from the vessel traffic services. Pilots must be taken on board from the approach up to Dundee. Beyond Dundee the acceptance of a pilot is urgently recommended.

In the "Guide to Port Entry", the water densities in Dundee at MHWS[4] are given as 1015 and at MLWS[5] as 1010 and in Perth as equivalent to fresh water density.

The tide tables of the BSH show a high water level of 2.9 m at 13.42 h on 13 November 2005 (mid-tide)[6] and of 3.1 m for 01.44 h on 14 November 2005. According to the tide table published by Proudman Oceanographic Laboratory (see Figure 3), the high water level at 13.49 h on 13 November 2005 was predicted as 3.9 m, and at 01.49 h on 14 November 2005 as 4.2 m.

[2] At spring tide the average highest high water and at neap tide the average lowest high water occur.
[3] LAT Lowest Astronomical Tide
[4] MHWS Mean High Water Springs
[5] MLWS Mean Low Water Springs
[6] Mid-tide is the time in the middle between the spring tide and the neap tide or between neap tide and spring tide. The high water level is interpolated towards the more unfavourable value when drawn from the tide table.

4.4 Perth Harbour Inward and Outward Passage Plans

The Perth & Kinross Council has published a sailing plan with recommended courses and manoeuvring aids for the passage Dundee to Perth that should be observed in the estuary (see Figure 4). The estuary is described as difficult and risky. No depth data were provided in the plan. The tidal current in the area of the accident is given as +/- 0.5 to 0.6 kn. There is a reference to a shallow patch by the submarine pipeline that is not sketched in (see 4.4.1 and Figure 4).

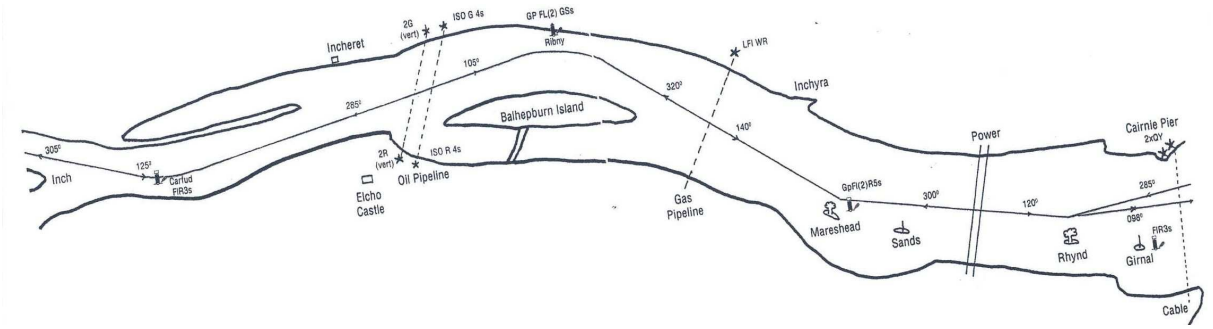


Figure 4: Excerpt Perth Harbour Passage Plan

4.4.1 Cairnie Pier to Sleepless Inch

Local Regulations and/or Information

1. There is a shallow patch underneath the electricity cables spanning the river. Height of cables is 24 m.

2. There are numerous small boat moorings off Inchyra.

3. There is a shallow patch at the oil pipeline.

4. At Incheret the river is relatively deep across its breadth. If for any reason it is decided not to continue inbound to Perth, vessels can be turned short round here.

Sailing Directions Inwards

1. At the Rhynd (submerged tree island) alter course to pass under the power lines in the middle of the spans, course 300°. Slow down for the shallow patch at the power lines.

2. From the power lines it is 5 miles to Perth. When clear can increase speed to half ahead. Adjust course leaving the Mareshead (Gp.Fl(2)R.5s) on the port bow.

3. At Mareshead alter course to keep to middle or 2/3rds across to the port side of the river, course 320°. Steer for the Ribny (Gp.Fl(2)G.5s) heading for deeper water on the north side of the river.

4. Alter course around bend to the west of the Ribny adjust course to pass over the pipeline centre to left of centre of river, Carfud (Fl.R.3s). Reduce to dead slow for passing over the pipeline.

5. When clear of pipeline increase speed. Alter course around the bend at Carfud continuing towards Sleepless Inch with Bowes (Fl.G.3s) fine on the port bow adjust courses keeping initially to the left of centre of the river.

Tidal Streams

Flood and ebb tide effect follows the river channel. Ebb rates +/- 0.6 knts. Flood rates +/- 0.5 knts.

5 Investigation

5.1 Survey of ILKA in Husum

On 28 November 2005 BSU inspected ILKA in the dock at HDR[7] Husum. The course of the accident was described again and documents were secured.

ILKA has amongst others the following navigational equipment on the bridge (see Figure 5).

Figure 5: Bridge ILKA

ECS Transas Navisailor 2400 BSH 6579/080188/00
Radar system Bridgemaster IIB BSH 29/01647/92 and Furuno 1510 M2 IIB BSH 23/01/1805/96
Echo sounder Furuno FE 700
GPS Shipmate RS 5400 BSH 150/08251/96
Gyro-compass system Standard 12 Raytheon
Automatic pilot 02-840 Raytheon

In the course of the inspection of the hull, BSU ascertained denting at the forward port side behind the bow thruster canal that was already marked with chalk (see Figure 6). Approx. 3m² plating is to be replaced here. Slight denting and bending was visible aft at the propeller and rudder (see Figure 7). The blades of the variable pitch

[7] HDR Husumer Dock und Reparatur GmbH & Co KG

propeller could be moved slightly by hand. A piece of fishing net was lying on the ground – it had become caught in the propeller. The damage aft is probably not attributable to the accident. In the estimation of the vessel operator the total costs can be quantified at approx. € 120,000.--. This reportedly includes tug costs of GBP 40,000.

Figure 6: Bottom damage ILKA

Figure 7: Rudder and propeller ILKA

5.2 Evaluation of the electronic chart

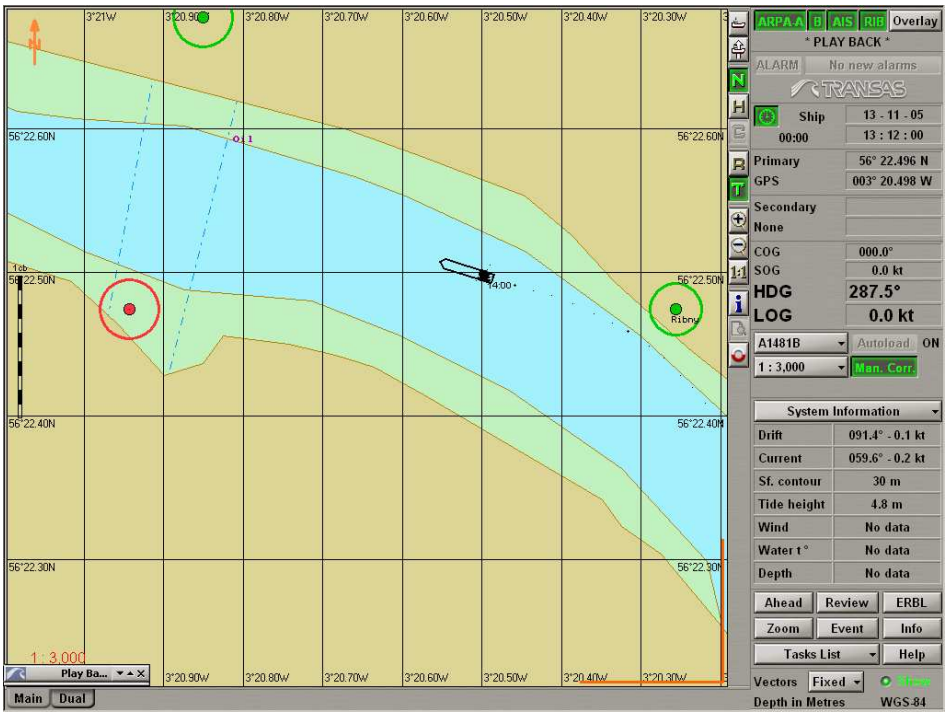


Figure 8: Grounding on 13 November 2005

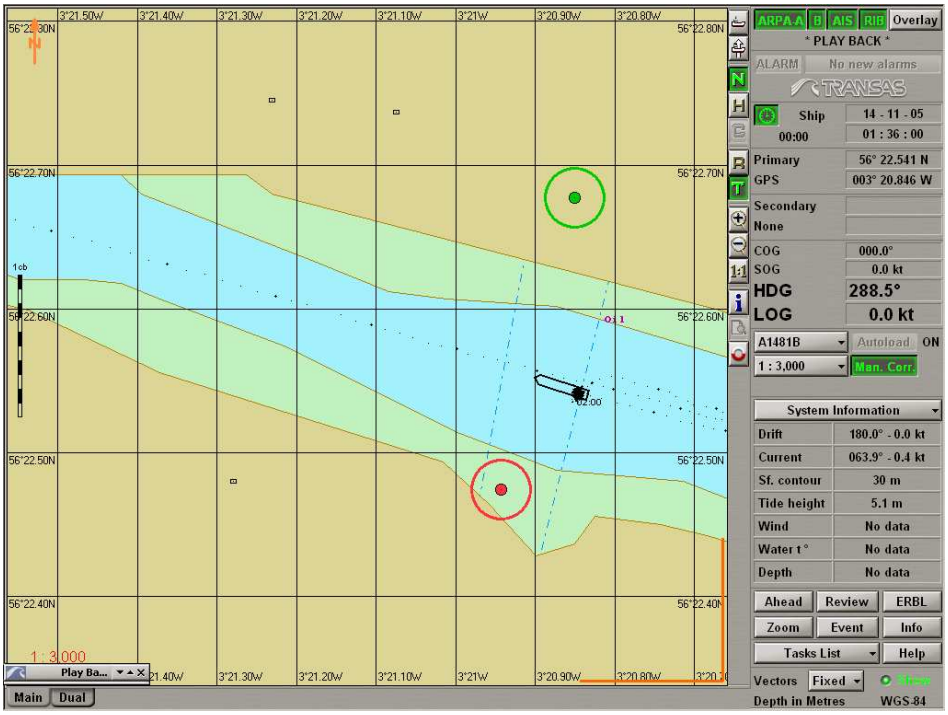


Figure 9: Grounding on 14 November 2005

The data of the electronic chart of type ECS Transas Navisailor 2400 provide a very generalised picture of the topography by comparison with the Perth Harbour Inward and Outward Passage Plan and chart BSH No. 228. According to this, the track followed by ILKA was in line with the recommendations of the Perth & Kinross Council in the Inward and Outward Passage Plan. The data stored by the ECS are visualised in Figures 8 and 9 and document the double grounding of ILKA.

5.3 Port authorities

At the beginning of the year the Perth & Kinross Council ordered dredging work to be carried out in the upper part of the River Tay in order to eliminate accumulations in the river bed. After this, the tide height at the scenes of both incidents should have been sufficient to allow the passage of ILKA, according to the documents. After the incident, the port authorities initially reduced the maximum admissible draft by 0.2 m because soundings in the area of the pipeline revealed that less water than officially published was available. In the course of time further surveys are to be conducted in order to take further measures if necessary.

5.4 Weather expertise

On 30.11.2005 BSU commissioned Germany's National Meteorological Service (DWD) to analyse the weather and wind conditions prevailing on the River Tay near Perth in Scotland at about 13.00 h UTC on 13.11.2005 and at 01.36 h UTC on 14.11.2005.

Thanks to international exchange of weather data, Germany's National Meteorological Service (DWD) has hourly measurements and observation values from shore, coastal and island stations available for the area to be assessed and for the requested time period. The satellite photos published by the Institute of Meteorology of the Free University (FU) Berlin were also used for the assessment. In addition to analysing the available measuring and observation data in the area to be of interest, a scientific analysis of the large-scale weather situation and its development was carried out. This forms an essential basis for drawing up the expert opinion.

Scotland and thus also the Firth of Tay and the River Tay were under the influence of a pronounced western drift in mid-November 2005, with which troughs of low pressure from the Atlantic were steered eastwards in swift succession. The steering centre was a comprehensive and extensive area of high pressure north of the Azores with a core pressure of occasionally over 1040 hPa. A wedge of this high pressure area swivelled behind a retiring area of low pressure from the Shetlands over the Scottish eastern coast south-eastwards on 13 November 2005 and led to temporary calming of the weather here too. Already in the evening and night of 13 to

14 November 2005 a further disturbance followed swiftly from the west with rain and once again freshening SW winds.

In order to assess the weather and wind conditions it was possible to fall back on the measurements and observations of the nearby station Leuchars in addition to the large-scale weather situation. A westerly wind (280°) with a speed of 9 kn (Bft 3) without significant gusts was registered here at 13.00 h UTC on 13 November 2005. The clouds were very loose and visibility was 50 km. The air temperature reached almost 8° C and the atmospheric pressure was 1028 h Pa. At about 01.36 h UTC on 14 November 2005 the wind had already turned back to WSW and was much fresher. The mean wind speed was 20 kn (Bft 5) and 27 kn (Bft 6 to 7) was measured in gusts. No rain was falling yet, but the sky was almost overcast and visibility was still 35 km. At temperatures of 8° to 9° C the atmo spheric pressure was now only 1020 hPa and was falling steadily.

Taking into account the special geographic situation at the scene of the accident in the River Tay, under these wind conditions somewhat higher wind speeds can certainly be caused by local effects (jet, corner effect). This statement applies in particular for the time of the second incident in the night of 13 to 14 November 2005, for which gusts of strength 8 to 9 Bft cannot be ruled out. However no notable sea reportedly formed on the River Tay.

The sea conditions in the open North Sea off the Firth of Tay were initially characterised by a wind sea and swell going south on 13 November 2005. In the evening and in the night of 14 November 2005 the wind sea, whipped up by new low pressure, turned in a north-easterly direction with characteristic wave heights of 1 to 2 m.

On 13 November 2005 there was high pressure influence prevailing at the scene of the incident in the River Tay that was broken down quickly in the night of 13 to 14 November. At midday on 13 November the wind was blowing from the west at a force of 3 to 4 Bft. In the night of 13 to 14 November it turned to south-west, freshened and developed gusts. In the night of 13 to 14 November at about 01.30 h UTC gusts of strength 8 to 9 Bft. cannot be ruled out. During the subject period the air pressure dropped from initially 1028 hPa to 1020 hPa.

On the grounds of the weather conditions during the subject period the possibility that the tides in the River Tay were lower than usual cannot be ruled out. However, the Germany's National Meteorological Service (DWD) has no information available on this.

5.5 Expertise by the Federal Maritime and Hydrographic Agency (BSH)

With the wind conditions the local orography can cause jet and corner effects (see expertise by DWD on this).

This applies much more strongly for the current conditions, where the local topographic conditions of the river bed can have a strong influence on the direction and tide turning times of the current. These are not known here in the area of the pipeline so that it is not possible to comment on the current conditions at the scene.

What is much more critical for the course of the accident are the tide predictions used and the gauge data transmitted that led the Captain and the pilot to assume an under keel clearance of 0.25 m at a draft of 3.95 m.

An excerpt from the tide table of Proudman Oceanographic Laboratory (POL) is enclosed with the statement by the Captain and the pilot, in which a high water level 4.2 m is stated for 01.49 h UTC on 14.11.05.

Tide tables are offered by a variety of institutions. They are mainly based on a harmonic analysis and harmonic tide constants determined by this for some partial tides. In tidal rivers it is particularly important to use a large number of partial tides and associated tide constants and to regularly validate these with the aid of new series of soundings.

It is noteworthy that if the Admiralty Tide Tables and the BSH tide tables based on the same data are used, much lower high water levels are obtained for Perth. The high water level can be taken as follows from the first source named:

Noon high water on 13.11.2005 and night high water on 14.11.2005 in Perth according to the Admiralty Tide Tables (ATT) Vol 1:

- Time zone: UTC (Greenwich)
- Moon phase: mid-tide
- Height: high water
- Levels: above chart datum in metres
- Water depth in the chart: 0.0 to 5.0 m, a precise depth cannot be taken from the chart (INT 1543).

According to ATT Vol 1 S. xxxiii the chart datum in Perth is equivalent to the Ordnance Datum of the United Kingdom.

Table 1: Level of the tide according to the Admiralty Tide Table

13.11.2005					14.11.2005		
No	**Location**	**Time**	**Height**		**Location**	**Time**	**Height**
244	Aberdeen	11:19	4.1		Aberdeen	23:21	4.3
236b	Perth	+2 20	-1.1		Perth	+2 25	-1.1
236b	Perth	13:39	**3.0**		Perth	1:46	**3.2**

From the local British tide table 2005 (Proudman Oceanographic Laboratory):

- Time zone: UTC (Greenwich)
- Height: high water
- Levels: metres above gauge zero lower harbour, 1.1 m below chart datum

Table 2: Level of the tide according to the POL tide table

13.11.2005					14.11.2005		
No	**Location**	**Time**	**Height**		**Location**	**Time**	**Height**
236b	Perth	13:49	**3.9**		Perth	1:49	**4.2**

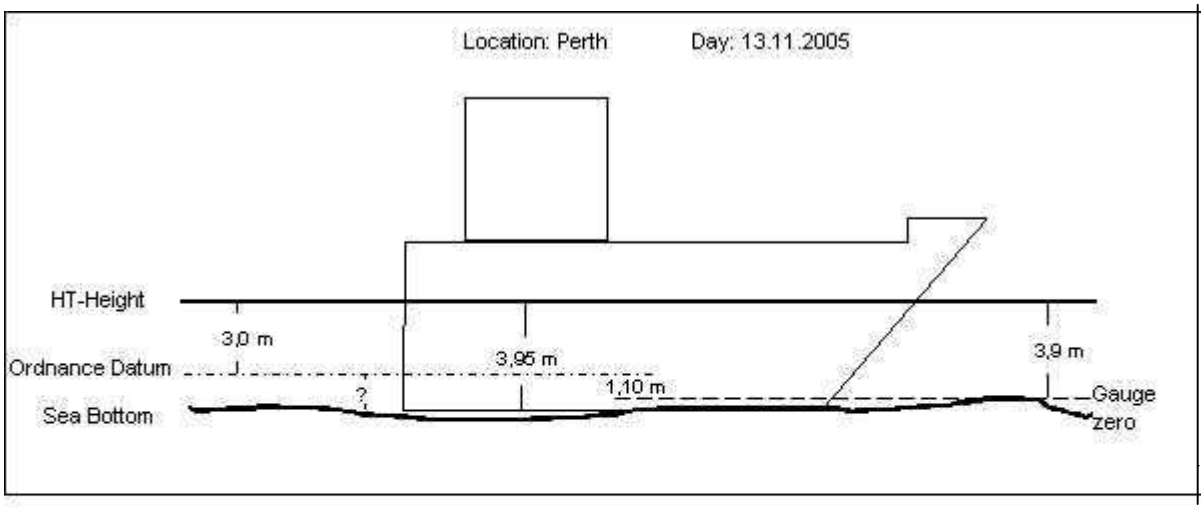
POL was enquired about the reference datum for these predictions in the table. The following information dated 11.05.06 was received:

"The datum of predictions for Perth Lower Harbour is to tide gauge 0 which is 1.10 metres below ODN."

This means that 1.10 m must be deducted from the values in Table 2 in order to obtain the height above chart datum.

ODN (Ordnance Datum Newlyn) = Chart Datum
Gauge zero = 1.10 m below ODN in the River Tay

The circumstances are summarised once again in the following sketch:



Water level conditions on 13.11.2005 according to Table 1 and Table 2.

5.6 Assessment Proudman Oceanographic Laboratory

Proudman Oceanographic Laboratory (POL) runs the UK National Tide Gauge Network and hosts the National Tidal and Sea Level Facility. It is the sole provider of tidal data to the UK Environment Agency and the Storm Tide Forecasting Service which issue all UK flood warnings.

All tide tables, irrespective of the organisation computing them, gives the height of the tide at a specific location and to a particular datum (the height which is defined as zero for that tide table). The data are computed based purely on astronomical forcing and local conditions such as sea depth, estuary and harbour topology. Meteorological effects such as onshore and offshore winds, variations in atmospheric pressure etc. are not included in any tide table.

When specifying the height of sea level, one must define what is taken as the zero for that measurement. For computed tide tables, the most common datums are Chart Datum (usually defined as being very close to the Lowest Astronomical Tide) or Ordnance Datum (a common datum used by a country and is the same horizontal level for all locations).

Occasionally, harbour masters ask POL to compute tide tables to a special datum for which they will provide the datum information – and POL will adjust the tide tables accordingly. This is often set to a local tide gauge zero (positioned at the sea bed) such that the values in the tide table give a representation of how much water is available when bringing ships into the harbour. Additionally, the name of the port on the tide table will be changed to reflect the new datum (gauge) used (for example, “lower harbour” or “dock sill” will be added to the port name).

When the data is adjusted to Chart Datum, the predictions are very similar to those computed by other organisations such as the UKHO.

POL has provided the harbour master at Perth with tidal data for Perth Lower Harbour since 1994 (the records only go back this far).

The datum for Perth Lower Harbour is 1.1 metres below chart datum for Perth – therefore the values for the tidal height will be shown as 1.1 metres larger when compared to a tide table computed to Chart Datum.

Perth is a secondary port based on the standard port Aberdeen. Tidal data for Aberdeen are based on an analysis of 6714 days of observed data starting in 1983 and based on 105 harmonic constituents. Secondary Port time and height differences for Perth are supplied by the UKHO.

During passage up the River Tay, MV ILKA grounded twice:

- 13-Nov-2005, 13:00h
- 14-Nov-2005, 01:36h

POL predicted tidal levels for these dates are:

Perth Lower Harbour / Times to UTC / Datum 1.1m below chart datum

13-Nov-2005	00:58 h	3.94 m	13:48 h	3.93 m
14-Nov-2005	01:48 h	4.16 m	14:31 h	4.08 m

In the Perth Tide Tables supplied to the Perth Harbour Master, the data is rounded to 1 decimal place as is the convention for all secondary port tide tables.

On 14-Nov-2005, 00:25 h, the air pressure was read off as 1031 hPa with offshore winds of force 4-5 Bft. Both of these factors would reduce the water level from that shown in a tide table. The atmospheric pressure of 1031 hPa alone would account for approximately 20 cm reduction in water level.

The height given in the tide table is for the exact point of high tide – any time either side of this will lead to less water, and therefore a reduced clearance below the keel. At the point the vessel grounded for the first time (13-Nov-2005 13:00 h), high water was predicted for 13:49 h. The tidal level 49 minutes before high water would have been approximately 13 cm lower than the level at the exact time of high water. The

time of the second grounding was very close to the time of high water and predicted water level would have only been about 1cm below the predicted level for time of high water.

This factors combined would account for a water level 33 cm lower than predicted for the 1st grounding and 21 cm for the second grounding. Thereby local effects (s. weather expertise) such as jet, corner effects for the River Tay, with gusts to strength 8 to 9 Bft, are not taken into consideration. Thus the sea level could have been reduced by even more.

To prevent a similar incident in future – namely ensuring a full understanding of the limitations of any tide table, making adjustments for meteorological conditions and time of passage relative to time of high water, and allowing sufficient clearance beneath the keel.

POL supports the decision by Perth Harbour to reduce the allowed draft from 4.2 m to 4.0 m in future, and also recommends that external factors such as atmospheric pressure, offshore winds and time of passage relative to high water is carefully considered, especially for ships with an under keel clearance close to the limit for travel up the River Tay.

6 Analysis

At the time of the survey at Husumer Werft by BSU, ILKA was in a soundly maintained condition apart from the accident damage. All the charts and sailing directions for the voyage from Rostock to Perth were on board. In addition to the compulsory navigation equipment, ILKA also had an electronic chart system.

The "Inward and Outward Passage Plan" published by Perth & Kinross Council and the tide table from Proudman Oceanographic Laboratory were used for the estuary trading to Perth. In addition, ILKA was running under pilot advice and was regularly given the current gauge data. According to these, a water depth of 4.2 m could be expected in the area of the pipeline or 2 cables east of the pipeline. In fact this water depth was not achieved. When ILKA grounded for the second time on the easterly submarine pipeline that runs 3 m below the sea bottom, the crew apart from the Captain were evacuated by way of precaution.

On the basis of this incident Perth Harbour Office reduced the allowed draft from 4.2 m by 0.2 m in future. Further measurements are to follow in order to be able to decide for the near future what measures are necessary to enable a safe passage for the draft allowed. The under keel clearance for the port authorities is still very tightly dimensioned. The predicted and accepted under keel clearance of ILKA was only 0.25 m. The charts have a relatively small scale of 1:100.000 beyond Dundee on the River Tay. No water depths are entered any more as of Flisk Pt. (approx. 11 sm below Perth). Nor does the detailed sailing plan of Perth & Kinross Council contain any soundings. The predictable water level thus corresponds to the high water level that can be taken from the tide tables.

The predictions in the tide tables of the BSH and the Admiralty Tide Tables (UK) differ considerably from those of Proudman Oceanographic Laboratory, UK. For 13. November the data predicted a high water level of 2.9 m at 13.42 h (BSH tide tables), while POL data showed a level of 3,9 m for 13.49. According to the gauge readings the POL tide data were initially plausible for the port of Perth with the allowed draft of 4.2 m at MHWS stated in the German and British sailing directions. However, it should have been noted that the tide levels of the data relate to the gauge and not to chart datum. A conversion to chart datum would have resulted in more or less the same tide level. On this basis, according to the voyage planning and the BSH nautical publications a water depth of 2.9 m should have been expected on 13 November 2005 at mid-tide. According to the DWD-weather and POL-expertise, however, on the grounds of the weather situation at the time under review it is not possible to rule out that the tides in the River Tay were lower than is normally the case. However, ILKA did not have any information on this.

In Perth it was ascertained that the echo sounder was defective. The damage might possibly be attributable to the ground contact. However, even an intact echo sounder would only have been helpful to a limited extent on the River Tay shortly before the grounding. According to the performance standards of the type approval[8] in the

[8] See performance standards for echo sounders, IMO decision A.224(VII)

shallow measuring range the echo sounder need only be able to show a measuring precision of +/- 1 m as of a water depth of 2 m below the transducer, so that the under keel clearance would not have been sufficient for a reliable measurement.

The Master of the ILKA had to rely solely on the locally read gauge data, the data in the nautical publications, and the experience of the port authorities and pilots in Perth. Despite this, the expected water depth of 4.2 m was not available. To what extent this risk and the relatively small under keel clearance of ILKA is accepted ultimately remains the decision of the port authorities, the vessel operator and the Master.

7 Safety recommendations

The Federal Maritime and Hydrographic Agency (BSH) as publisher of the German nautical publications is advised to check the data integrity with the tide predictions for plausibility and if appropriate to draw attention to any uncertainties in its data in the sailing directions, especially as regards entries of ships' drafts and water depths in tidal waters.

Vessel commands are advised at water level predictions not published by hydrographic offices to pay attention to vertical reference systems (zero levels) in the nautical publications used. The water depths in the German nautical publications of charts and sailing directions refer to chart datum. The chart datum generally varies from state to state and is taken over from foreign waters into the German charts. Furthermore attention must be paid to data of tide tables that heights of tides alone are not sufficient to calculate water levels but local meteorological effects like atmospheric pressure, offshore winds, jet and corner effects could be decisive for the actual water level. During calculation of sufficient under keel clearance in advance, morphology (variability) of the seabed, different densities of water and at least squat-effect have to be considered in particular cases.

8 Sources

- Survey on board by BSU on 28 November 2005 in the dock of HDR, Husum
- Schiffsmanagement Arp, Thordsen, Rautenberg GmbH & Co. KG, Husum
- ILKA crew
- Survey by Germanischer Lloyd

- Expertise/technical contributions
- Germany's National Meteorological Service (DWD) – Business Division Sea Shipping – (Seewetteramt) Hamburg
- Federal Maritime and Hydrographic Agency (BSH)
  Department of Water Level Predictions and Tidal Services, Hamburg,
  Department of Nautical Information Sailing directions
- Proudman Oceanographic Laboratory, UK

- Written statements/comments/records
- ILKA crew
- Pilots report
- MAIB Marine Accident Investigation Branch, Southampton
- MCA Maritime and Coastguard Agency, UK
- Germanischer Lloyd, UK
- Perth Harbour Office

- Charts, Sailing directions and vessel particulars
- BSH Hamburg

- Documents
- Logbook excerpts, ship's plans, ILKA equipment list
- Data of the Electronic Chart ECS Transas Navisailor 2400 ILKA
- Tide table Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA
- Perth Harbour Inward and Outward Passage Plans from the Port of Dundee to Perth Harbour, Perth & Kinross Council
- Guide to Port Entry, Shipping Guides Ltd, UK
- Lloyd‘s List, UK
- Photos BSU