R E P U B L I C O F B U L G A R I A
NATIONAL AIR, MARITIME AND RAILWAY ACCIDENT INVESTIGATION BOARD

FINAL REPORT

THE INVESTIGATION OF VERY SERIOUS MARINE ACCIDENT –

Death of two crew members in an overflow pipe of the Trailing Suction Hopper Dredger "MILFORD" on 03.07.2023

2024

Sofia 1000, 9 "Dyacon Ignatiy" St
Tel.: +359 2 9409 864, https://ntib.bg/ntib/

PREFACE:

The National Air, Maritime and Railway Accident Investigation Board (NAMRAIB) is an independent specialised govenmental body within the Council of Ministers of the Republic of Bulgaria, which investigates maritime casualties and marine incidents occurring in the internal sea waters and in the territorial sea of the Republic of Bulgaria, which occurred on or with a ship flying the Bulgarian flag, regardless of the place of accident, which affected other important interests of the Republic of Bulgaria, which affected river ships navigating in the internal sea waters and in the territorial sea of the Republic of Bulgaria, or sea ships navigating in inland waterways.

The investigations carried out by the NAMRAIB aim to improve maritime transport safety and prevent marine casualties by establishing the causes and circumstances of a particular casuaty, without seeking to approtion blame or determine liability.

The investigation shall be carried out in accordance with Article 79 of the Merchant Shipping Code and Ordinance No 23 of 24 October 2011 on the reporting and investigation of marine casualties and incidents in application of the International Maritime Organisation (IMO) Code of the International Standards and Reccomended Practices for a Safety Investigation into a Marine Casualty of Marine Incident (Casualty Investigation Code) as well as the EU secondary law.

The analyses and the safety recommendations made in this report do not give rise to any presumption of liability or guilt. In terms of content and style, the report has not been prepared for use in legal proceedings.

The report is published on the Internet, in the public domain, on the official page of the National Air, Water and Rail Accident Investigation Board: https://www.ntib.bg/ntib/.

Events in this report are reflected in local time (UTC+ 2).

Dredger " MILFORD "

CONTENTS

SUMMARY

On 3.07.2023 *Trailing Suction Hopper Dregger "MILFORD"* made a passage from Burgas, Bulgaria to Constanta, Romania for the purpose of bunkering fuel. At 21:03 LT, two people from the ship's crew went into the cargo tank (hopper), which was filled with ballast (sea water), and were subsequently sucked in the pipe of the overflow device.

A Helmsman (AB) on watch, conducting a safety round, went on deck and heard cries for help. The situation was immediately reported to the Second mate on watch, the ship general alarm was activated and rescue operations were undertaken, which were unsuccessful and the crew members died. The ship was headed to the port of Varna, where the bodies of the deceased have been removed from the pipe of the overflow device.

The Investigation Commission considers that the main cause of the very serious accident was a violation of the safety rules, resulting in the entry of the deceased crewmembers into the hopper tank under ballast. A contributing factor was the drunken state of both. Their death was caused by mechanical asphyxiation by drowning.

As a result of the actions taken by the ship operator specified in item 5, no safety recommendations have been issued by the Investigation Commission as a result of the safety investigation.

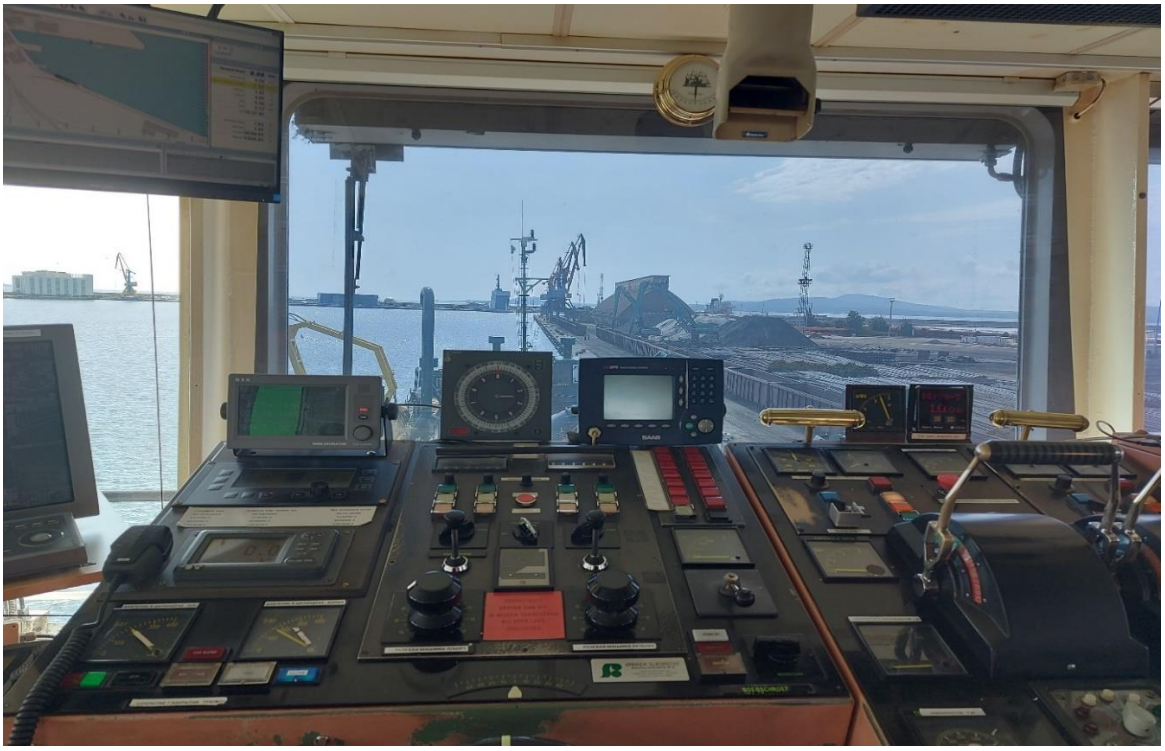

Fig. 1 – Navigation control panel on the bridge of the *dredger "MILFORD"*

1. FACTUAL INFORMATION

1.1. SHIP, VOYAGE AND MARINE ACCIDENT INFORMATION.

1.1.1 DATA ABOUT THE SHIP	
Name	*MILFORD*
Flag	Belize
IMO No	8215883
Call sign	V3RK4
Register number	36G507
MMSI	312135000
Ship owner	MIAFAN BUSINESS LIMITED
ISM company	GLANFORD LTD
Ship's operator	GLANFORD LTD
Port of registration	Belize City
Classification organization	Bureau Veritas
Type	Trailing Suction Hopper Dredger
Year build	1983
Gross tonnage	2 039 t.
Length (overall)	78.15 m.
Beam	14.50 m.
Draft	4.35 m (max. summer); 4.80 m (max. draft during dredging operations)
Deadwaite (max)	2 883 t.
Main engine	2 x Bolnes – 2 Stroke, 10 cylinder, 2502 kW at 600 rpm
Max. speed	10.4 knots

1.1.2 VOYAGE PARTICULARS	
Last ports of calls	Burgas, Bulgaria - 21.06.2023 Istanbul , Turkey - 07/08/2023
Port of departure	Burgas, Bulgaria
Port of arrival	Constanta, Romania
Type of voyage	International
Cargo information	Under ballast
Manning	14 people, citizens of the Russian Federation (13 people) and Lithuania (1 person)

1.1.3 MARINE CASUALTY INFORMATION	
Date and time	03.07.2023, 21:03 LT
Type of marine casualty or incident	Very serious marine accident - death of two crew members in the overflow pipe in the hopper tank
Location of incident	43°05.9' N, 028°00.7' E, – 5.1 miles southeast of Cape Galata.
Hydro-meteorological conditions	Visibility: very good, dark part of the day, wind: SW – 2 , sea state: 1, sky - clear
Place on board	Pipe of the overflow device (overflow pipe) in the hopper tank.
Injures/fatalities	Yes - two crew members: helmsman-operator and cook
Consequences for the vessel	No
Consequences for the cargo	No
Effects on the environment	No

1.2 . GENERAL INFORMATION ABOUT THE VESSEL

The dredger "MILFORD" (fig. 2) was built in 1983. It is a type of Trailing Suction Hopper Dregger - floating means for doing of dredging works by suction and injection. The essence on the process generally consists in suction from the bottom of the seabed to the tank by means of a suction pump, through the suction pipeline, of mixture from water and particles from the sea bottom, called pulp, and swelling it in collective tank (hopper). It is not equipped with a ballast system, as during transition, when there is no pulp mass in the tank, a certain amount of sea water is taken into it as ballast.

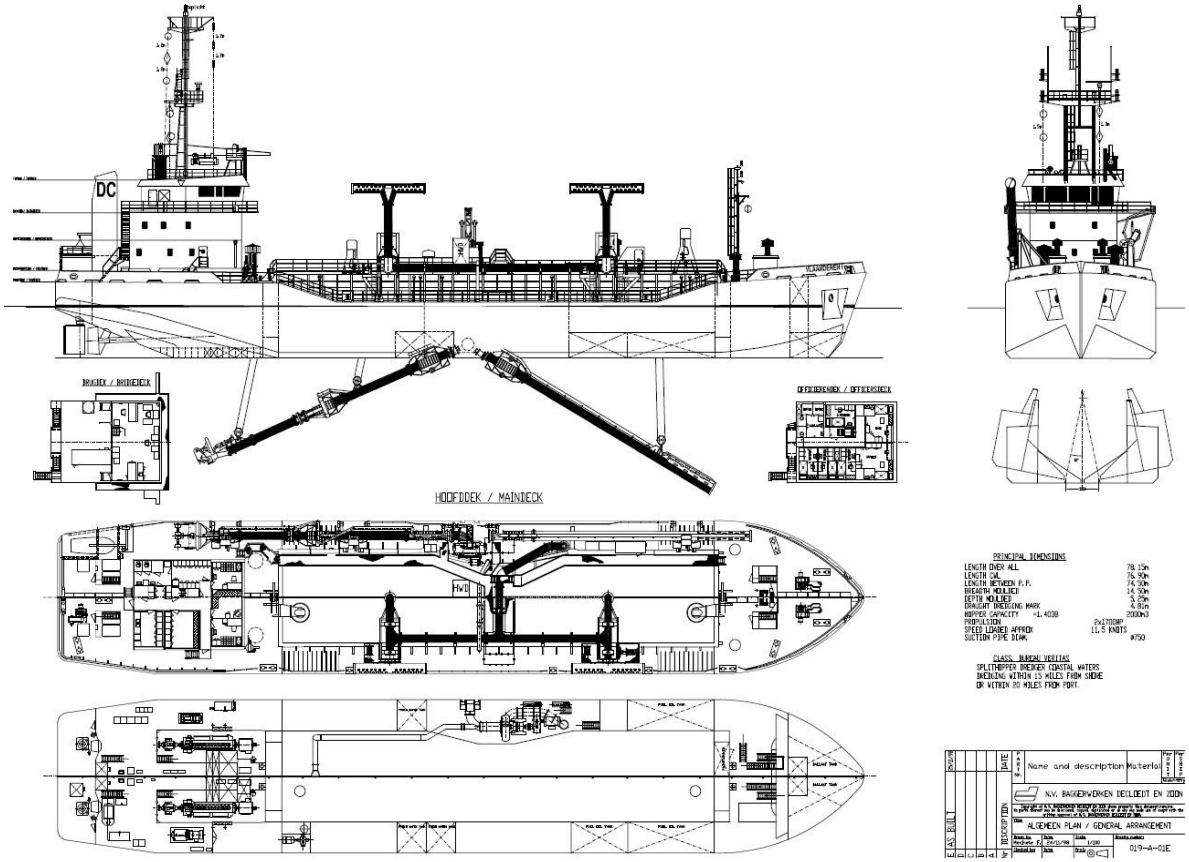

Fig . 2 - General arrangement of the *dredger "MILFORD"*

It is equipped with a device designed to suck mud, sand and gravel from the bottom of the seabed, lakes, canals e.t.c..

The cargo hopper tank (fig.3) is one, with vertical sides, opening at the bottom for disposal of the pulp mass and an overflow device designed to drain the water that has entered the tank when the pulp mass mixed with water is sucked in.

Structurally, the tank is equipped with an overflow device (fig. 4), located in the aft part. The front overflow device had been removed, with the hole in the flor (bottom) plugged. The hopper tank is 42 m long and is of the open type, i.e. does not have a cover.

The principle of operation of the dredger involves suction of the dredged masses into the tank, where they settle, excess water is separated and thrown overboard, and the remaining solid consistency is transported to a pre-marked area (depot), where it is dumped. In this regard, an element of the suction equipment is the overflow device, immovably attached to the floor in the rear part of the hopper tank, ending at its upper end in the form of a cone (Fig. 5).

The ship's navigational equipment complies with Regulation 19, Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), as amended, according to the requirements of the relevant ship type, gross tonnage and year of construction.

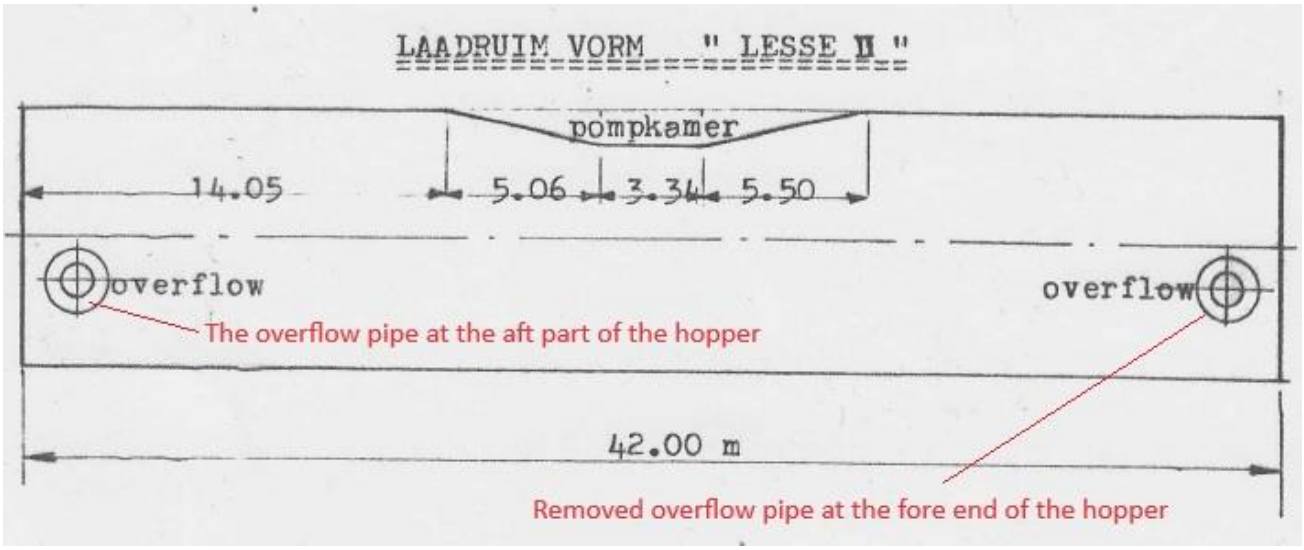

Fig . 3 – The hopper tank of *the dredger "MILFORD"*. In the left part is shown the overflow pipe in which the accident occured.

The vessel is under the supervision of Bureau Veritas and holds valid class documents.

Fig . 4 – Overflow device and gangway for access to the cargo tank of *dredger "MILFORD"*.

In the process of operation, the hopper tank of the dredger is filled with pulp sucked from the sea bottom. The filling of the tank continues until reaching its full cargo capacity or until reaching the maximum draft of the vessel, whichever of the two parameters is reached first. In order to avoid reaching the full cargo capacity of the tank before reaching the maximum draft of the ship, simultaneously with the sedimentation of the solid fraction from the pulp, the excess water is discharged through the overflow device. In this way, the amount of dredged solid mass is increased, at the expense of the water consistency in the suctioned amounts of pulp. The purpose of the overflow device is to throw overboard the excess water from the settled pulp (fig. 5).

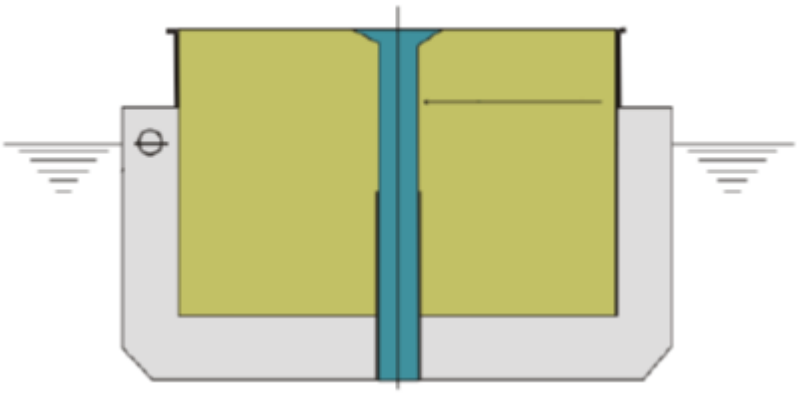

Fig. 5 – General view of the overflow device.

The overflow device includes two tubes telescopically connected to each other. One pipe (the lower one) is immovably attached to the floor of the tank. The other tube, the upper end of which has the form of a conical funnel, is capable of being moved in height so that the conical funnel is positioned above the level of the outboard sea water. In this way, the excess water in the cargo space, on the principle of the jumped vessels, is thrown overboard (fig. 6). In order for the functioning of the overflow device to be possible, the water level in the cargo hold must be above the level of the outboard water.

Fig. 6 – Principle of operation of the overflow device.

When the water level in the tank is below the freeboard water level, the water column in the overfow pipe is equal to the ship's current draft. When the water level in the tank is higher than the level of the outboard water, if the pipe is lowered to the water level in the tank, then the water column in the pipe is equal to the water level in the hopper tank.

The maximum height of the overflow pipe is 7.45 m (Fig. 7). The maximum capacity of the hopper tank, according to documents, is 2 065 m^3. At 85-90% filling of the tank, its capacity is approximately 1750-1850 m^3, or about 6.70-7 m height of water column in the pipe of the overflow device.

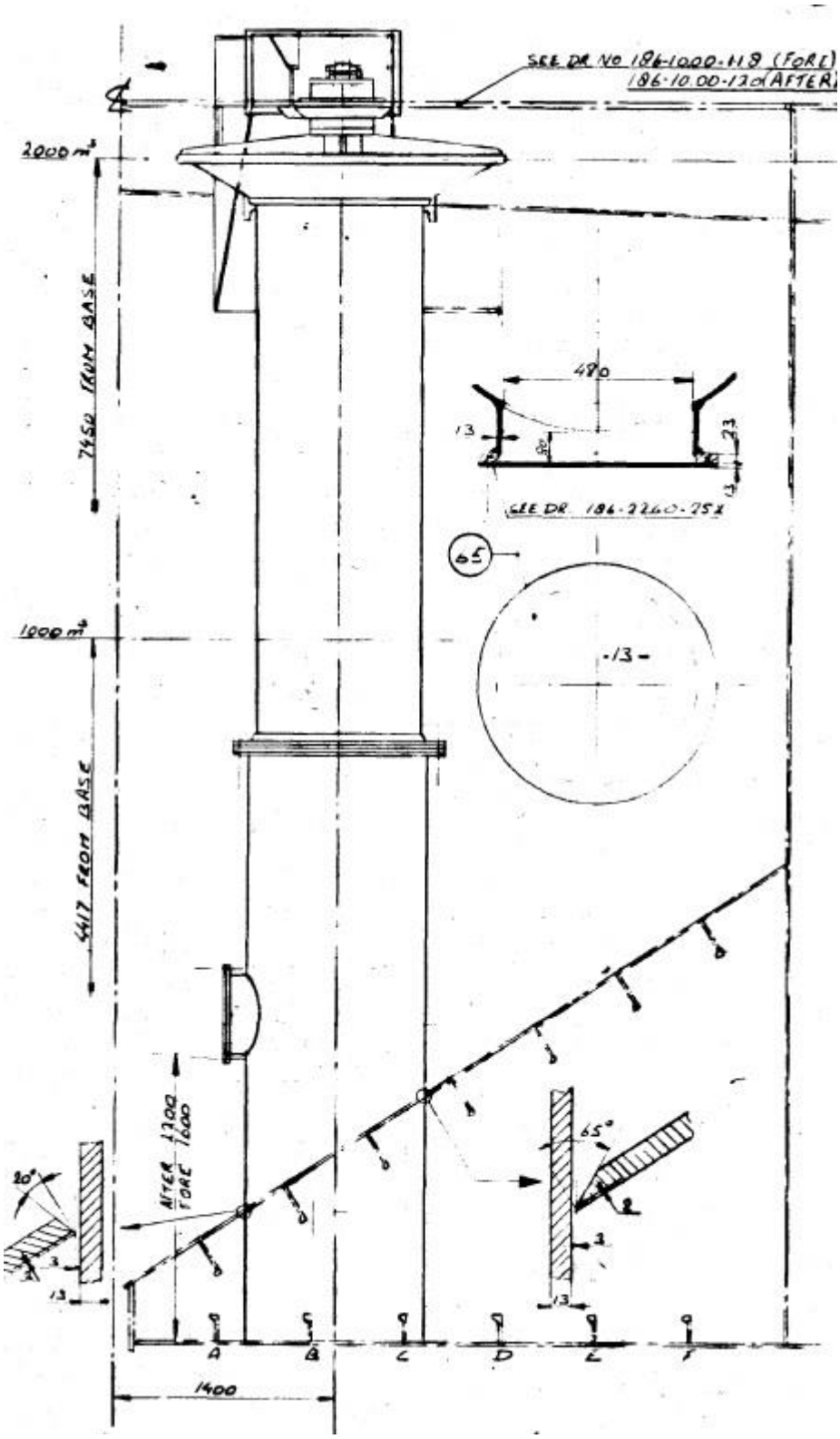

Fig. 7 – Dimensions of the overflow device.

The movement of the movable overfow pipe in height in the tank is carried out hydraulically, by means of a pump controlled by a bridge, and a hydraulic cylinder installed along the axis of the pipe (fig. 8).

The lower end of the pipe of the overflow device fixed to the floor is connected through an opening in the bottom of the cargo tank directly to the outboard water. For this reason, according to the principle of jumped vessels, the water column in the pipe is directly dependent on the draft of the ship, respectively on the amount of cargo on board.

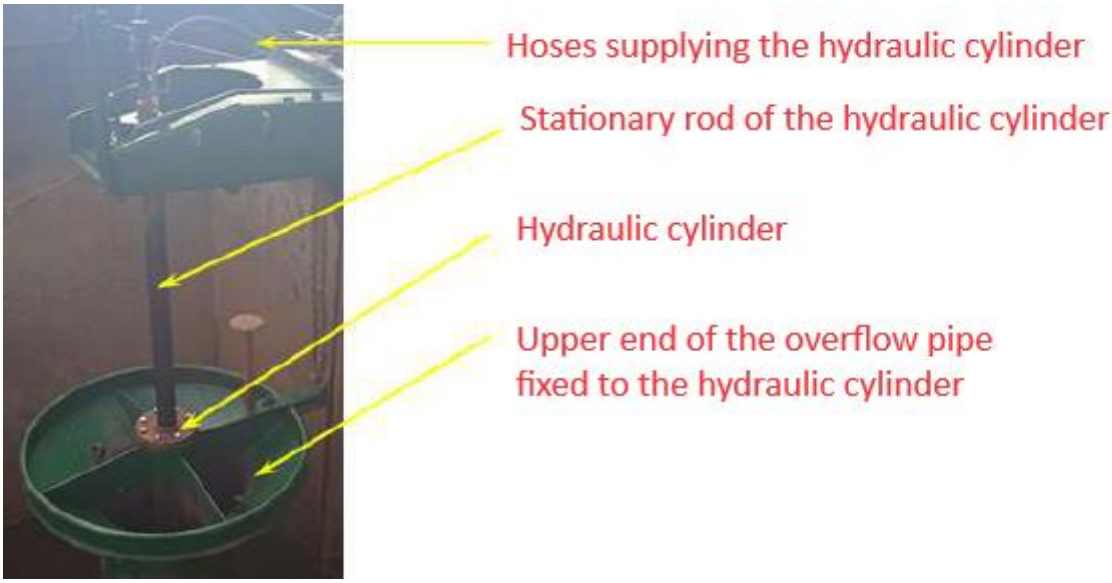

Fig. 8 – Overfow pipe‘s height positioning system.

The height control of the pipe, as well as the dredging operations themselves, is carried out by consoles located on the port side of the navigational bridge (Fig. 9)

Fig. 9 – Control panels for dredging operations.

1.3. INFORMATION ABPOUT THE DROWNED CREW MEMBERS.

The drowned crew members were the helmsman-operator (AB-operator) and the ship‘s cook.

1.3.1 The AB-operator, 33 years old, is a citizen of the Russian Federation. Holds a valid certificate of proficiency and certificates of proficiency for special and additional training in accordance with the International Convention on Watchkeeping and Standards of Training and Certification of Seafarers 1978 (STCW Convention), as amended and supplemented. He had been on the ship since 23/03/2023 (3 months and 11 days in total).

According to the ship's documentation, on the day of boarding he was instructed on the safety measures, the Safety Management System, the duties performed as helmsman and operator, etc. From his characterization by the shipping company, it is clear that he knew the safety policies of the shipping company, could perform his duties, complied with the safety rules to the degree of "very good" (rating 4 on the five-point scale, with 5 being "excellent") .

1.3.2. The ship's cook, 58 years old, is a citizen of the Russian Federation. Holds a valid certificate of proficiency for a ship's cook according to the Maritime Labor Convention, 2006 (MLC), of the International Labor Organization and certificates of proficiency for special and additional training in accordance with the STCW Convention, as amended and supplemented. It had been on the ship since 23/03/2023 (3 months and 11 days in total).

According to the ship's documentation, on the day of boarding, he was briefed on safety measures, on the Safety Management System, on his duties as a ship's cook, etc. From his characterization by the shipping company, it is clear that he is familiar with the safety policies of the shipping company, can perform his duties to a "good" level (rating 3 on the five-point system, with 5 being "excellent"). In terms of mastery of the safety rules, he was rated "very good".

1.3.3. Results of the forensic medical examination

After the ship was bearthed at quay No. 6 in the port of Varna - East, the bodies of the dead were removed from the pipe of the overflow device.

The AB-operator was the first to be taken out, he was dressed only in red shorts, with his head down and his arms outstretched above his head. The ship's cook was taken out second, wearing only black shorts.

The examination and autopsy of the ship's cook and AB-operator revealed multiple traumatic injuries in various areas of the body caused by compression in the ribs of the cross grate located at the inlet and outlet of the movable pipe of the overflow device and by the pressure on the bodies exerted by the large amount of water draining through the overflow device. All established injuries have weakly expressed signs of vitality and were probably obtained in the final stages of the occurrence of death or shortly after it. All of them could be obtained in the circumstances of the particular incident.

The cause of death of the ship's cook and the ship's AB-operator was determined to be mechanical asphyxia by drowning. No traumatic injuries were found for both of them, which could not have occurred in the conditions of the specific accident, i.e. there is no evidence of violent actions against them before the incident.

1.3.4. Results of the toxicology study

The toxicological examination established the presence of ethanol in the blood and urine of the ship's cook and the ship's helsman-operator.

The values correspond to a mild degree of alcohol intoxication in the phase of elimination. The mild degree of alcohol intoxication is characterized by certain changes in the psycho-motor functions of the body, such as easy fatigue, delayed reactions, moderately pronounced coordination disorders, vegetative disturbances, weakening of concentration, attention, intelligence, etc.

1.3.5. Minimum safe manning of the ship with crew.

The vessel has a valid Minimum Safe Manning Document issued by the Belize Flag Administration on 02/01/2023, valid until 31/01/2028. The minimum safe manning document is specified in the document, which is 8 people (master, chief officer, officer of the watch (OOW) , chief engineer, second engineer, oofficer of the engineering watch, AB and deckhands). It is explicitly stated that two officers from the deck department must hold a general category GMDSS ship radio operator certificate (GMDSS – GOC) or that the ship has a qualified radio officer.

In this case, the first condition is fulfilled.

According to the crew list, *dredger "MILFOR"* is manned in accordance with the above document, and there are additionally 3 helmsmen on board - operators, boatswain, electromechanic and motorman.

In the Minimum Safe Manning Document of the ship with a crew, a restriction is entered - coastal navigation in the areas of the Black sea, Baltic sea, and Mediterranean Sea, the coastal zone of the Atlantic Ocean. The engine room is not unattended .

2. NARRATIVE

On 03.07.2023, the ship was enroute from Burgas to Constanta for the purpose of bunkering fuel. Due to the fact that the ship does not have a ballast system, sea water was accepted as ballast in the cargo hold of the ship up to the summer load line. The formed free surface did not deteriorate the initial stability parameters below the safe ones and the ship was seaworthy and ready for passage. The movable pipe of the overflow device was raised to the extreme upper position, in which condition the upper end is above, but almost to the level of, the ballast water in the tank.

At 14:40 LT, *dredger "MILFORD"* began a transition, which until the time of the accident was routine. The crew went into the performance of their watchkeeping duties on the move.

When the ship was about 5 n. miles south-east off Cape Galata, the duty AB was sent by the Second officer on the watch - to carry out a routine safety round, as well as to take cleaning materials for cleaning the bridge. At 21:03 LT, going out on the main deck, the helmsman heard cries for help, looked into the tank and saw two crew members in bathing suits in the water. The AB immediately called the bridge and informed the 2-nd mate on watch that there were people in the cargo tank. Meanwhile, the people in the hold were no longer visible from the wheelhouse.

The Second officer on watch immediately activated the general alarm and reported the situation to the master. Most of the ship's crew gathered around the cargo tank and began to visually search for the people who had been in the water in the tank.

When the master came to the bridge, he assessed the situation, stopped the vessel to lay adrift and took action to take out the people from the water in the hold. The Second officer (who in this case was the OOW) was sent to lead the rescue operations on deck.

The Chief Officer began dumping the water from the tank by means of the cargo pump, deliberately not using the method of opening the bottom of the tank, in order not to throw the people in the tank overboard. The water began to recede rapidly, but the people in the tank could not be visually detected by the crew. As the water level in the tank was lowering, so did the water level in the overflow pipe, with crew members seeing human limbs inside.

The Second Officer tried to descend into the pipe of the overflow device, but because he was very big man, he did not succeed.

First, with a life jacket, belt and ropes, the bosun was lowered into pipe and he saw two bodies, in unnatural positions, intertwined with each other and stuck on the second ribs of the inner pipe, with the heads of both of them under the remaining water in it. As the bosun was also big enough and his movements in the tube were severely restricted and he was beginning to show signs of being unwell, he was removed and the ship's third engineer was lowered in his place with a life jacket, harness, ropes and lantern. The latter managed to tie a rope to the leg

of one of the suffered and a group of the crew started trying to pull him out. After they failed, a waist was also brought, but also to no avail.

It was clarified that the ship's cook and the AB-operator were into the pipe. Despite all the actions taken, it was clear that the people could not be removed from the pipe and had no vital signs.

At 21:40, the ship operator was informed about the accident, who issued instructions for the ship to proceed immediately to the port of Varna.

At 23:00, the ship established a connection with the Maritime Rescue Coordination Center, from where they issued an instruction for the *dredger " MILFORD"* to go and berth at quay № 6 of the port of Varna - East.

At 00:30 on 04/07/2023, the ship was moored to the pier and rescuers from the General Directorate of Fire Safety and Protection of the Population, an investigator, police officers and border control officers boarded.

At 05:00 on 04/07/2023, the action on the removing of the bodies of the crew members was completed. After the extraction, the death of the ship's AB-operator and the cook was confirmed.

3. ANALYSIS

The purpose of a safety investigation is to establish the circumstances and facts that contributed to the accident, to serve as a basis for making safety recommendations to prevent similar accidents in the future.

An analysis of the accident was carried out on the basis of the collected evidence and witness statements of the direct participants in the marine accident by the crew and coastal authorities.

3.1. Probable cause of got into the tank of the deceased on the *dredger " MILFORD"*

The Commission considered four possible hypotheses of the ship's cook and AB-operator falling into the tank of the *dredger"MILFORD":*

- going down into the hopper tank in order to carry out an activity related to the operation of the ship during ballast operation (elimination of a possible malfunction of the overflow device);
- accidental fall into the tank (falling as a result of slipping due to lack of lighting on the main deck);
- willfully entering the cargo hold for the purpose of swimming;
- violent death of the cook and helmsman, both of whom were subsequently moved and placed in the overflow pipe.

The Investigation Commisson found no evidence of a malfunction of the overflow pipe control device (for positioning height, etc.) that would have necessitated the entering of crew members into the tank. Deliberate entering in the absence of light on the main deck for the purpose of repairing damage would be an unjustified risk involving great danger to the lives of the crew members who would carry out this activity. In addition, the ship's cook's functional duties do not include repair activities on the main deck and in the ship's cargo hold.

The manner in which the two were dressed (with briefs and shorts, not work clothes) strongly supports the third hypothesis, i.e. intentionally going down into the tank when it was filled with sea water for the purpose of recreational swimming. Additional evidence in support of this hypothesis was the amount of alcohol found in the blood of the deceased and the traces left on the upper deck. Entering the tank as a result of slipping in low light on the main deck is unlikely, given the way the deceased were dressed.

Based on this, the first two hypotheses are rejected by the Investigation Commission.

The fourth hypothesis was rejected by the Investigation Commission, as contradicting the mechanism of injuries of the deceased, indicated in the forensic medical examination.

Based on the above, the Investigation Commission considers that the entering of the ship's AB-operator and the cook into the water-filled ship's tank was more intentional (for the purpose of recreational swimming) than accidental (falling) or for the purpose of

carrying out some repair work. The hypothesis of a violent death of the two is rejected, as very unlikely and contrary to the findings of the forensic medical examination.

3.2. Probable mechanism of entry of the deceased into the overflow pipe.

During the investigation, the Commission encountered difficulty with the explanation and mechanism of the two crew members falling into the pipe of the overflow device. The Commission's attention was drawn to the following facts :

- The position of the two bodies in the pipe - both bodies were found upside down;
- The location of the trap for entering the tank - it is located in close proximity to the pipe of the overflow device;
- The accepted amount of ballast.

The first two facts are physically existing objectively, while the third one is considered by the Investigation Commission to be debatable. Ballast acceptance is specific to each ship and depends on many factors. This aims to ensure the following most important minimum conditions for making a safe transition under ballast :

- Sufficient initial sustainability on the ship;
- Seaworthiness on the ship;
- Optimal speed and fuel consumtion.

For the purpose of each ship there are relevant instructions and procedures for determining the required quantity. But statistically, it can be assumed that this amount generally varies from 15÷45% of the ship's deadweight. In the case of "*MILFORD*", the Investigation Commission considers that 700÷900 tons would be sufficient, especially since the transition takes place in summer under good hydrometeorological conditions. In practice, there was about 1,800 tons of ballast on board, which means that the ship essentially sails in "loaded condition". It should also be taken into account the fact that this leads to an increase in draft of the ship, which directly affects the speed and fuel consumption. The difference in the ship's speed when loaded and sailing under ballast can be average up to 2 knots and more. The relationship between speed and fuel consumption is almost cubic - if the ship reduces its speed by 10%, it also reduces consumption by 20÷25% and vice versa. This is the so-called " slow steaming" mode in shipping - looking for a balance between speed and fuel consumption.

The Investigation Commission considered the following two possible hypotheses of the fall of the dead into the overflow pipe:

3.2.1. Hypothesis 1 – those who died fell into the overflow pipe during resonance wave or carrying out an operation to partially deballast the ship.

Every material body has its own frequency of vibration. This also applies to the ship. More precisely, in this case we have own oscillation frequency of a system – ship + ballast. Sea waves also have their own frequency of oscillation. When the two frequencies coincide or are very close, the phenomenon of resonance can occur. The Investigation Commission tried to make a preliminary assessment of the probability of the occurrence of such a phenomenon in the tank. This would cause a resonance wave to occur in the tank which would drag the two people into the pipe of the overflow device. From the calculations made using a simplified model, it is clear that such a possibility is unlikely .

- $f_{\mathbf{natural}}$ is around **5.03 (Hz)** .
- $f_{\mathbf{wave}}$ is around **0.29 (Hz)** .

Another point of investigation is to determine what the speed and flow rate of water in the pipe would be in the event of a ballast discharge. Again using a simplified model, the

The Investigation Commission tried to determine their values at two different positions of the upper conical end of the pipe:

- The height of the ballast level is **0.2** meters above the pipe - (**Case 1**)

- The height of the ballast level is **1** meter above the pipe- (**Case 2**

After performing the calculations, the following values were obtained:

- **Q = 1.553 (m ^{3} /s), v=1.98 (m/s) for Case 1 and**
- **Q = 3.477 (m ^{3} /s), v=4.427 (m/s) for Case 2.**

So the calculated speed and flow rate through the pipe give the reason to assume that the entrainment on the two of them members on the crew in the tube is completely possible. Except this is permissible and the occurrence of the Vortex effect at the top part on the pipe.

The Investigation Commission considers the following course of events to be relatively likely:

- The ship departed from Burgas after receiving ballast, almost "loaded", with a small amount of fuel. The pipe of the overflow device was in its uppermost position (7.45 m). The tank was filled with ballast to 85÷90% of its full capacity (2,065 m³).
- At 20:00 LT, the Second Officer and an AB took-over the watch on the bridge.
- The master went up on the bridge and gave instructions to the watch. What exactly they were, the Investigation Commission was unable to reliably establish. They were not recorded either in the mastert's night order book or the ship's logbook.
- Meanwhile, two crew members entered the tank in bathing suits. The Investigation Commission believes that they entered simply to bathe.
- It could be assumed that the Second Officer (or the Chief Officer) began to lighten the ship by discharging the excess amount of ballast.
- To discharge 800÷900 m³ of ballast, it will be necessary to lower the upper end of the overflow pipe by about 3 meters from its height below the water level.
- The Iinvestigation Commission found no records of this in the "Ship's Logbook".
- The distance from Varna (the place of the accident) to Constanta is about 60÷65 miles.
- The reason for the disposal of the ballast could be compliance with the declared ETA of the ship, fuel economy or preparation for the upcoming bunkering.
- The discharge of the ballast was done by lowering the overflow pipe below the level of the water in the tank. This is relatively the most economical and easy option for partially deballasting the ship (requires starting of one pump for the hydraulics of the overflow device).
- The Invetigation Commission found no record of this in the Ship's Logbook.
- The whole operation, at a flow rate of approximately 3÷4 m³ /s, would take some time (10÷15 minutes). This time is more from theoretically the calculated the minimum time (1÷2 minutes). The reason for this is that the process would not be one-time, but in stages. This is necessary because the level in the tank must always be higher than the sea level. In the meantime, the height of the pipe should also be adjusted depending on the decrease in draft of the ship.
- The AB on watch went down on deck not to retrieve cleaning materials, but rather to perform a visual inspection of the process and the tank.
- At this time the two members realized the danger and tried to get out of the tank by swimming towards the ladder.
- Since the ladder is located in close proximity to the pipe of the overflow device, they were entrained by the flow of water pouring into the pipe.
- This could explain their position in the tube – upside down.
- The AB on watch saw that there were people in the tank and called the 2-nd mate on the bridge.
- Ship general alarm was announced and rescue operations began for the sailors caught in the pipe.

3.2.2. Hypothesis 2 – Falling into the overflow pipe because of a momentary overflow of water due to heeling of the ship.

The Investigation Commission considers that it is highly probable that the fall of the deceased into the overflow pipe could be due to the overflow of a quantity of water from the tank during the rolling of the ship, due either to the effect of hydro-meteorological factors or to

the effect of the ship heeling in result of making a turn. In the area of Varna, the ship moved on variable courses, following a direction to the village of Kaliakra. At some point, it was possible that the upper end of the overflow pipe ended up below the surface of the ballast water as a result of a heel caused by making a turn. In this case, there would be also be an effect of swirling the water around the pipe, in which at least one of the two was dragged, followed by the second, who most likely started to help him.

It can be assumed, judging by the position of the bodies, that the ship's cook, who was closest to the pipe at that moment, was sucked in first, and the AB-operator second.

3.3. Analysis of the actions of the master, the OOW the other creww members in rescuing the injured

The Investigation Commission considers that the actions taken to rescue the crew members caught in the overflow pipe by the ship's master and the crew are rather adequate, given the lack of information about similar cases after breaching a basic safety barrier - a ban on entering the hold when there is water or land mass in it.

During the visit of the ship, the investigators found that there was no visibility from the bridge of the ship to the deck of the gangway, located in the aft part of the tank, through which the ship's cook and the AB-operator most likely descended. The only way to visually observe was to go through the wings and out on the platform in front of the bridge, which is atypical for watchkeepers during a transition. Even so, visually the overflow pipe is only half visible.

It was not clear the circumstances under which the AB who was on the deck lose sight of the people who got into the tank and for what reason did not start throwing into the water a lifebuoy located on the sides of the ship.

The Ivestigation Commission considers that the installation of a video surveillance system (CCTV) allowing coverage of all points on the upper deck could have prevented the tragic accident.

3.4. Analysis of the Ship Operator's Safety Management System and Ship Crew Safety Culture.

In the "Vessel Dredging Manual" provided to the investigators, it is noted that " **entry into the hopper tank is permitted only with the permission of the ship's master with the observance and execution of a specific checklist (check list CHL 3-03-03.2.)** ".

The Investigation Commission could not establish the existence of a specific detailed procedure (except for the above-mentioned checklist) in the Ship Operator's Safety Management System regulating the prohibition of crew access to the ship's tank during dredging operations or when making a ballast passage, actions of the crew in the event of a crew member accidentally falling into the tank and conducting training for actions in such cases.

The use of alcohol and entering the tank for the purpose of swimming show of a low safety culture, which leads to the tragic consequences.

3.5. Analysis of the actions of the ship’s operator and the coastal authorities

The Investigation Commission considers that the instruction issued by the ship‘s operator to direct the ship to the nearest port was correct.

Violations in the actions taken by the coastal authorities to retrieve the dead have not been found.

4. CONCLUSIONS

4.1. The ship's AB-operator and the ship's cook consumed alcohol before the accident;

4.2. They deliberately entered the ship's tank, filled with seawater for ballast, for the purpose of swimming;

4.3. The two crew members were sucked into the overflow pipe, and the large amount of water flowing through the pipe caused multiple injuries and both perished, the cause of death being mechanical asphyxiation by drowning;

4.4 . Rescue efforts undertaken by the ship's master and crew were unsuccessful but generally adequate;

4.5. A specific detailed procedure is missing in the Ship Operator's Safety Management System, regulating the prohibition of crew access to the ship's hold during dredging operations or when making a ballast passage, actions of the crew in the event of a crew member accidentally falling into the tank and conduct of training for actions in similar cases;

4.6. The lack of visibility of the deck and approaches to the cargo space from the ship's bridge does not allow a timely response to such accidents;

4.7. The use of alcohol and the actions taken by the ship's AB-operator and the ship's cook show to the lack of control on the part of the ship's master.

5. ACTION TAKEN BY THE SHIP OPERATOR

Following the accident, the ship operator took the following preventive actions:

- The crew of all vessels operated by Glanford Ltd. were notified of the incident, information was provided in full;
- A procedure regulating the prohibition of access to the ship’s cargo hold was developed within the framework of the Glanford Ltd. Safety Management System (SMS). The SMS contains the scenario for a drill when crew member is injured. Training sessions are carried out on a regular basis;
- All vessels operated by Glanford Ltd. were equipped with a video surveillance system (CCTV);
- Certified breathanalyzers were supplied for all vessels operated by Glanford Ltd. and a system of blind crew testing was introduced.

6. SAFETY RECOMMENDATIONS:

As a result of the actions taken by the ship operator specified in item 5, no safety recommendations have been issued by the Investigation Commission as a result of the safety investigation.