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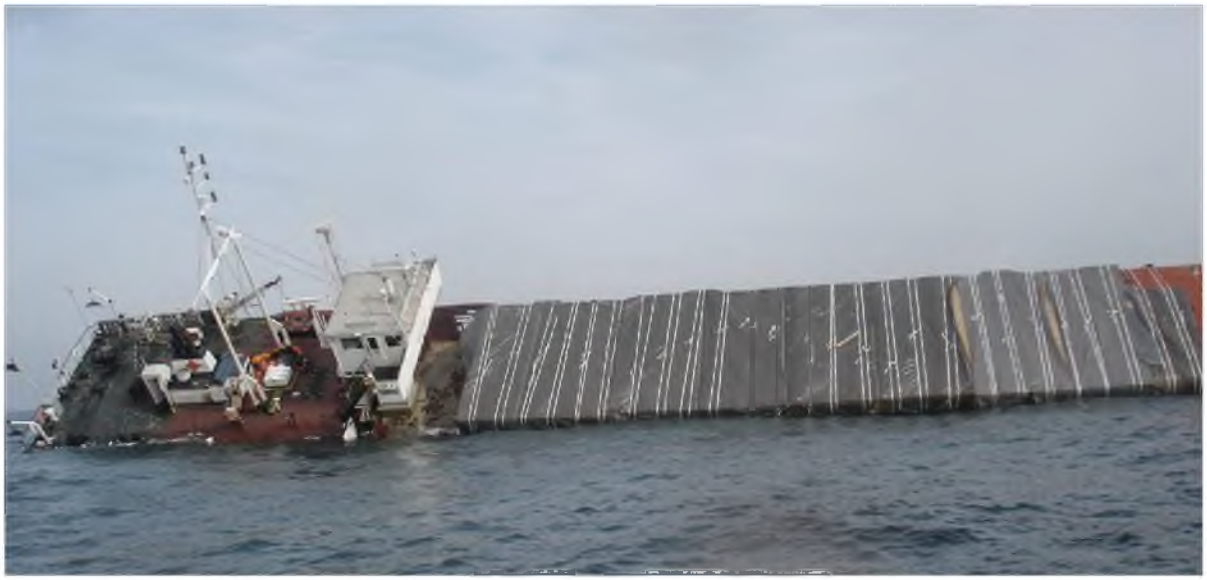
Aircraft, Maritime and Railway Accident Investigation Directorate
Maritime Accident Investigation Unit

FINAL REPORT

Investigation of very serious marine casualty – capsizing and sinking of *m/v „ELLAND"*

on 08.02.2014

2017



FOREWORD:

Extract from the Merchant Shipping Code:
"....Art. 79.

(1) The investigation of accidents in the maritime areas of the Republic of Bulgaria shall be carried out by a specialized unit in the Ministry of Transport, Information Technology and Communications.

(2) The specialized unit under para. 1 investigates accidents in order to help preventing them. The investigation shall identify the causes and circumstances of the particular accident occurrence without making any conclusions about guilt or the distribution of the guilt.

(6) The specialized unit under para. 1 performs safety investigations that are independent of criminal or other ones which aim to determine liability or guilt. Safety investigations cannot be prevented, suspended or delayed by such other investigations. "

Note: Investigation materials should not be used in litigation and/or settlement of trade disputes, and the specialized unit, respectively the Ministry of Transport, Information Technology and Communications, cannot be a part to or involved in such proceedings and disputes.

All times stated are local time(UTC +2 hours).

CONTENTS:

USED TERMS AND ABBREVIATIONS

s/b	Starboard side
p	Portside
m/v	Motor vessel
MAIU	Maritime Accident Investigation Unit
p.c.	Point with coordinates
E	East
IMO	International Maritime Organisation
m/s	Meters per second
N	Nord
nm	Nautical miles
Port State Control	Vessel inspection by port authorities upon the Paris MoU
SE	South-East
BN	Beaufort number from Beaufort wind force and wave height scale

SUMMARY

At 1430 on 07.02.2014 *m/v "ELLAND"* left the port of Constanţa, Romania, with a course to the port of Izmir, Turkey, loaded with about 1 784 tons of wooden boards, allocated in the hold and on the deck. By 1600 on the same day, entering the territorial sea of the Republic of Bulgaria, the ship unexpectedly received a10° list to the portside.

The big list interrupted the cooling and lubrication of the diesel generator and it stopped working. The main engine stopped too. The ship remained without steerability, drifting, with a list to the portside. The crew tried to decrease the list by filling a starboard ballast tank by an emergency fire pump. The heel was reduced to 2-3° to port. The anchor had been dropped out. Unsuccessful attempts had been made for one hour to start up the diesel generator when the ship listed to starboard side. The heel reached 20° to starboard side and was increasing. The subsequent attempts to restore survivability were unsuccessful, and by 2100 the captain ordered a muster on the boat deck to the crew and a readiness to abandon the ship. Contact with the ship management was established. Two Turkish ships, as well as a Bulgarian border police cutter, approached *m/v"ELLAND"*. The crew was transferred to *m/v "M. IZMIR"*, after which all were transported to the port of Varna.

On 08.02.2014, attempts were made to rescue the ship in disaster by means of the tug *"ELIZA"*. Salvation was not possible due to the steadily increasing heel of the ship. The heel of *m/v "ELLAND"* reached 45° to the starboard side and at 1635 on 08.02.2014 the ship capsized and sinked at the place, where it was anchored in p.c. 43°43',5 N; 028°45',5 E, about 7 nm east of Cape Sivriburun, at a depth of 50 m.

The investigation of the accident started in the territory of the port of Varna, with the taking of witnesses of the captain and the crew. Only ship's logbook was saved from the ship's documents. Information about ship loading was received from Constantsa port, Romania. No saved ship drawings. There was no underwater survey of the sunken ship. Investigators did not receive documents from the last class repair of the ship in 2013 at the ship repair yard in Tuzla, Istanbul.

As a result of the analysis of the collected evidence, the investigation Commission came to the conclusion that the main cause of the accident was the substandard condition of the ship, which had led to its disturbed stability. A contributing cause for the ship' capsizing and sinking were the nonprofessional actions of the crew, whilst loading and ballasting the ship, as well as to the struggle for survivability - to its straightening and restoration of the electrical power supply.

The Constanţa port authorities did not sanctioned the temporary loss of ship' stability when, during the loading of timber on deck, it received a 10° static list at the quay. No account had been taken to the formally calculated stability estimates and the ship was allowed to leave Constanţa port with initial stability impaired.

1. FACTUAL INFORMATION

1.1. VESSEL'S DATA	
Name	*Elland* from 10.2013 (former names: *Ulusland 1*, *Susa*, *Lumar*, *Eleonore*, *Altamira*, *Bottensee*)
Flag/nationality	Saint Kits and Nevis (in effect from 30.10.2013)
IMO №	8111788
Shipowner	Elland Shipping Co. Ltd.(from 30.10.2013), IMO № 8111788
Port of registration	Basseterre, St. Kitts & Nevis
Group Shipowner, Manager and operator	Albros Shipping & Trading Ltd.(from 01.12.2004), IMO 1959999
Classification authority	International Register of Shipping (from10.2013)
Insurer	Allianz Moscow
Type	General cargo ship
Date of built	1982
Shipyard	Jansen Schiffswerft – Leer, Germany
Gross tonnage:	1 988 t
Deadweight	2 864 m.t.
Length (max)	87,58 m
Width (max)	11,30 m
Board height (max)	6,53 m
Maximal winter draft	5,185 m
Displacement (max)	3 884 t
Main engine	MWM/TBD-440-8K; 441 kW at 700 rpm
Diesel generator	MWM type TD232V08 – 3 x 140 kW – 1500 rpm
Rescue boats	1– port side

1.2. VOAGE INFORMATION	
Last visited ports	Giresun, Turkey 07.01.2014 Novorossiysk, RussianFederation 28.01.2014 Constanţa, Romania 07.02.2014
Sail port	Constanţa, Romania
Destination	Izmir, Turkey
Type of voage	International
Load information	1783.809 t wooden slabs, in the hold and on the deck
Crew	11 persons, international – 5 Turkish, 5 Georgians, 1 Indian

1.3. INFORMATION ABOUT THE MARINE ACCIDENT	
Date and time	08 February 2014, 16:35 h
Type of accident	Very serious marine casualty– loss of stability and sinking
Position and coordinates	43°43,5N; 028°45,5E, Black sea, West area, Territorial sea of the Republic of Bulgaria
Voyage section	Transit
Weather conditions	Wind - 2.1 m/s, from 140° SE; temperature: 5,9 °C, waves: 2 BN
Injured crew members	None
Consequences for the ship and load	Total loss of ship and load
Consequences for the enviromental	Possible pollution of a part of the Bulgarian or Romanian coast due to spill of 10 t light diesel fuel oil

Fig. 1. ***m/v "ELLAND"***

2. DESCRIPTION

2.1. GENERAL INFORMATION.

The *m/v "ELLAND"* is a general cargo ship with a single cargo hold. The ship was built more than 30 years ago. He had changed its name 6 times, its flag 8 times and owner 5 times. The captain of the ship, a 52 years old Turkish citizen, had taken the command of the ship 2.5 months before the accident. He had a certificate of competence, issued by the Panama Maritime Authority from 22.06.2010.

2.2. ARRIVAL IN CONSTANTA PORT.

M/v "ELLAND" arrived in Constanţa -port of Agigea, on 02.02.2014 from Novorossiysk, Russia, from where it had sailed on 28.01.2014. The cargo of the ship – 2 326,530 m.t metal ingots "Hot Rolled Blooms" (a total of 414 pieces) wad unloaded on quay № 116. Each metal ingot is about 6 meters long and weighs 5.62 tonnes, up to 7 metal bars in connection. There was reason to assume that the load had contributed to the degradation of the strength of the floor of the hold - the double bottom, but a deliberate survey was not carried out.

2.3. INSPECTION FROM MARITIME ADMINISTRATION.

On the day of its arrival in Constanţa, 02.02, 2014, the ship was detained following a Port State Control by the Romanian Maritime Administration in Constanţa. 25 remarks were found, six of which were grounds for detention. Inspected objects: bridge; living quarters and kitchen; steering gear compartment; engine room; deck and forecastle. The load compartment (hold) and ballast tanks were not inspected. A second inspection was carried out on 07.02.2014, by the Romanian Maritime Administration after which the ship was released from detention. The six remarks, grounds for detention, were rectified.

2.4. LOADING IN CONSTANTA.

At 1530 on 05.02.2014 the ship was moved for loading of timber on quay 37 in the port of Constanţa. The loading commenced at 1900 on 05.02.2014.

Fig. 2. Stages of loading and consolidation of the cargo in the hold.

By 0400 on 07.02.2014 the loading in the hold finished and the hatch was closed. The loading continued on the deck(over the hatch), until 0500 on 07.02.2014, when it was stopped, due to the listing of the ship at about 10° to its portside. A big number of the crew in panic escaped from the ship. The captain remained on board to receive ballast in the starboard ballast tanks to straighten the ship. At 0830 the ballast operations were completed. Neither the agent nor the stifador company reported to the port authorities about the ship's list. Loading continued without any clarifiing of the reason for the ship's list. The ship's cargo operations ended at 1200 on 07.02.2014. At 1315 on 07.02.2014 the port authorities issued a permit for sailing.

Fig. 3. Consolidation of the load on deck.

1.1. LOSS OF STABILITY.

At 1430 on 07.02.2014 *m/v "ELLAND"* sailed to port of Izmir, Turkey, loaded as follows: 1649,809 tons “Oriented Strad Board” in 1 029 packs in the cargo hold, and 134 tons “Oriented Strad Board" in 89 packs on the deck (**Fig. 4**).

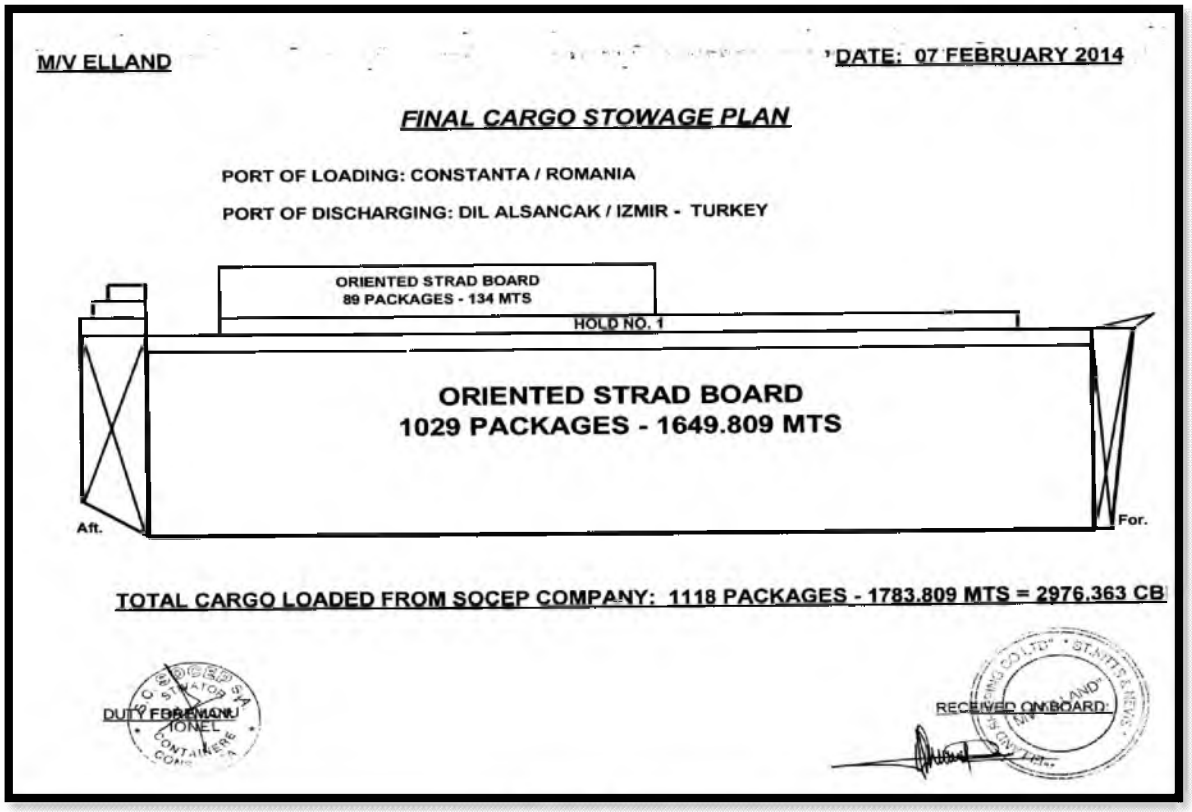


Fig .4 Cargo plan

The ship headed with a course of 174° to Bosphorus. Wind - southeast, 3-4 BN from portside, course angle around 40° port side; sea state: 2 BN, good visibility - 6 nm. At 1600, the captain handed over the watch to the chief officer and retired to rest.

Around 1900, the captain was awakened and summoned to the bridge. He found that the ship had a list to port side - 10.5° on the inclinometer, for no apparent reason. The chief officer reported that the ship had listed a few minutes earlier. "Black out" followed – electrical supply power cut due to diesel generator shutdown (lack of cooling and lubrication), which caused the main engine to stop. The ship remained unsteerable, drifting, with a list to port side.

During the survey of the internal compartments, a presence of water was found in the hold, about 1 m deep, in the area of the bilge water well № 5 to the portside. The water was believed to had penetrated through cracks in the hold's floor in the area of tank 5. Water up to one meter high was also found in the cofferdam between the hold and the engine room.

The captain went to the forecastle, started the emergency fire moto-pump and began taking ballast in the starboard wing ballast tank № 6, nearest to the bow. 20 minutes later the heel decreased to 2-3° to the portside. The anchor was dropped out - 7 anchor chain keys, in position: latitude 43°43',69 N and longitude 028°45',55 E (**Fig. 5**).

The crew had made unsuccessful attempts for an hour to start up the diesel generators into the engine room. During this time, the ship began to heel to the right and at 2030 the list reached 20° the the s/b side and was increasing (**Fig. 6**).

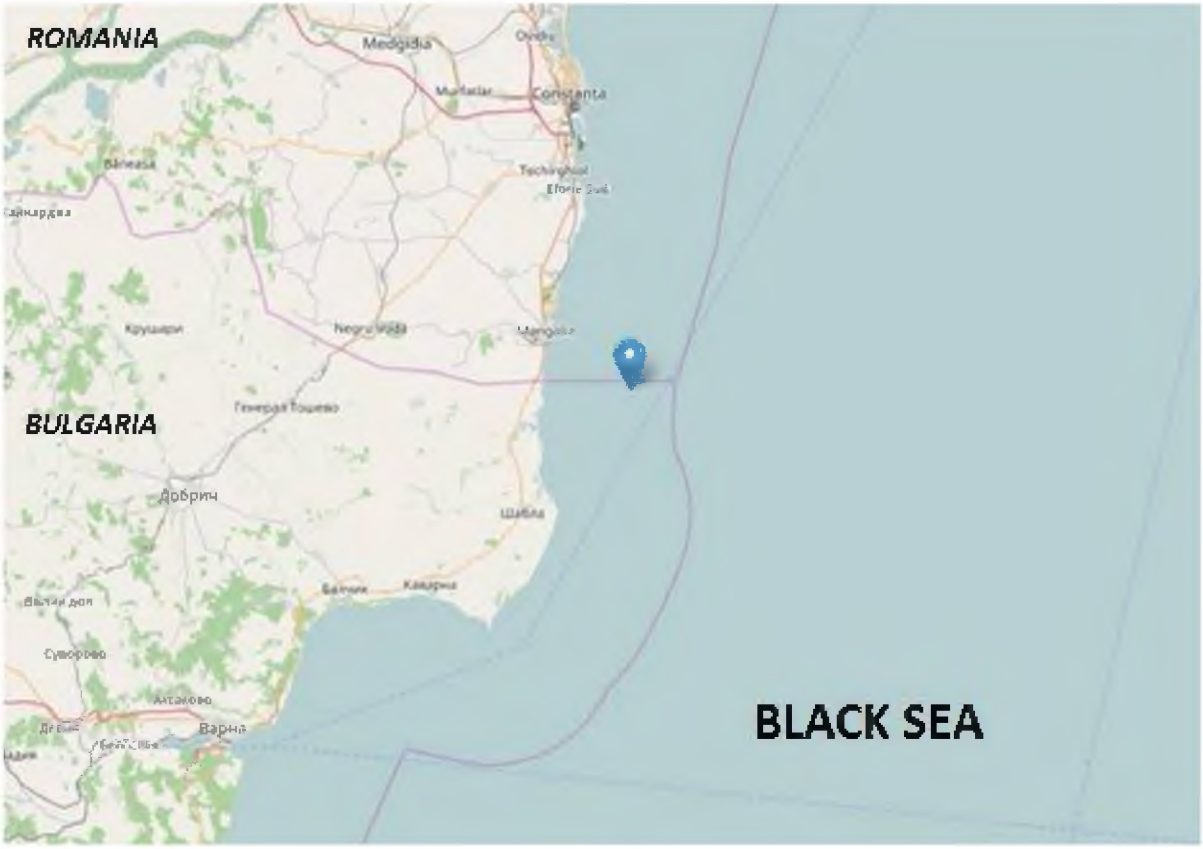


Fig. 5. Ship's position at the time of the accident.

The captain made a contact with the shipping company "Bora Shipping" and two Turkish ships –*m/v "OSMAN EKSIOGLU"* and *m/v "M. IZMIR"* approached to the listed *m/v "ELLAND"*. At 21:00, the captain ordered a muster on the boat deck to the crew and a readiness to abandon the ship. Three rescue life rafts were prepared for abandoning the ship, but the crew decided not to use them.

Fig. 6 The listed *m/v ELLAND*

Instead, the captain asked the captain of *m/v "M. IZMIR"* to send a lifeboat. *M/v "M. IZMIR"* sent a rescue boat to portside of *m/v"ELLAND"*. From 0500 to 0515 on 08.02.2014 the crew left the *m/v "ELLAND"* and boarded the lifeboat of *m/v "M. IZMIR* ".

The ship remained anchored with a big heel to s/b side - over 20°, constantly increasing. At 0615 the lifeboat of *m/v "M. IZMIR"* stood on its side. At 0630 the entire crew of *m/v "ELLAND"* was evacuated to *m/v "M IZMIR "*. From the ship's documents, the captain saved only the logbook. The crew of *m/v ELLAND* was transferred to the rescue boat *"VYARA"* of the Directorate of Maritime Administration –Varna, and was transported to the port of Varna. The captain was transported to the port of Varna by the motor tug *"ELITZA"*.

2.6. ATTEMPTS AT SAVING THE VESSEL.

"Bora Shiping" hired "Bon Marin Ltd" as their agent in Varna. The captain of *m/v "ELLAND"* was transferred to the motor tug "ELITZA", owned by "Bon Marine International"AD, and on 08.02.2014 concluded a contract for the rescue of the ship in disaster. The salvage operation was not possible due to the constantly increasing list of *m/v "ELLAND"*. At 1355 the list was already about 45° to the s/b side. An overboard water began to enter the ship through the ventilation ducts of the tanks and through the hatch cover of the holds, leading to loss of buoyancy.

At 1635 on 08.02.2014 *m/v "ELLAND"* capsized and sank at the point where it was anchored, with coordinates 43°43',5 N; 028°45',5 E. (**Fig. 7**)

Fig. 7 Sinking of "ELLAND"

2. ANALYSIS.

The cause for the capsizing of *m/v"ELLAND"* was an impaired stability. Possible reasons for loss of stability of the ship could be: cargo shifting; insufficient initial stability; an additional list created by overflowing ballast water through broken partitions of ballast tanks and inadequate crew actions.

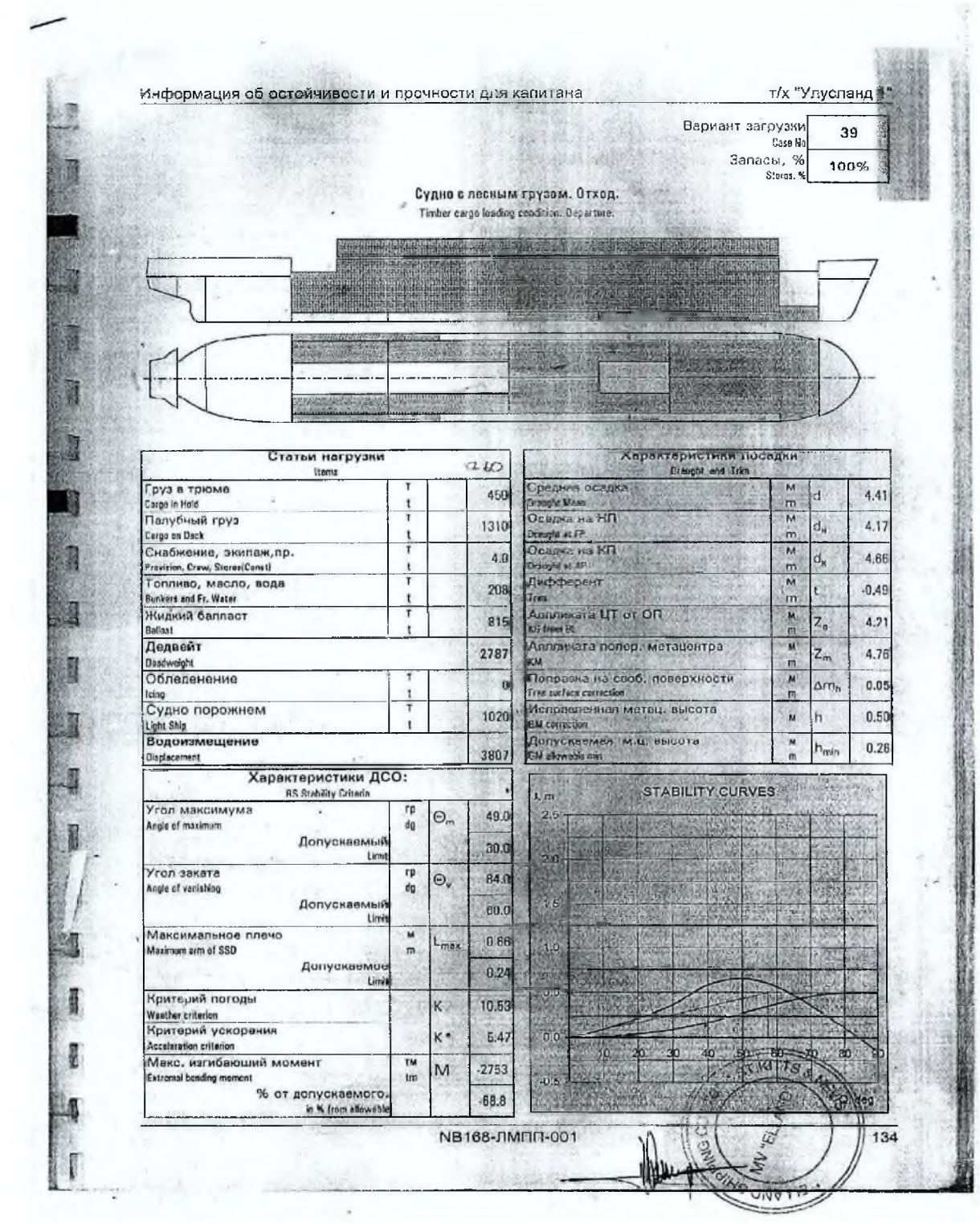
2.1. SHIFTING OF THE LOAD.

The cargo loaded in the cargo hold was perfectly arranged and fortified, as it was evident from **Fig. 2**. The cargo loaded on the deck was also well arranged and fortified as shown in **Fig. 3** and particularly in **Fig. 6,** when the ship was already abandoned by the crew, and its s/b side was in the water. Therefore, the ship had not received any additional list moment by a load shifting. Load shifting was not a cause for the capsizing and sinking of *m/v "ELLAND"*.

2.2. INSUFFICIENT INITIAL STABILITY.

2.2.1. LOAD:

The ship was loaded according to “Types of load” by Russian publications: „Информация об остойчивости и прочности для капитана“, „Вариант загрузки 39“ – „Судно с лесным грузом. Отход.“ The same “Types of load №39” was certified by the captain with a signature and a stamp and handed over to the port authorities in Constanta at the outgoing control (**Fig. 8.1** and **8.2**).



Информация об остойчивости и прочности для капитана — т/х "Улусланд"

Вариант загрузки (Case No): 39

Запасы, % (Stores, %): 100%

Судно с лесным грузом. Отход.

Timber cargo loading condition. Departure.

Статьи нагрузки (Items)			
Груз в трюме (Cargo in Hold)	T t		450
Палубный груз (Cargo on Deck)	T t		1310
Снабжение, экипаж,пр. (Provision, Crew, Stores(Const))	T t		4.0
Топливо, масло, вода (Bunkers and Fr. Water	T t		208
Жидкий балласт (Ballast	T t		815
Дедвейт (Deadweight			2787
Обледенение (Icing	T t		0
Судно порожнем (Light Ship	T t		1020
Водоизмещение (Displacement			3807

Характеристики посадки (Draught and Trim)			
Средняя осадка (Draught Mean)	M m	d	4.41
Осадка на НП (Draught at FP)	M m	d_H	4.17
Осадка на КП (Draught at AP)	M m	d_K	4.66
Дифферент (Trim)	M m	t	-0.49
Аппликата ЦТ от ОП (KG from BL)	M m	Z_g	4.21
Аппликата полер. метацентра (KM)	M m	Z_m	4.76
Поправка на сооб. поверхности (Free surface correction)	M m	Δm_h	0.05
Исправленная метац. высота (GM correction)	M	h	0.50
Допускаемая м.ц. высота (GM allowable min)	M m	h_{min}	0.26

Характеристики ДСО: (RS Stability Criteria)			
Угол максимума (Angle of maximum)	гр dg	Θ_m	49.0
Допускаемый (Limit)			30.0
Угол заката (Angle of vanishing)	гр dg	Θ_v	84.0
Допускаемый (Limit)			60.0
Максимальное плечо (Maximum arm of SSD)	M m	L_{max}	0.66
Допускаемое (Limit)			0.24
Критерий погоды (Weather criterion)		K	10.53
Критерий ускорения (Acceleration criterion)		K*	5.47
Макс. изгибающий момент (External bending moment)	тм tm	M	-2753
% от допускаемого (in % from allowable)			68.8

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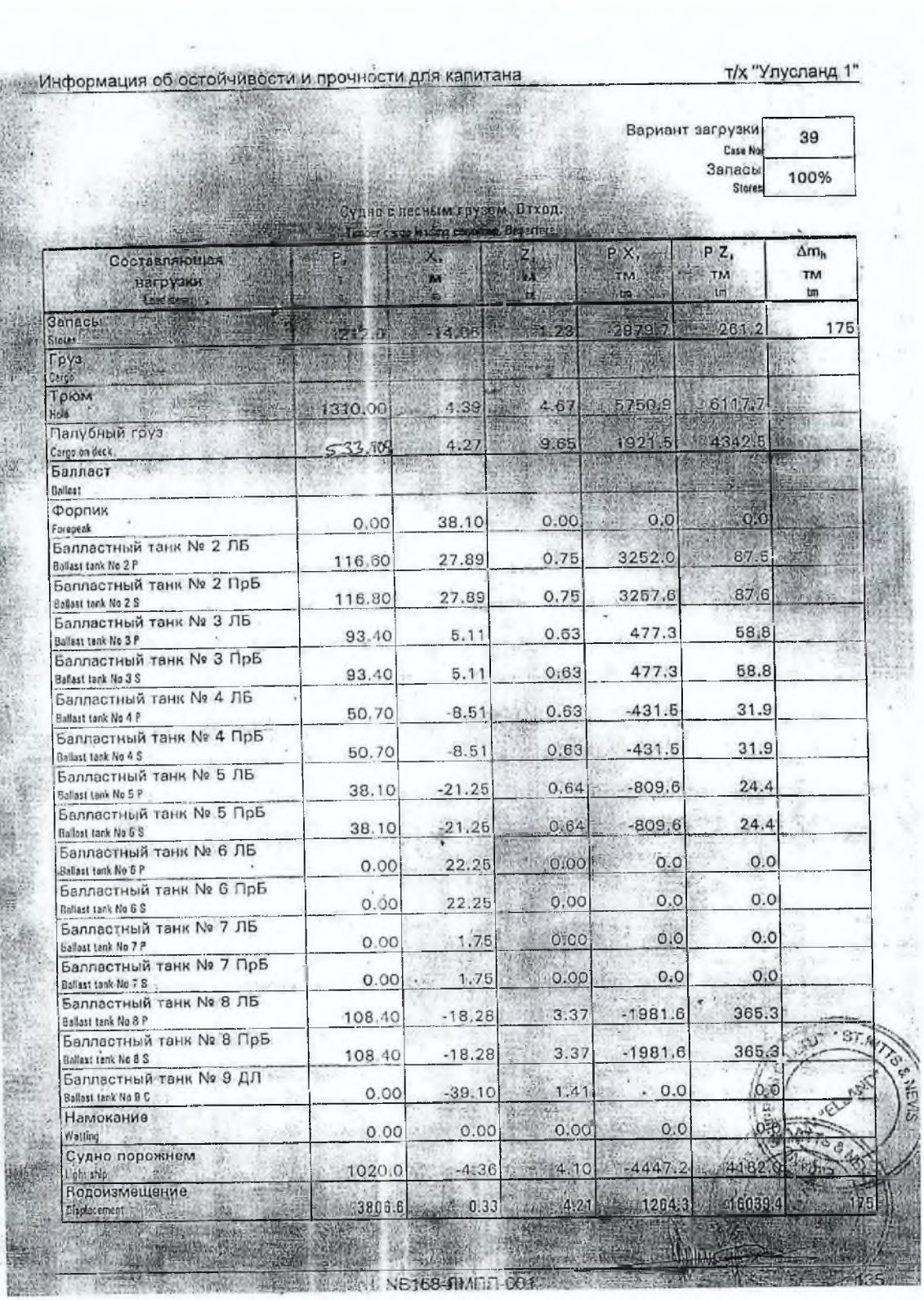
Fig. 8.1. Types of load № 39 (1)



Информация об остойчивости и прочности для капитана т/х "Улусланд 1"

Вариант загрузки Case No. 39

Запасы Stores 100%

Судно с лесным грузом. Отход.

Составляющая загрузки Load items	P_i т t	X_i м m	Z_i м m	$P_i X_i$ тм tm	$P_i Z_i$ тм tm	Δm_h тм tm
Запасы Stores	121.0	-14.06	1.23	-2879.7	261.2	175
Груз Cargo						
Трюм Hold	1310.00	4.39	4.67	5750.9	6117.7	
Палубный груз Cargo on deck	33.10	4.27	9.65	1921.5	4342.5	
Балласт Ballast						
Форпик Forepeak	0.00	38.10	0.00	0.0	0.0	
Балластный танк № 2 ЛБ Ballast tank No 2 P	116.60	27.89	0.75	3252.0	87.5	
Балластный танк № 2 ПрБ Ballast tank No 2 S	116.80	27.89	0.75	3257.6	87.6	
Балластный танк № 3 ЛБ Ballast tank No 3 P	93.40	5.11	0.63	477.3	58.8	
Балластный танк № 3 ПрБ Ballast tank No 3 S	93.40	5.11	0.63	477.3	58.8	
Балластный танк № 4 ЛБ Ballast tank No 4 P	50.70	-8.51	0.63	-431.5	31.9	
Балластный танк № 4 ПрБ Ballast tank No 4 S	50.70	-8.51	0.63	-431.5	31.9	
Балластный танк № 5 ЛБ Ballast tank No 5 P	38.10	-21.25	0.64	-809.6	24.4	
Балластный танк № 5 ПрБ Ballast tank No 5 S	38.10	-21.25	0.64	-809.6	24.4	
Балластный танк № 6 ЛБ Ballast tank No 6 P	0.00	22.25	0.00	0.0	0.0	
Балластный танк № 6 ПрБ Ballast tank No 6 S	0.00	22.25	0.00	0.0	0.0	
Балластный танк № 7 ЛБ Ballast tank No 7 P	0.00	1.75	0.00	0.0	0.0	
Балластный танк № 7 ПрБ Ballast tank No 7 S	0.00	1.75	0.00	0.0	0.0	
Балластный танк № 8 ЛБ Ballast tank No 8 P	108.40	-18.28	3.37	-1981.6	365.3	
Балластный танк № 8 ПрБ Ballast tank No 8 S	108.40	-18.28	3.37	-1981.6	365.3	
Балластный танк № 9 ДП Ballast tank No 9 C	0.00	-39.10	1.41	0.0	0.0	
Намокание Wetting	0.00	0.00	0.00	0.0	0.0	
Судно порожнем Light ship	1020.0	-4.36	4.10	-4447.2	4182.0	
Водоизмещение Displacement	3806.6	0.33	4.21	1264.3	16039.4	175

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Fig. 8.2. Types of load № 39 (2)

"Types of load № 39" describes a full shipload. Which makes 1,760 t of timber in the hold and on the deck (on the hatch cover of the hold), that is, almost identical to the loaded quantity (1783,8 t). In fact, 1649.8 t were loaded in the hold and 134 t on the deck. The "crew and supplying" values were identical and negligibly small. "Stock fuel and water" according to the "Types of load №39" were given as a total amount of 208 t. In fact, the stocks were diesel fuel oil 10 t and 13-15 t of drinking water, a total amount of 25 t.

Consequently, the actual load situation was more favorable to the stability than the "Types of load" was.

2.2.2. BALLAST.

- Types of load ballast.

According to "Types of load № 39", all bottom ballast tanks in pairs, equal quantities in left and right tanks, were to be ballasted at 100%, i.e. the tanks had to be fully filled, as metacentric height corrections for free water surfaces in the tanks were not marked. Total bottom ballast - **597.8** tons.

Ballasted at 100% should also have been the wing ballast tanks № 8 to por and № 8 s/b sides in the stern of the ship, to improve the trim.

High ballast - **216.8** t.

Total amount of bottom and high ballast = **814,6** t.

Types of load draft: average draft **4,41** m.

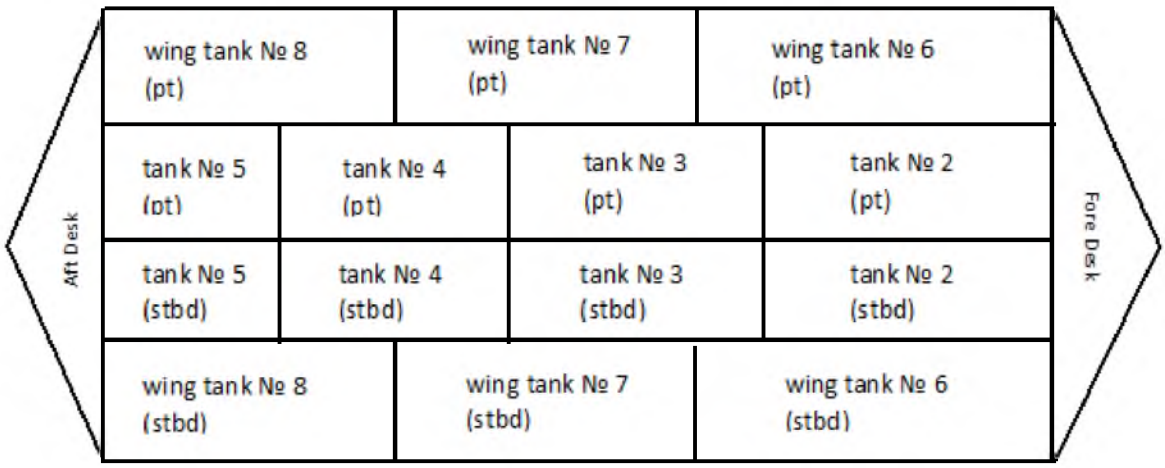

Fig. 9. Layout diagram of ballast tanks

- A really loaded ballast.

The ballast actually loaded could be estimated by the ship's draft. The ship sailed from Constanta port with an average draft of **3.80** m. The calculations showed that such a draft was corresponding to a ballast of **447.7** t, or:

The really loaded ballast : **447.7** t

Ballast by Types of load: **814.6** t

Deficient ballast: 366.9 t.

Therefore, the ship was not ballasted under the "Types of load № 39".

The deficient ballast was basically in the double bottom, which had made the ship unstable. The ballast tanks (bottom and wing), were not filled at 98-100%, as it was required to avoid overflowing, i.e. to eliminate the free surfaces. The captain was aware of the inadequate amount of the ballast. Proof of insufficient bottom ballast was the listing of the ship on the pier at Constanta port, while loading the cargo on deck and the ship lost its stability. The captain had accepted some ballast in bottom tanks to straighten the ship - probably in №. 4 and №. 5, claiming that all bottom ballast tanks were "pressed". This was not the case, because the calculations show that the total ship's ballast was **447.7** t, and 100% ballast only in the bottom tanks makes **597.8** t at a water density of 1.025. At a water density of about 1,007 as is in Constanta/Agigea area, 100% ballast in the bottom tanks makes **587.3** t.

2.3. IMPAIRED STRENGTH OF THE DOUBLE BULGE AND THE PARTITIONS OF THE BALLAST TANKS.

Why was the ship not ballasted under the "Types of load № 39"?
Probably the ship was structurally unfitted to accept the ballast quantity according to the "Types of load № 39". The ship's captain has had doubts about the strength of the double bottom and the ballast tanks partitions. The vessel was a substandard one, as evidenced by the results of the port inspection carried out by the "Romanian Naval Authority"- Constanta on 02.02.2014. Inspectors had found no clear grounds for inspecting the cargo and ballast tanks - to carry out a watertight test to load compartment by "pressing" the ballast tanks using a ballast pump. "Romanian Naval Authority" - Constanta, they could have had a reason for inspection of the cargo compartment and the ballast tanks if there was a procedure obliging the ship's agent and the stifador company to report to port authorities incidents, similar to the one of loss of stability on the quay. Such a procedure wasn't existing in Port Constanta.

2.4. INCORRECT OPERATIONS FOR STRAIGHTENING THE SHIP.

After the ship's listing (loss of initial stability) at Pier 37 in Constanta, the captain did not take into account that the deck cargo was critical for breaking the stability, along with the insufficient ballast.

The ship listed during the voage. Attempting to straighten it the crew took a ballast in a s/b side ballast tank and this created a straightening moment, which, after ballast water overflow, became a listing moment to s/b side. This is because the ship sailed with an insufficient initial stability.

The right thing to do at the last moment was to cut out the OSB's tackles on the deck and to allow them to freely fall into the sea for improving the initial stability, and then to straighten the list by ballast loading in the wing ballast tanks №. 6 (left/right) with the emergency fire motor-pump. To start up the diesel generator and to return the ship to Constanta for unloading.

3. CONCLUSIONS.

The main cause for the sinking of the ship is impaired stability.

The first unquestionable proof of this was the fact that during the loading in Constanta the ship received a heel of 8-10°. No one reacted to this warning, and in practice the ship sailed with an impaired stability.

Due to the uncertain condition of the ballast system, the ship was not suitable for loading, moreover for loading of timber for which there were specific requirements due to loading it on and deck, with a high mass center and relatively low metacentric height.

From the analysis of the evidence, it was clear that the reception of the ballast was chaotic and that the double bottom above tank №. 5 had been broken. This resulted to the existence of a large free water surface, which subsequently had led to the ship's listing a few hours after sailing.

The calculations of the metacentric height performed by the ship's captain prior to loading (**Fig. 8**) were totally unprofessional and formal. The quantiity of the ballast was **814.6** t as was the case with the attached "Type of load" № 39 scheme, i.e. 100%. Simple calculations based on the ship's draft (according to the average draft of **4.41** m, and in fact the ship sailed with a **3.80** m average draft) showed that the actual ballast was a maximum of **450** t, assuming the deadweight for **0** t. Furthermore, the formal character of the metacentric height calculation was also apparent from the fact that in the attached type scheme №39, the quantities of deck cargo and cargo in the hold did not correspond to the actual ones. The "Fuel and water reserves" values for the type of load were given a total of **208** tons, and the real value was **183**

tons less. These reserves also affect the stability because they were located lower than the center of the gravity of the load, they would improve the stability, as much as they were.

All aforesaid, shows an absolutely unprofessional attitude to the task of stability. The simplest and recommended by IMO action that was to be done is to verify the real metacentric height using the onboard shaking period. The formula is simple and can be used on the quay and at sea.

$h = K^2 * B^2 / T^2$

where: T is the shaking period in seconds

K is a coefficient, for a cargo ship equal to 0,78

B is the width of the ship's midsection

There was also a lack of knowledge of IMO recommendations from the Code of Safe Practice for ships carrying timber on deck, 2011 (2011 TDC CODE) for timber loading and actions in case of impaired stabbility. In this case, instead of releasing the deck cargo to fall freely into the sea, which would cause the ship to straighten, the crew tried to correct the list by ballast taking in a side wing tank. Although not essential, but it was also wrong to adjust the heel by taking a ballast, being anchored.

4. RECURRENCE OF THE ACCIDENT.

The majority of marine accidents associated with loss of stability are due to insufficient attention paid to the ship ballasting. In order to accommodate a larger load, ships take less ballast.

Just three months after the accident, on May 11, 2014, the ship "MOHAMMED H"

(IMO No 8605193) received a heavy listing when loading bags with soda at the 14th pier at the port of Varna - West.

The acccident was caused by a rough failure to follow the intermediate states of the stability in the cargo operations, resulting in a negative stability.

Fig. 10. The listed "MOHAMMED H" on the quay

5. POSSIBLE ENVIRONMENTAL CONSEQUENCES.

Possible consequences for the environment were described in a report by the National Institute of Meteorology and Hydrology at BAS "Expert assessment of the alleged pollution with 10 tons of light diesel fuel oil from a sunken ship".

As a result of the constant wind simulations, it was found that a Northwest, West or Southwest wind would not cause a rapid reaching the shore from the spill or its long-term stay in the open seas.

In no wind, south wind, southeast wind or east wind, pollution was expected on the Romanian coast.

In north, northeast or eastern winds, pollution was expected to occur on the Bulgarian coast, north of Cape Kaliakra, and the risk north of Cape Shabla was particularly serious, as the stronger was the wind, the faster the pollution would occur.

As a result of simulations was found that in such a scenario with winds of N/NE/E, during emerging of the spill, all of the fuel oil would reach the coast - over 90% of the ascent volume.

Real wind simulations confirmed the risk for the area around and north of Cape Shabla, as well as the lower risk in case of the expected long-term west wind.

No possible contamination of 140 litters of lubricating oil had been reported.

6. SAFETY RECOMMENDATIONS.

6.1. TO THE SHIPOWNER ALBROS SHIPPING & TRADING LTD.

6.1.1. To increase the requirements to the command staff upon knowledge and enforcement of timber deck loading rules in accordance with the Code of Safe Practice for ships carrying timber on deck, 2011 (2011 TDC CODE).

6.1.2. To enhance crews' capabilities on emergencies.

7.1. TO THE PORT AUTHORITIES IN CONSTANTA, ROMANIA.

7.1.1. When loading timber, it is imperative to check the crew's calculations for stability.

7.1.2. To oblige port operators to report to port authorities on any case of impaired stability during loading and unloading operations.