



**REPUBLIC OF BULGARIA
MINISTRY OF TRANSPORT, INFORMATION
TECHNOLOGY AND COMMUNICATIONS**

1000 Sofia, 9 "Dyakon Ignatiy" str.,
tel.: (+359 2) 940 9771
fax: (+359 2) 988 5094

www.mtirc.government.bg
mail@mtirc.government.bg

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

FINAL REPORT

**Investigation of a serious marine accident –
FIRE IN THE SPACE BETWEEN QUAY AND SHIP BOARD AND
EXPLOSION IN BALLAST TANK OF M/T "VF TANKER 7" IN THE
PORT OF SPECIAL PURPOSE "TEREM - KRZ FLOTSKI ARSENAL -
VARNA"**



2018

FOREWORD:

Extract from the Merchant Shipping Code:

Art. 79. (Amended, SG № 41/2001, amended, SG № 113/2002, amended, SG № 87/2005, in force since 01.01.2006., amend., SG № 92/2011, amend., SG № 93/2017)

(1) Investigation of marine accidents and incidents shall be carried out by investigating officers in the specialized unit for investigation of marine accidents and incidents at the Ministry of Transport, Information Technology and Communications.

(2) The investigation under para. 1 aims to contribute to enhancing the safety of maritime transport and preventing marine casualties by identifying the causes and circumstances of the occurrence of a particular accident without making any conclusions about the existence of fault or liability. The investigation under para. (1) shall be carried out separately and irrespectively of the criminal administrative penal or civil proceedings conducted in respect of the same marine accident and shall not be prevented, suspended or delayed by reasons of the conduct of such proceedings.

10) Any safety investigation shall end with a report drawn up in the form and content specified in the ordinance referred to in paragraph 13. Within 12 months from the date of the marine accident or incident, the head of the specialized unit under para. 1 shall publish the report, including the conclusions and recommendations contained therein, on the website of the Ministry of Transport, Information Technology and Communications. The conclusions and recommendations contained in the report can not be used in the course of civil, administrative or disciplinary proceedings

Note: Investigation materials should not be used in litigation and/or settlement of trade disputes, and the specialized unit, or the Ministry of Transport, Information Technology and Communications, can neither be a party to nor involved in such proceedings and disputes.

The report is published on the Internet at the official website of the Ministry of Transport, Information Technology and Communications: <https://www.mtitc.government.bg/>.

All times used are local time (UTC+2).



Fig. 1 m/t „VF TANKER 7“

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USED TERMS AND ABBREVIATIONS

m/T	Motor tanker
IMO	International Maritime Organization
gas-free	No harmful or explosive vapour, smoke or gases concentrations
mts	metric tons
BN	Beaufort number from Beaufort wind force and wave height scale

SUMMARY

At about 1030 on 3 April 2017, as a result of welding works on the s/b side of m/t "VF TANKER 7", moored in the special purpose port "TEREM- KRZ Flotski Arsenal - Varna ", a fire occurred in the space between the ship and the adjacent pier.

Vapors from spillage of oil products on the water surface ignited. The fire spreaded quickly from the nose to the stern with flames reaching 3-4 m, the highest being in the superstructure mirror area. Approximately one minute after the start of the fire, an explosion occurred in the s/b side ballast tank № 7. The fire was extinguished with the help of the crew and the fire safety shore means.

There are no injuries to crew members and shipyard workers in the accident area. As a result of the explosion, the hull of the ship in the area of s/b ballast tank № 7 is heavily deformed to her outside. A subsequent diving inspection found 3 holes under the waterline. A floating boom was deployed around the ship.

The tanker has arrived in the port the day before, 2 April 2017, from Aliaga, Turkey, where she has unloaded 5,747.7 mts of straight-run gasoline (NAFTA). The ship has arrived in Varna under a ballast, empty and gas-free cargo tanks.

The same evening, after the mooring, the ship's de-ballasting was carried out as a stage of her preparation for repairs in the shipyard.

The Special Investigation Unit for Marine Accidents classifies the accident as "Serious Casualty"¹.

As a result of the investigation, the Committee came to the following conclusions:

The main cause leading to the serious accident is the failure of the ship's officers to comply with the requirements of the main documents concerning the safety of ship operations.

Contributing causes leading to the accident are: the failure by shipyard representatives to comply with the fire safety rules and lack of control over prevention of pollution of the port's aquatic environment.

After the accident, the management of "TEREM KPZ Flotski Arsenal-Varna" Ltd., as well as the shipowner of "VF TANKER 7" have taken measures to prevent from its happening in the future.

The Commission makes two safety recommendations to the management of "TEREM KRZ Flotski Arsenal-Varna" Ltd.

¹ In accordance with the definition given in the IMO Code for the Investigation of Marine Casualties and Incidents, transposed in Ordinance № 23 on Reporting and Investigation of Accidents in the Maritime Spaces from 24.10.2011, in § 1, item 13 of Additional Provisions: A Serious casualty is such which is not classified as a very serious one and includes: fire, explosion, beach, bottom contact, shore or gear or other vessel contact, bad weather or ice damages, hull damage or suspected hull defects and others, leading to structure damages that make the ship unable to sail as ingress of water into the hull, stopping the main engine, extensive damages in residential rooms or contamination (regardless of the amount) and/or a damage requiring towing or shore assistance.

1. FACTUAL INFORMATION.

1.1. VESSEL'S DATA	
Name	„VF Tanker 7“
Flag/nationality	Russia
IMO №	9640554
Ship owner	„VF Tanker“
Port of registration	BOLSHOY PORT OF ST. PETERBURG
Operator	OOO „V.F.Tanker“ Nizniy Novgorod sq Markina d 10
Classification authority	RUSSIAN MARITIME REGISTER OF SHIPPING
Type	Oil tanker
Date of construction	2012
Shipyard	Krasnoye Sormovo Shipyard, Nizhniy Novgorod
Gross tonnage	5 075 t
Length overall	140.85 m
Beam	16.7 m
Deadweight	7 036 t
Main Engine	2 x Wartsila 6L20 – 2 400 kW

1.2. VOYAGE INFORMATION	
Ports of call	Rostov on Don, Russia 19.03.2017 Aliaga, Turkey 26.03.2017 Varna, Bulgaria 02.04.2017
Port of departure	Aliaga, Turkey
Destination	Varna, Bulgaria
Type of voyage	International
Cargo Information	Empty, ballasted
Crew	12 persons, Russian citizens
Working language	Russian

1.3. INFORMATION ABOUT THE MARINE CASUALTY	
Date and time	03.04.2017/10:25 LT
Type of accident	Serious marine casualty – fire and explosion in ballast tank
Position and Location	43°11,26' N; 027°45,78' E – Black Sea, port of TEREM – KRZ Flotski arsenal – Varna Ltd.
Weather conditions	Good visibility – 6-8 nm, daytime, wind 1 BN from south, waves 1 BN, clouds - clear
Place on board	s/b ballast tank № 7
Injuries/fatalities	None
Ship damage	Structure deformations
Consequences for the environment	None

1.4. INFORMATION ABOUT THE SHIPOWNER AND THE SHIP.

The Russian shipping company "VF TANKER", established in 2000, is a part of the shipping division VBTH of the international transport group UCL Holding. It is specialized in the transportation of bulk cargo on internal and international waterways. The fleet of the company exceeds 80 vessels at an average age of 14 years and a total tonnage of more than 400,000 t. The company's SMS meets the requirements of ISM Code and OCIMF and is certified by the Russian Maritime Register of Shipping.

VF TANKER 7, constructed in 2012 under project RST27, is a single-deck steel vessel with two drive shafts mounted at the stern side of the superstructure and the engine room double bottom, double-boards and double-deck in the area of cargo tanks.

The tanker is intended for the transport of crude oil and petroleum products, incl. gasoline, without limitation to ignition temperature, vegetable oils, biofuels and chemical loads class IMO-II. The construction allows simultaneous transport of two types of cargo, with the possibility of maintaining a load temperature up to 60 °C. She has six cargo and two slop tanks, with a total volume of 7 828 m³. Tankers RST27 meet the additional ecological requirements of the ECO-S Class of the Russian Maritime Register of Shipping.

Maritime navigation area - R2 with a wave height of up to 7.0 m, distance from a shelter of up to 100 nm as well as the inland waterways of the Russian Federation.

1.5. INFORMATION ABOUT SHIP'S LAST CARGO.

In her last laden voyage from Rostov on Don port, Russia to Aliaga Port, Turkey, the ship has transported 5 747,700 mts of straight-run gasoline (NAFTA) in bulk.

The NAFTA load is a fraction of the type of gasoline intended for processing with the following characteristics:

Name: UN №.:	Straight-run gasoline (NAFTA)
IMO Class:	1203
Application:	3 - <i>Flammable liquids</i>
Appearance, color, odor:	Raw material in the oil and gas industries Colorless, transparent liquid generating specific odor of a petroleum product
Major transport dangers:	Easily inflammable, forming inflammable/explosive mixtures with air
Density at 15 °C:	0,730 kg/m ³

According to International Safety Guide for Oil Tankers and Terminals (ISGOTT), NAFTA product falls into the category of volatile materials having a very high vapor pressure, which should be treated as static accumulators.

According to Russian State Standard GOST 12.1.044 (the cargo had a Russian origin), the product falls into the category of extremely dangerous inflammable liquids.

1.6. SHIPYARD „ TEREM - KRZ FLOTSKI ARSENAL - VARNA “Ltd.

The 120-year-old shipyard "TEREM - Flotski Arsenal - Varna" Ltd. is the first ship repair enterprise in Bulgaria experienced in complex ship repairs. The company maintains a quality system that meets the requirements of ISO 9001 and ISO 14001, certified under AQAP 2110 by the Ministry of Defense of the Republic of Bulgaria and under BS OHSAS 18001 by the German Register of Shipping.

The Company is the operator of the Special Purpose Port "TEREM - KRZ Flotski Arsenal - Varna" and has two floating docks, four quays, three floating movable berths, and one floating pier. In the harbor area, there are also three active dry docks, served by a floating dock № 2.

2. DESCRIPTION.

2.1. LAST CARGO VOYAGE OF THE SHIP.

On 19 March 2017 the ship has sailed from Rostov on Don port, Russia, with a course to Aliaga, Turkey. The cargo weight has been 5 747,7 mts (or 7 986,244 m³ at 15 °C) Straight-run bulk gasoline (NAFTA), loaded in cargo tanks 1÷6 and in both slop tanks as declared in the cargo plan (Fig. 2). It makes the impression the difference of 3,988 mts between the declared volume of cargo in the manifest/cargo bill of lading from Rostov on Don to Aliaga (5,747.7 mts) and the quantity accepted in cargo and slop tanks (5,743,712 mts), as well as the difference in the names of the cargo in the cargo plan of "Fuel Oil 100 / Мазут топочный 100", as declared in the cargo documents "Straight-rungasoline(NAFTA)".



«ВФ ТАНКЕР-7» / «VF TANKER-7»

порт погрузки: Ростов на Дону
Port of loading: Rostov on Don
порт выгрузки: Алиага
Port of discharging: Aliaga

ГРУЗОВОЙ ПЛАН / CARGO PLAN

ГРУЗ / CARGO: Fuel Oil 100 / Мазут Топочный 100

№П	№П №1		№П №6	№П №5	№П №4	№П №3	№П №2	№П №1	№П №7
	В. Кюв tank	СТ №. 6	СТ №. 5	СТ №. 4	СТ №. 3	СТ №. 2	СТ №. 1		
В. Кюв tank	99,981 mt								
№ СТ	989,995 mt								
№ СТ	99,981 mt								
СБС									

Total: 5747,7 mt. (NET figure)

Имя / Type	Легенд борт / Tons	Имя борт / Tons
Легенд / Type	3,80	3,80
Имя / Type	3,80	3,80
Легенд / Type	3,80	3,80
Имя / Type	0	0



Дата / Date: 19.03.2017

Ст. ном. капитана / Ch. Matr: / Журба В.В. / V. Zhurba

Fig. 2 Cargo plan. A mistake according to the load type has been made - „Fuel Oil 100/ Mazut “, instead of “Straight-run gasoline (NAFTA)”

On 25 March 2017, at 0535 the ship has arrived in Aliaga, Turkey and has moored. On 26 March 2017, at 0150 the ship has moored on quay № 5. After completion of the entrance control, local authorities have taken measurements and calculations of the available quantities of cargo and samples were taken, but the unloading operations had not begun. On 27 March 2017, at 1305 the ship has moved from the quay to the anchorage area. On 29 March 2017 at 2340 the ship has moored again on quay № 4.

On 30 March 2017, from 0245 till 2125 the unloading operations has been performed. The whole cargo on board's been unloaded and no remarks about differences in the amount of cargo at the bill of lading have been made. "*Post-Landing Facility Viewing Act*" and "*On-Board Surface Relief Report*" have been issued.

During the unloading of the ship on 30 March 2017, from 0335 to 0800, 3 000 m³ of ballast in the ballast tanks have been received on board.

On 30 March 2017, at 2300 the ship has sailed from the port of Aliaga to Varna.

2.2. ARRIVAL AND MOORING IN SHIPYARD „TEREM – KRZ FLOTSKI ARSENAL - VARNA“Ltd.

From 30 March 2017 to 2 April 2017 the ship made a transition from Aliaga to the special purpose port "TEREM - KRZ Flotski Arsenal - Varna" for a first class repair. During the transition, from 0535 to 1600 on 31 March 2017 cargo tanks 1 ÷ 6 have been washed with tank cleaning machines. In washing "*Sea Clean Plus*" chemical reagent has been used and 73 m³ of dirty waters has been generated and transferred to both slop tanks - port and starboard side. The washed cargo tanks 1 ÷ 6 have been ventilated for 12 hours, after which the atmospheric composition is measured. On 2 April 2017, a document certifying the "*gas-free*" status of cargo tanks has been issued by the Chief Officer.

On 02 April 2017, in the interval between 0015 and 0815, in Black Sea during the transition, the ballast has been replaced. The change has been made in accordance with the existing IMO resolutions (200 miles from shoreline, 200 meters deep).

On 02 April 2017, the ship with a pilot on board, entered the Lake of Varna, and at 1730 was moored with s/b side on the repair quay № 3 at the port of "TEREM - KRZ Flotski Arsenal-Varna" Ltd. (Fig. 3). The port of the shipyard, an element of the integrated port Varna scheme, is located at the western end of Varna Lake, on the southern coast of Canal № 2 (Fig. 4).



At the entrance control, in violation of Art. 33, para. 1 of the "*Ordinance on the organization of the implementation of border passport, customs, health, veterinary and phyto-sanitary control, as well as control of transport devices in the ports*"

of the Republic of Bulgaria serving ships engaged on international sailing", the ship has not submitted a report on the intention to discharge ballast water in the port (*Ballast report*). No information is provided on the type and volume of the waste - a result of shipping activity, and the ship's cargo residues, as per Art. 33, para. 1 of the aforementioned Ordinance. The reports should have been submitted to the National Electronic Documentation Center of the Maritime Transport in accordance with the established procedure for the tanker to receive a "free practice". The lack of reports was established the following day, 3 April 2017 in Directorate "Maritime Administration" - Varna.

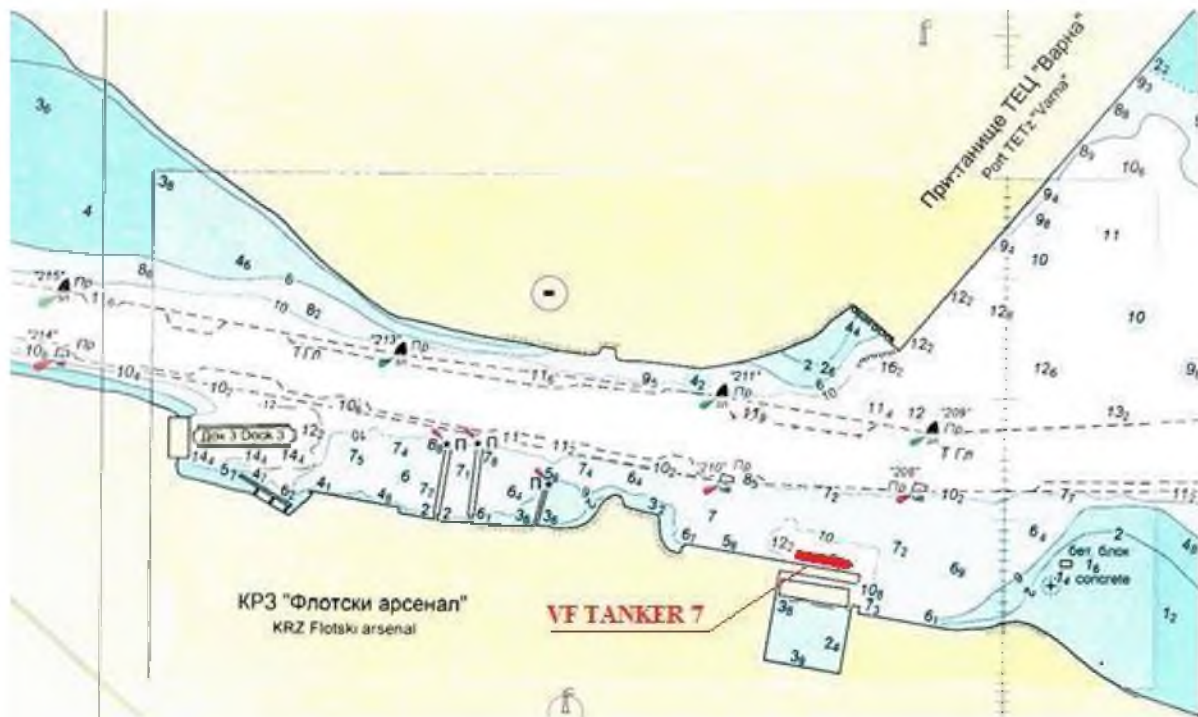


Fig. 4

The cargo tanks of the ship were empty and "gas-free". Slop tanks № 1 and № 2 contain 73 m³ of slop from tanks washing. The ballast in the ballast tanks port № 1 ÷ 8 and s/b side № 3.1 ÷ 8.1 is 3 000.0 m³, with a total capacity of the tanks 4 570.0 m³.

2.2. PREPARATION OF THE SHIP FOR STARTING REPAIR WORKS AND CAUSING AN OIL PRODUCTS SPILLAGE.

In the evening on 3 April 2017, after mooring, the ship management met shipyard representatives to specify the repair details.

From 1900 on 2 April 2017 till 0100 on the following day, according to records in the Ballast Operations Journal, a de-ballasting of the ship has been carried out as a stage of her preparation for the repair. A record in the ship's logbook certifies that at the beginning of the de-ballasting a visual inspection has been carried out for the presence of oil products in the ballast water. Oil products in ballast water have not been found. After completion of the de-ballasting, the "*Замеры атмосферы балластных танков*" table has been filled and signed by the chief officer. It states that in all ballast tanks the concentrations of CO₂, H₂S and toxic gases are 0% and the level of O₂ is higher than 20 %.

On 03 April 2017, at 0147 and at 0148, the ship's *Integrated control, command and signaling system* signaled the presence of hydrocarbons in the air conditioning system (Fig. 5), as a result of which the ship's alarm has been triggered. The ship's duty service has not responded.

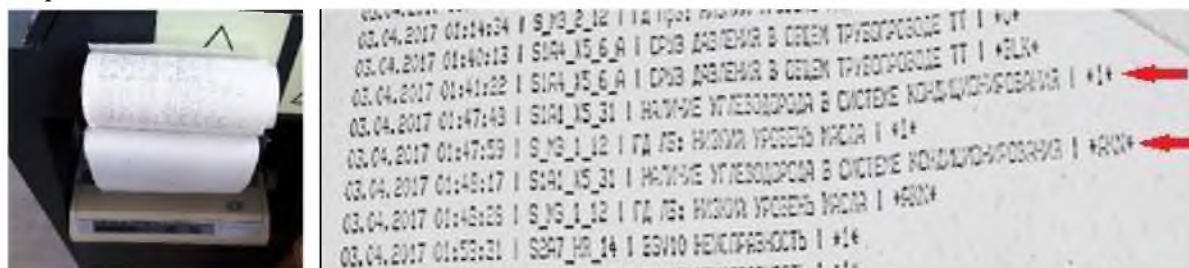


Fig. 5

On the morning of 03 April 2017, a strong odor of petroleum products has been feeling in the area of the shipyard without its source being identified. Due to the western wind, the smell of petroleum products is also felt in the neighborhoods of Varna, located about 15 km east of the shipyard, as a result of which in the social networks there were many comments of citizens. The chemical plants near Devnya town were cited as an alleged source of pollution. The automatic air quality monitoring stations in the city of Varna has reported a slight increase in the concentrations of benzene, methane and non-methane hydrocarbons, as their peak being at about 0800 on 03 April 2017.

The registered values are below the limit values for harmful substances in the ambient air.

According to citizens' signals, during the period 0530 ÷ 1030 on 03 April 2017, experts from the Regional Inspectorate of Environment and Waters (RIEW) have carried out a detour from the territory of Varna to Industrial Zone-South, Devnya. It is found that in the territory from Varna to the village of Strashimirovo, with different concentrations of intensity, the characteristic odor of petroleum products (naphtha, mazut) has been felt. The smell is sharper in the ground layer of air, in the lower sections of the relief and in the areas with permanent fog along the lake of Varna. The potential local source of odor propagation has not been detected.

At the same time, there was a spill around the tanker - the water between the ship and the wharf was covered with yellowish foam, and a small oil stain was visible at the stern.

Despite the formal completion of the deballasting, a liquid of unsubstantiated content and yellowish color has been pouring into the water. Neither the crew nor the duty service at the shipyard has responded in any way to this pollution.

At 0900 on 03 April 2017, an expert group from the shipyard, consisting of: the head of repair works, a fireman from the fire department and a shipyard laboratory representative, boarded the ship and performed a visual inspection and technical measurements of the atmosphere in cargo tanks № 1 - № 6 through the open hatches port/starboard sides. It is accounted that cargo tanks are "gas-free", dry and clean. Measurements of the atmosphere in the empty ballast tanks were not carried out since petroleum products should not be transported in them, and their man holes were not opened for an inspection yet. Upon completion of the measurements of the cargo tanks, the group went to the bridge and, in the presence of the ship's command, drew up a *"PROTOCOL № 48/ 03.04.2017 with data from the observations of VF Tanker-7's enclosed atmosphere control parameters"*. On the basis of this protocol, an *"ACT for carrying out hotworks at temporary locations"*

for the welding of reinforcing rails to the tanker's boards. The act is also signed by the chief officer of the ship. Upon receipt of the hotworks act, at 1000 a group of three hull specialists from the shipyard began preparation for the welding of rails along the starboard facing the quay. The workers felt the smell of gasoline, noticed the foam in the water between the ship and the quay, and paid the attention of the head of repairs and the fireman in the fire department to this fact but the danger of ignition was ignored. At the same time, the shipyard ecologist boarded the ship to prepare the request for waste water transfer. The official has only completed the application without paying attention to the spillage around the ship and the acute smell of petroleum products.

At 1025 the ship's bosun opened one of the two ballast tanks man holes № 7 s/b, located on the main deck. The tank was empty, with a minimum amount of liquid at the bottom, which the pump failed to discharge during the deballasting. With the opening of the man hole, a strong smell of petroleum products, which was identical to the smell of the last carried cargo, blowed from within. The captain was also informed and he ordered the opening of the second man hole of the tank, for its quicker ventilation.

2.3. FIRE OCCURRENCE AND CAUSING AN EXPOSITION IN THE BALLAST TANK.



Fig. 6

At 1028 the welders positioned on the quay try to weld at the s/b outside of the ship, in the area of the midship, a metal plate (fig. 6) for which the zero conductor of the welding apparatus to be connected to the hull. When welding the plate to the hull, sparks and slag began to fall into the water between the tanker and the warf. The falling sparks/slag in the water ignited the mixture of air and vapors from the spillage between the ship and the warf containing a significant quantity of petroleum products.



Fig. 7

The fire is strong, the flames for few seconds spread along the entire starboard of the ship, as the highest reaching to 4 m were in the area of the superstructure (fig. 7). Workers and crew moved away at a safe distance. A fire alarm was triggered on the ship, the shipyard fire brigade located in the immediate vicinity of the ship arrived and began extinguishing the fire.

One minute after the fire occurred, the flames reached the open man hole of s/b ballast tank № 7 and ignited the inside of the oil products vapors (Fig. 8).



Fig. 8

There was a strong explosion in the ballast tank, the ship was pushed at a distance of 5-6 meters from the wharf, but the mooring ropes hold her and take her back. The fire was burning 10 minutes and extinguished both because of the flammable substance was over and the actions of the crew and the shipyard fire brigade. The crew, the shipyard fire brigade, the arrived fire cars and the shipyard cutter continued to pour the boards for their cooling. A floating boom was set around the ship. A coercive ventilation of the ballast tank was organized.

2.4. CONSEQUENCES FOR THE VESSEL AND INSPECTIONS CARRIED OUT.

As a result of the explosion, the wall of s/b ballast tank № 7 was strongly deformed and bulged in the direction to its outside (Fig. 9). The internal partition between the ballast tank and cargo tank № 6 was deformed and bent. In the area of s/b ballast tank № 7 deformations were caused to the outer hull, the open deck, transverse and longitudinal frames. In s/b ballast tank № 7 and cargo tank № 6 begins to enter overboard water. The ship gets a list to starboard side. An underwater diving inspection found 3 holes under the waterline, on which patches were placed. Pumping of entering water and straightening the list were organized.



Fig. 9

After the accident, the ship was inspected by representatives of the Directorate "Maritime Administration" - Varna. The inspectors have found the presence of waste on board the ship - a result of shipping activity and load residues that have not been declared at the *National Electronic Documentation Center* of the Maritime Transport at the entrance control of the ship. When checking the performance of the oil detector system "*Oil Detector & Alarm*" ORGS 11-2 (fig. 10), it is found that the crew encounters difficulties in its launching and adjustment, which raises doubts in its regular usage.



Fig. 10

The area of the accident was also inspected by representatives of RIEW-Varna. During the inspection, it was found that, due to the fire and the explosion in the tanker, one-off quantities of harmful substances have been emitted and quickly dispersed into the atmosphere. Recheck of the



ambient air quality in the accident area was carried out at 2300 on 3 April 2017, with high concentrations of benzene, methane and other hydrocarbons were ascertained. Similar results have been accounted in the village of Strashimirovo, on the shore of Lake Varna.

A verification of the contamination degree of the aquatic environment after the accident with the tanker was carried out by experts from the "Black Sea Region Basin Directorate" at the Ministry of Environment and Waters. During the inspection, a contamination of the boom-enclosed water surface around the ship was found. The pollution is colorless, opalescent, and with a strong smell of petroleum products. Outside the harbor aquatic environment, no pollution was found.

Fig. 11

In the evening after the incident, a spillage was continuing to be visible and a sharp, asphyxial smell was feeling around the tanker. For this reason, the Captain of the moored nearby m/v "Galaxy Eco" sended a letter of protest to the shipyard manager demanding urgent measures to stop the discharge of harmful substances from the tanker and to limit and neutralize the spill. On 04 April 2017, the atmosphere of the tanker's ballast tanks was measured. Inside the s/b ballast tanks № 6 and № 7 a significant concentrations of hydrocarbons have been reported.

2.5. SHORE AUTHORITIES PARTICIPATION.

The shipyard worker on duty received a fire signal from the dispatcher on duty and immediately informed the shipyard fire department, the medical service, the guards and the shipyard management. Also Fire Protection - Varna, Police and Civil Protection were informed. Due to an omission in the shipyard on-duty's instruction, the captain of the Port of Varna and the Operational Vessel Traffic Management Service (VTS-Varna) were not notified about the fire, as they learned about the accident with a great delay.

For this reason, the traffic of ships in this part of the Lake of Varna and along the Canal № 2 in the area of the shipyard was not limited, thus creating a danger for the passing ships.

3. ANALYSIS.

3.1. CAUSING OF A HIGHLY INFLAMMABLE SPILLAGE AROUND THE SHIP.

The occurrence of a fire in the space between the ship's starboard and the adjoining quay as a result of sparks from welding operations can only be explained by the presence of flammable liquid vapors or a mixture thereof on the water surface around the ship. The pollution could be caused by an external perpetrator (vessel or shore) or by m/t "VF TANKER 7".

The pollution variant by an external perpetrator should be categorically rejected on the basis of the findings of the inspections carried out by the Basin Directorate "Black Sea Region" and RIEW Varna before and after the accident, who have registered the presence of petroleum products only on the water surface around the tanker.

Therefore, the only variant for the contamination to be caused was by "VF TANKER 7". The probability of this pollution being caused by discharging of lubricants or oil mixtures from the ship as a result of the technical operation of the ship has not been confirmed in the MARPOL inspection carried out by DMA-Varna on 4 April 2017. The other possible option was that pollution being caused by discharging residues of the last cargo carried - *Straight-run gasoline* (NAFTA) falling under the category "extremely hazardous inflammable liquids". In support of this version came the nature of the fire with the specific bluish colour of the flame, as well as the specific smell of this substance felt even by the inhabitants of Varna.

The probability of remaining some unloaded cargo on the ship is supported to some extent also by the 3,988 mts difference between the declared cargo volume in Rostov on Don's cargo manifest/bill of lading and the quantity accepted in cargo and slop tanks. Normal commercial practice treats this difference as a "shortage" or lack of cargo at the unloading port, but on the other hand, quantities below 0.5% depending on the trade relations of the consignor and consignee are considered acceptable and, in this sense, their lack is neglected. Since ship's cargo tanks have been washed and "gas-free" and in slop tanks only the washing water was stored, the only way to store the undelivered cargo was in the ballast tanks.

3.2. OIL PRODUCTS PRESENCE IN S/B BALLAST TANK № 7.

The explosion in the empty ballast tank proves that petroleum products or their vapors have been caught in a tank designed solely for overboard water. This fact was confirmed by the results of the measurements carried out by the shipyard administration in ballast tanks after the accident. The measurements of s/b ballast tanks № 7 and № 6 were indicating a presence of hydrocarbons for days after the accident and therefore the tanks were not "gas-free".

There are three possible causes of oil products (part of the load) to enter the ballast tanks: an error in loading and unloading operations; connecting a ballast tank with a cargo or a slop tank; a criminal act in order to smuggle a part of the cargo.

Falling a part of the load in the ballast tanks due to a mistake in loading operations practically is impossible for the following reasons:

1. The ballast system of the tanker is intended solely for segregated ballast, i.e. a connection of the ballast system with other ship systems is constructively impossible.

2. There is no constructive possibility of transferring cargo from the ship's cargo tanks through the linkages of the ship's ballast system, the cargo tanks' washing system and the ship's fire protection system, and the ship's sea chest.

The version for a connection between a ballast tank and a cargo or a slop tank can also be rejected for the following reasons:

1. Both ballast tanks do not physically contact a slop tank (Fig. 12).

2. Although a physical contact through the inner casing of both s/b ballast tanks № 6 and № 7 respectively with cargo tanks № 5 and № 6 is possible, even after the explosion in s/b ballast-tank № 7 there are no broken welds, cracks or openings through which a connection between s/b ballast tank № 7 and cargo tank № 6 and, hence, overflowing cargo from the cargo in the ballast tank could happen. The state of s/b ballast tanks № 6, its construction and welds also exclude the possibility of a direct connection through the partitions both with cargo tank № 5 and s/b ballast tank № 7.

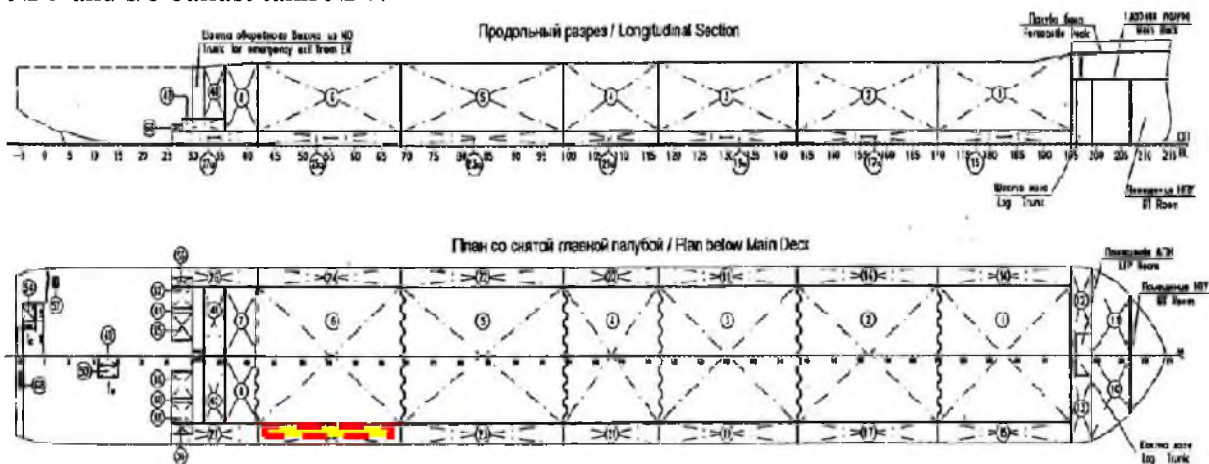


Fig. 12 A scheme of ballast tanks

With the dropping of both versions outlined above, remains only the version of a criminal act in order to smuggle a part of the cargo. The absence of a load of approx. 4 mts in Port Aliaga is likely to be neglected as an error within the permissible market relationships of the stakeholders. On the other hand, such a quantity of cargo, at the cost of a ready-to-use fuel in many directions, in the event of smuggling would benefit the participants in such a criminal act.

For an unregulated fuel transportation in ballast tanks would also facilitate the location of the man holes for access to the upper deck tanks and the distances of 3-4 m between them (Fig. 12). In the case of cargo smuggling, the fastest and easiest option for doing this is by a transferring pump similar to that in Fig. 13, found on board, from a cargo tank, in an on-board ballast tank. The transfer could be accomplished by the cargo access hole through which cargo is controlled to the ballast tank access man hole on which there is a ballast control hole (Fig. 14). The smuggling version gains even greater weight than the very nature of the cargo and its physicochemical properties - it does not dissolve in water and stay on the surface of the water when mixed. i.e. smuggled quantities may be the result of residuals from previous voyages.



Fig. 12



Fig. 13



Fig. 14

3.3. CARGO RESIDUES OVERBOARD.

According to the *Ballast Operations Log*, the de-ballasting has commenced at 1900 on 2 April 2017 and ends at 0100 the next day. Since the relative weight of the cargo in the ballast tanks is less than that of the seawater used for ballast, its discharge has begun at the end of the de-ballasting, after the discharging of the ballast water. This also explains the activation of the alarms signaling at 0147 on 03 April 2017 for the presence of hydrocarbons in the ship's conditioner supplied by the ship's *Integrated control, command and signaling system*.

Overboard cargo residues due to their nature could not dissolve in the water but because of their volatile character with their very high vapor pressure they actively form inflammable/explosive mixtures with the air.

The following factors contributed to the creation of the fire environment in the space between the warf and the starboard side of the tanker:

1. The technological capability of the tanker's ballast system, allowing the ballast, including the cargo residues, to be discharged only from the ship's s/b side into the space between the board and the quay.

2. Weather in the area of the special-purpose port "TEREM KRZ Flotski Arsenal" - Varna before and during the accident - wind W- NW 2-3 BN, no drift in the channel.

3. The high hilly terrain the of Lake Varna's south coast and the orientation and location of the shipyard.

All of these factors cause the dropped cargo residues to concentrate in the tanker's mooring area and above all between her s/b side and the warf wall.

3.4. ANALYSIS OF HUMAN FACTOR.

3.4.1. ANALYSIS OF CREW ACTIONS:

The accident investigation did not establish conclusive shreds of evidence that the crew has had an attitude to the presence of petroleum products in the ballast tank. The ship has made two consecutive cargo races with load "NAFTA" to Aliaga. Meanwhile, a change of crew has taken place. If the new crew had a piece of information about the state of the ballast tank, the latter would be thoroughly cleaned before the tanker arrived at the shipyard.

An analysis of the circumstances surrounding the occurrence of the accident indicates that a number of gaps in the performance of the crew's operational duties have led to the serious accident that caused an oil spillage and significant material damages to the ship. The ship has not had the necessary organization to comply with the requirements of the guidance documents on the safety of shipping operations.

The procedures and safety rules maintained by modern oil tankers to prevent environmental pollution and port terminals, as well as fire safety measures and systems, greatly limit the risk of such accidents. The ship, however, arrived in Varna without cargo. The fact that the NAFTA inflammable cargo has been unloaded at Aliaga and the cargo tanks have been washed and ventilated, has probably dimmed the ship's crew's attention to complying with fire safety measures. The presence of hydrocarbons in starboard ballast tanks № 6 and № 7 after the accident shows that:

1. The tanker has not replaced the ballast when entering the Black Sea or has carried out a partial change, without checking for the presence of oil-based mixtures in the ballast pipeline, visually and through the *Oil Detector & Alarm system* ORGS 11-2.

2. During the de-ballasting of the ship at TEREM port, no monitoring has been carried out on the ballast water quality. The record in the watch diary for an implemented check and a lack of oil products in ballast water was clearly fictitious. Moreover, during the inspection, the crew showed a lack of skills to work with the ORGS 11-2 technical tool.

3. After completion of the de-ballasting, no atmosphere check has been carried out in the empty ballast tanks. The Chief Officer fictitiously has filled in the format "*Замеры атмосферы балластных танков*", according to which in all ballast tanks the concentrations of CO₂, H₂S, and toxic gases are 0% and the level of O₂ is higher than 20%. The fact, that the data in the table is filled formally is evidenced both by the subsequent few hours later explosion in a ballast tank and by the actual ballast tank atmosphere measurement made by shipyard representatives after the accident and showing a lack of "gas-free" on two of the tanks.

The Chief Officer and the Chief Engineer did not respond to the alarm warning of a significant concentration of hydrocarbons in the air.

The actions of the tanker's crew when announcing the fire alarm and triggering a fire pump with a delay of 7-8 minutes after the alert signal show insufficient training in fire fighting.

3.4.2. ANALYSIS OF SHIPYARD REPRESENTATIVES ACTIONS.

Despite the long-term experience of "KRZ TEREM Flotski ARSENAL" Ltd. in the ship repair, in this case the representatives of the shipyard inspecting the ship and issued a permit/act for hotworks have demonstrated a non-compliance with fire safety rules and formalism in their actions, issuing the act basing only on the check of the cargo tanks atmosphere.

In the special purpose port "KRZ TEREM FLOTSKI ARSENAL Varna" no effective control organization has been set up for the protection of the marine environment from pollution.

4. CONCLUSIONS

4.1. MAIN REASON FOR THE ACCIDENT.

The main reason leading to the serious accident has been the failure of the ship's officers to comply with the requirements of the main documents concerning the safety of shipping operations: non-observance of the ballast tanks tightness, lack of control or conduct of a formal one of the ballast water quality that has led to a gassing of the ballast tank and an inflammable spillage around the ship, neglecting the hydrocarbon alarm in the air conditioner system.

4.2. CONTRIBUTING CAUSES LEADING TO THE ACCIDENT.

The main contributing factor for the casualty is the formal attitude of the shipyard group for the "gas-free" inspection and the issuance of a permit for fireworks before assuring the fire safety of the ballast and slop tanks as well as the aquatic environment around the ship.

An additional contributing factor of the accident is the allocation of "TEREM - KRZ Flotski Arsenal - Varna" special purposed port and the lack of 24-hour control of the port's aquatic environment with regard to the prevention of seawater pollution.

5. ACTIONS UNDERTAKEN.

5.1. BY THE SHIPOWNER AND MANAGER OF M/T „VF TANKER 7“:

Following the accident, adhering to the basic principles of IMO/Casualty Investigation Code-MSC Res.255(84)/and following the Safety Management System adopted by the company, following measures to prevent such accidents have been taken:

- Accident information has been collected and analyzed, the underlying reasons for its occurrence have been clarified.
- The circumstances and causes of the tanker's explosion have been briefed to all of the company's ships. A circular has been issued with the analysis of the serious accident to the company's ships.
- Non-plan audits of company ships have been organized to increase the crew's readiness to act in emergencies, to comply with safety and environmental regulations.
- Development and implementation of additional activities such as: =increasing the control by the captains to comply with the Safety Management System recommendations;
= increasing the number of audits;
= preparation of additional instructions for improving the quality of practical training of senior officers before their recruitment.

5.2. BY THE MANAGEMENT OF „ TEREM – KRZ FLOTSKI ARSENAL - VARNA “Ltd

- An additional number of specialists were trained to carry out "gas-free" analysis of ships arriving for repair;
- It is mandatory to carry out a "gas-free" analysis of all fuel and ballast tanks and enclosed spaces under the main deck of ships before commencing the repair.
- A document was issued "Order of action of the on duty at the shipyard upon announcement of the state institutions and bodies in case of incidents in" TEREM-KRZ Flotski Arsenal-Varna "Ltd".

6. SAFETY RECOMMENDATIONS.

Based on the investigation and analysis of the serious casualty as well as of the conclusions reached on the main and the concomitant causes for its occurrence, the Commission, in the light of the action taken by the shipowner, the crew and the management of the shipyard recommends:

6.1. TO THE MANAGEMENT OF „ TEREM – KRZ FLOTSKI ARSENAL - VARNA “Ltd

6.1.1. Additional regulations should be included in the Rules of Port's Work Organisation:

- to protect the marine environment from pollution, including periodic and off-plan monitoring of seawater purity.
- to improve safety in hotworks during repairs.

6.1.2. Additional training on safety rules in fireworks is planned and conducted on the shipyard hull workers.