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

FINAL REPORT

Investigation of very serious marine casualty –

DEATH OF A CREW MEMBER OF M/V "INDRA II" IN THE TERRITORIAL SEA OF THE REPUBLIC OF BULGARIA ON 09.11.2015

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 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.

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 stated are local time (UTC +2 hours).

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USED TERMS AND ABBREVIATIONS

m/v	Motor vessel
IMO	International Maritime Organization
MRCC	Marine Rescue Coordination Center
MAIU	Maritime Accident Investigation Unit
p.c.	Point with coordinates
E	East
m/s	Meters per second
mts	Metric tones
N	Nord
nm	Nautical miles
VTS	Vessel Traffic System
BN	Beaufort number from Beaufort wind force and wave height scale

SUMMARY

On 08.11.2015, the *m/v "INDRA II"* left Odessa, Ukraine, with a course to the port of Burgas, Bulgaria, with a cargo of 18,539.600 mts of metal. The next day, 09.11.2015, the ship approached the area of Burgas port and started maneuvering for mooring to the quay. The main engine of the vessel stopped due to the activation of low oil pressure protection in the luboil system. The ship remained temporarily on a drift. The chief engineer informed the captain that the engine room staff would try to fix the problem in a short time and the engine would be ready for operation again. The routine actions for such cases were undertaken - cleaning the luboil system filters. The oil pump had been stopped before each filter opening. When attempting to dismantle the filter element from the left section of the main luboil filter, the cover of the section remained attached to the body of the filter box, although the retaining nuts were unscrewed. By his own initiative, the third engineer climbed onto the filter housing and bent over the cover and attempted to release it. The suddenly released cover jumped out vertically, hitting the third engineer in the area of the chest, and pressing him against the pipelines that pass under the ceiling of the compartment. The injured person had been released from the hood and been given first aid by the crew. Emergency help was requested from the shore, but despite the measures taken, the injured person subsequently died as a result of injuries.

The specialized MAIU classifies the accident as a „very serious casualty"[1]. The investigation began on 10.11.2015 with the gathering of evidences, data and testimony aboard the ship, which in the meantime was moored on the quay in the port of Burgas.

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

- The main cause which had led to the very serious accident was the non-observance of the safety measures when working with vessels under pressure.

- Main contributing cause of the accident was the poor maintenance of the main engine luboil system.

- The additional contributing cause of the accident was related to the design of the main luboil filter, making it difficult to quickly and safely open and remove the items for cleaning purposes.

The Commission sent 2 pcs. safety recommendations to the ship-owner and the ship operator.

[1] In accordance with the definition given in IMO Code for the Investigation of Marine accidents and Incidents, transposed in Ordinance № 23 on Reporting and Investigating Accidents in Maritime Spaces from 24.10.2011, in § 1, item 6 of the Additional Provisions: " Very serious casualty is a ship accident resulting in its total loss, loss of life or heavy pollution. "

1. FACTUAL INFORMATION.

1.1. VESSEL'S DATA	
Name	*INDRA II* (former names: *Pacific Bangshen* till 2009; *Shan King* till 2007; *Princess Castle* till 1996.
Flag/nationality	Comoros
Identification IMO №	IMO 8301668
Shipowner	Plamocean Maritime LTD (IMO 544822)
Port of registration	Moroni
Manager and operator	Bulcom Ltd, Cyprus
Classification authority	Burgaski Koraben Registar
Type	Bulk carrier
Date of built	1984
Shipyard	Shin Yamamoto Shipbuilding Kochi, Japan
Gross tonnage:	12 872 t
Length (max)	152,63 m
Width (max)	24,00 m
Deadweight	21 387 t
Main engine	Sulzer 6RTA48 – 5627 kW

1.2. VOYAGE INFORMATION		
Last visited ports	Burgas, Bulgaria Odessa, Ukraine Burgas, Bulgaria	28.10.2015 - 02.11.2015 06.11.2015 - 08.11.2015 10.11.2015
Sail Port	Odessa, Ukraine	
Destination	Burgas, Bulgaria	
Type of voyage	International	
Load Information	18,539.600 mts metal	
Crew	17 persons, Bulgarians and Ukrainians	
Working languages	Russian and English	

1.3. INFORMATION ABOUT THE MARINE ACCIDENT	
Date and TIME	09.11.2015, 23:10 h
Type of accident	Very serious casualty - a casualty with a crew member
Position and coordinates	42°29,6'N; 027°36,7'E – Black Sea, Burgas roadstead
Voyage section	Arriving
Weather conditions	Good visibility – at about 6-8 n/m, night, wind from south-1 BN, sea -1 BN. Clouds – clear.
Place on board	Engine room
Consequences	A crew member died
Consequences for ship and load	None
Consequences for ship and load	None

Fig. *1 m/v „INDRA II "*

1.4. THIRD ENGINEER INFORMATION.

The died third engineer was a 48 years old Ukrainian citizen.

He was on board the ship for 2 months making his third voyage on it. He had a valid certificate of competency for a watch engineer from 2012, certificates of courses passed in accordance with the International Convention STCW 1978 and SOLAS 74, as well as a permit to perform his duties as a ship's watch engineer on board, issued by the Comorian maritime administration, based on a completed checklist for knowledge of the ship, service and operation of the systems, mechanisms and safety rules.

1.5. MAIN ENGINE LUBOIL SYSTEM.

The system is designed to ensure stable and reliable lubrication of engine friction parts, reducing friction and wear, heat dissipation, separation of wear off products and congestion of friction nodes and parts, as well as protecting engine parts from corrosion. It is essential for the normal operation of the oil system to ensure a permanent oil cleaning as well as an automatic pressure and temperature control (including emergency warning and engine protection). Oil purity is ensured by an oil separator, pump suction filters and a two-sectioned main luboil filter. The oil separator cleans the oil from water and mechanical impurities. In the case, prior to the accident, the oil separator had not worked for more than a year due to lack of spare parts, and the oil in the oil sump tank was heavily polluted with a solid sludge.

This is a prerequisite for easy clogging of the oil filters and lowering the oil pressure in the oil system, which causes the main engine emergency signaling.

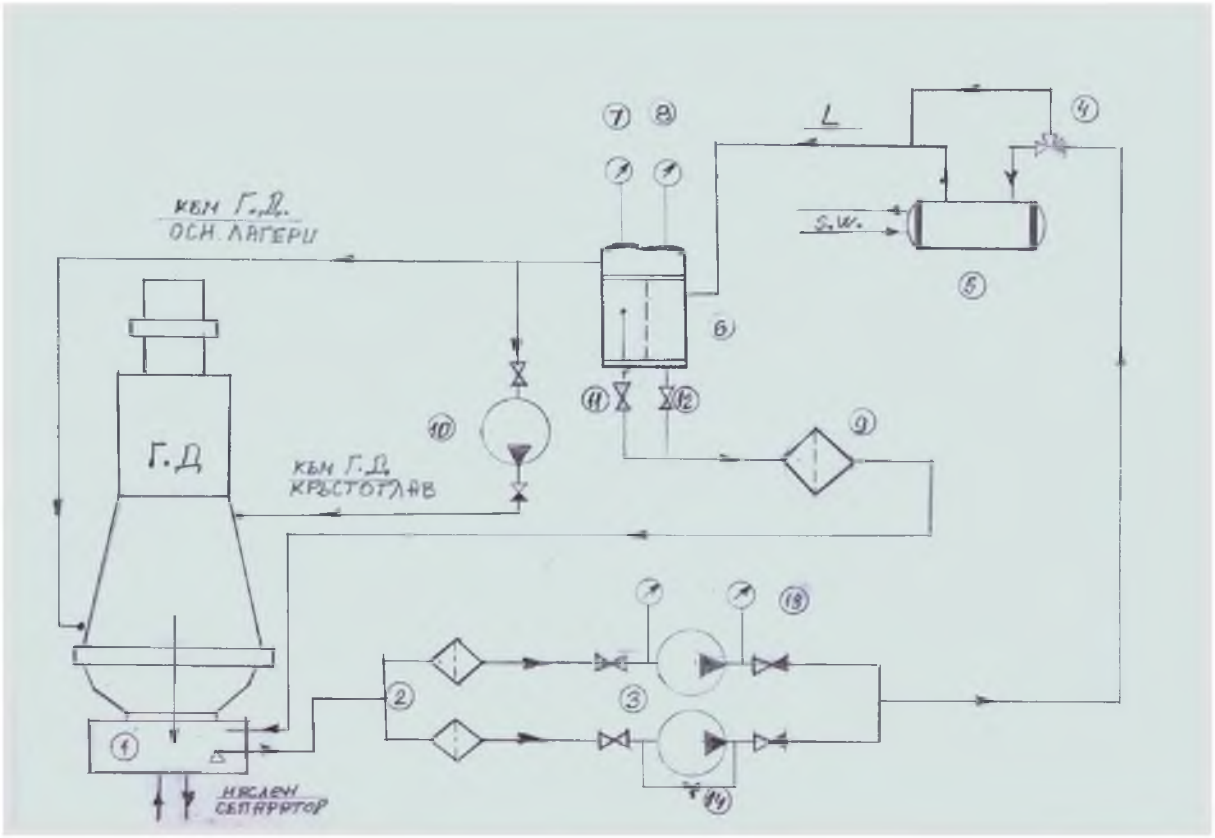

Fig. 2. Scheme of a part of the luboil system (main engine).
1. Oil sump tank 2. Suction filters 3. Oil pumps 4. TSV 5. Oil cooler 6. Two-sectioned, self-cleaning MAX filter 7. Pressure gauge 8. Arrow indicator 9. Filter (manual cleaning) 10. Oil pumps (crosshead/piston) 11. Air vent 12. Drain valve 13. Pressure gauge 14. Safety valve.

1.6. MAIN OIL FILTER.

The main oil filter (MAX-FILTER) (Fig.3) is a two-sectioned one, made by Niikura Kogyo Co Ltd, model MF-LSM. Represents a cast iron metal box with dimensions: height of 1.20 m, a width of 1.0 m and a depth of 0.50 m. It contains two separated sections with a height of 1.0 m and cylindrical openings in the upper part with a diameter of 0.35 m, in which the cylindrical filter elements are mounted. It is possible to clean the filter elements without their extraction, using the "backwashing" system, with rotating the cylindrical filter elements manually by means of devices mounted on both filter covers (**Fig.4**) and opening the drain valve 12 (**Fig.2**) for drainage of removed impurity. It is this device, when disposing the cover upwards, had become the cause of the severe injuries to the third engineer. The oil enters the MAX-filter from the oil cooler 5 (**Fig. 2**) through a 4-meter long pipeline.

Fig. 3 Main luboil filter

Fig. 4.
Filter left section cover with the manual cleaning system.

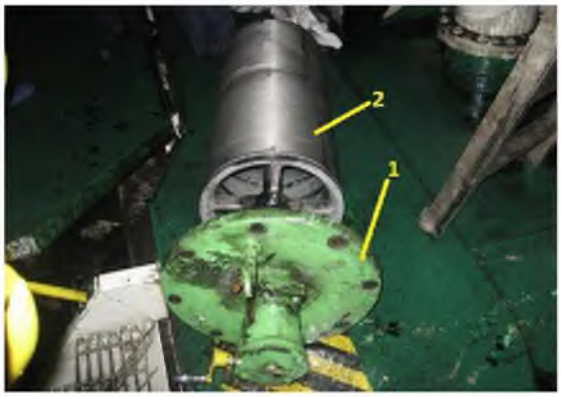

Fig. 5.
Dismantled filter cover (1) and a filter element (2).

The oil pressure before and after the filter is monitored by two pressure gauges (**Fig. 6**) mounted on the top part of the filter. The left pressure gauge reads the oil pressure after the filter. The right manometer/differential type/ indicates the degree of contamination of the filter elements, taking into account the oil pressure difference before and after the filter. The manometer scale is divided into three sectors - blue, yellow and red. The arrows in the blue (safe) are an indication of the normal operation of the filter, in the yellow (wash) - cleaning is required, and in the red (danger)- warning of a complete blockage.

Fig. 6. Max filter gauges

The filter elements had been removed for manual cleaning with a chemical every few months, or with an indication of the pollution gauges, and the crew had no problems with dismantling of the covers. For dismantling and lifting the covers of the filter sections (weighing about 35 kg), the windlass should have been used. Before opening the filter covers for cleaning purposes, the residual pressure could be decompressed by the drainage cranes ***12*** (**Fig.2**) of the boxes.

2. DESCRIPTION.

2.1. FAILURE IN THE ENGINE ROOM.

On 08.11.2015, *m/v"INDRA II"* vessel left Odessa, Ukraine, with a course to the port of Burgas, Bulgaria, with a cargo of 18,539.600 mts of metal.

On 09.11.2015 at 1855 the ship entered the responsible zone of VTS - Burgas.

At 2000, the captain took the command of the ship to prepare it for entry the port of Burgas. A "Engine standby" command was issued. The ship was in a maneuvering mode for mooring to the quay.

At 2105 the automatic alarm system for a low luboil pressure of the main engine was triggered. The main engine stopped and the ship remained drifting. Engine room members dealt with identifying and solving the problem.

At 2125, the ship, drifting, left the scheme of separate movement. The captain reported to VTS-Burgas duty operator for stopping the movement of the ship temporarily, and turned on the lights for signaling for a ship not under control. On the assurance of the chief engineer, within 20 minutes the breakdown had to be removed and the ship would have been in move.

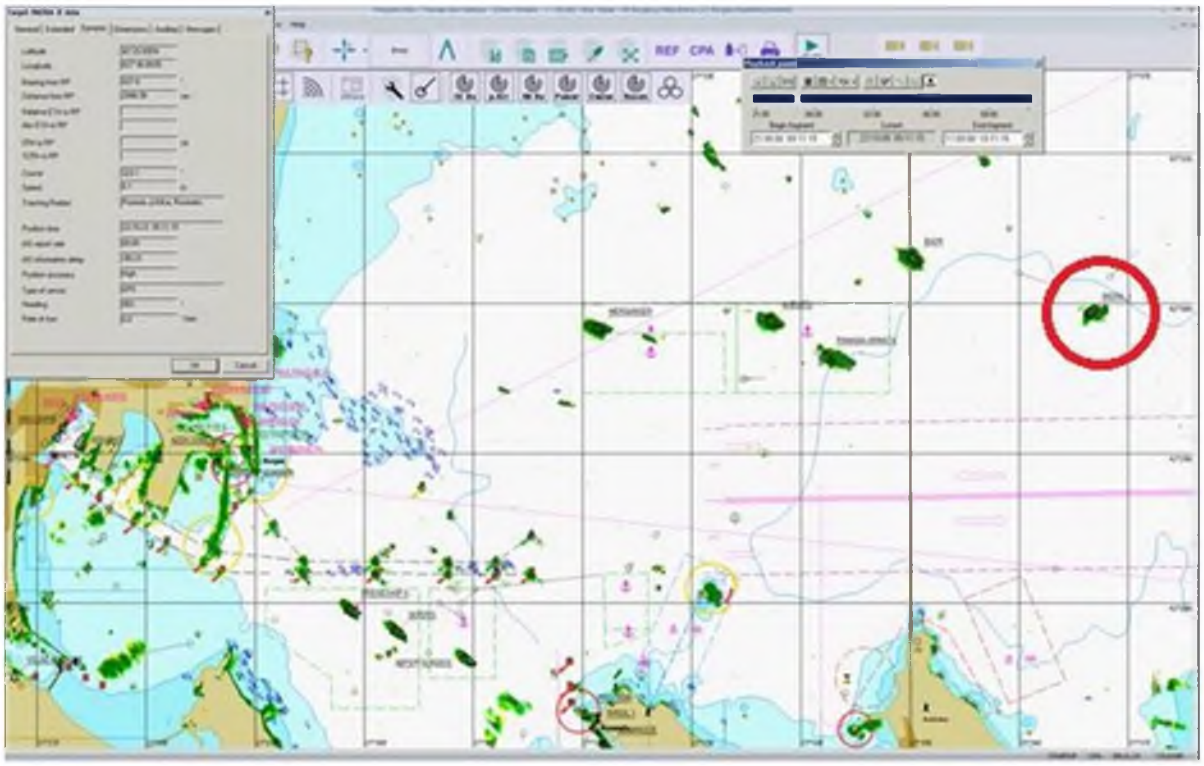

Fig. 7 Ship position in Burgas bay at the moment of the accident.
/picture of VTS/.

2.2. ENGINE ROOM STAFF' ACTIONS FOR FAILURE ELIMINATION.

During the ship's maneuver for entering the port, the inlet luboil pressure of the main engine dropped sharply from working rate of 4.4-3.4 kg/cm^2 to almost 0 kg/cm^2, with a running oil pump. At the same time, the oil pressure relief valve ***14*** (**Fig. 2**) activated due to an increased pressure before the filter. For the crew, it was obvious that the cause of the low oil pressure was due to dirty luboil filters of the oil system and undertook actions to clean them.

They switched off the luboil pump, removed the suction filters ***2*** and cleaned them(**Fig.2**). Then switched on the pump again, but the oil pressure at the outlet of the MAX filter remained 0 kg/cm^2 according to gauge readings ***7*** (**Fig. 2**), whereas the arrow indicator ***8*** (**Fig. 2**) was in the red section indicating that the problem was in the main luboil filter.

They switched off the pump again and undertook cleaning the right section of the main oil filter. When the nuts on the right-hand cover were released, the same had slightly lifted and from the gap formed under the edge of the cover came out a thin jet of oil due to residual pressure in the system before the filter, spraying the chief engineer and the motorman. The filter element was removed, cleaned and mounted back. The pump was switched on again but the oil pressure after the main oil filter remained low, indicating ineffective cleaning of the right filter element hence a new opening and cleaning of the left filter element was necessary. The pump was turned off for the third time. The air vent valve ***11*** (**Fig. 2**) and the drain valve ***12*** (**Fig. 2**) were open, but the differential pressure gauge ***8*** mounted on the filter remained in

the red zone, indicating that the in the oil system, between the non-return valve of the pump and the filter elements, there was a residual pressure **(**in the subsequent cleaning of the system after the accident it was found that the drain valve ***12*** was completely clogged**)**. This fact had not been taken into account by the engine room members and they proceeded to open the left section of the main oil filter, without waiting for the draining of the oil and the pressure drop in the system. The third engineer and the motorman, working on the cover dismantling, were warned by the chief engineer to watch out for a new oil spill.

The eight nuts securing the cover of the section were unscrewed and put apart, but the cover was not detached from the housing - due to the sticking of its gasket and the fact, that part of the studs were distorted (**Fig. 8**). This made it difficult for the cover to move freely and even with the nuts unscrewed, it was likely that it to be held in place by the studs. The several attempts to remove the cover were unsuccessful.

Fig. 8. Throat of the left section with curved studs.

At 2305, the third engineer, without being specifically instructed, stepped on the filter housing and leaned over the cover of the section tried to release it by a hammer. Suddenly, the cover, together with the filter element, was thrown upward, hitting the third engineer in the chest area and pressing him against the engine compartment ceiling piping. From the open section of the filter, oil was spilled in all directions under pressure, sousing in the room and the people working in it.

Fig. 9 Position of 3rd engineer during filter opening/restoration/.

The body of the injured 3rd engineer was freed from the strangulated him elements, and a first aid was given by the chief officer, with no desirable result.

2.4. SHORE AUTHORITIES PARTICIPATION.

The authorities of Burgas port were informed, by the shipping agency "Sea Partners Shipping", for an accident with an injured person on board the *m/v"INDRA II"*, at 2325 on 09.11.2015. MRCC Varna and the director of Directorate of Maritime Administration-Burgas were also notified.

- at 2345 on 09.11.2015 the captain of the ship asked for help - emergency medical assistance for a heavily injured person on board, if possible with a helicopter. Thirty minutes later, at 0015 on 10.11.2015, a rescue boat with two medical officers aboard, representatives of the border police and the ship agent left from the port of Burgas with a course to the ship. After another thirty minutes, at 0045, the medical team was on board the *m/v"INDRA II"*, checked up the suffered engineer and ascertained his dead.

3. ANALYSIS.

3.1. ANALYSIS OF HUMAN FACTOR.

Crew actions (step-by-step opening and cleaning of the filters) were routine to the situation, except in this particular case with an emergency stop of the main engine during a maneuver, where hurrying to eliminate the problem, by the crew's opinion, was imperative. The attempts to restore the normal functioning of the oil system had continued for more than 2 hours, despite the 20 minutes announced by the chief engineer, due to the unforeseen total contamination of both luboil filter elements. Cleaning the right filter element, as mentioned

above, did not solve the problem and removing the left filter element of the main oil filter, as the last possible barrier to the free circulation of the oil, was undertaken. After cleaning, the oil system should work normally. According to the crew, in any of the previous filter extractions and cleanings, given the longer period for these operations, no residual pressure in the oil system or spillage of oil had been observed. This, in all likelihood, had blunted the attention to the safe working of the engine room personnel, and combined with the nervousness generated by the emergency situation and the desire to quickly restart the main engine, the third engineer was deprived of self-preservation in his pursuit to successfully complete the solving of the problem. No attention was paid to the differential pressure gauge, the arrow of which had stood in the red sector, a sign that there was a high residual pressure in the filter. The good maritime practice implies that covers of the vessels under pressure are released completely after a minimum unscrewing of the threaded connections to check for residual pressure. Instead of this, all eight nuts holding the cover of the left filter section were unscrewed and removed. The fact that the cover remained in place once again misleaded the staff to a lack of pressure in the oil system. The third engineer's decision to climb the filter casing and to bend over it for to make it easier to open and remove the filter element was fatal.

3.2. ANALYSIS OF CAUSES OF FAILURE IN THE ENGINE ROOM.

- The reasons for the low oil pressure at the engine inlet, after the filter, may be varied. According to the records in the logbook, before and during the maneuver, the pressure was normal: 4.2 ÷ 3.4 kg/cm^2. The abrupt pressure decrease over a few minutes could have occurred if, for any reason, for example tilting the ship during a turn, the collected sediments at the bottom of the oil sump tank had been lifted, sucked by the oil pump and this could have caused a heavy contamination of fine oil filters and completely to stop the oil flow to the main engine. The main reason for this was the long-time not operational oil centrifugal separator and, as a consequence, an irreversible oil pollution in the oil sump tank, if it had not been checked and cleaned periodically and the oil had not been given for an analysis according to the working hours of the main engine. The above-mentioned assumption was made to explain the sudden and rapid fall of the oil pressure to the main engine and the shut down activation just when the maneuver to enter the port was started. In confirming the above-mentioned, the inspection of the filter element of the left section of MAX filter after the accident showed that it was completely clogged.

- The reason for high residual oil pressure in the oil system: The working oil pressure in the MAX filter was in the range 4.2 ÷ 3.4 kg/cm^2. The bottom diameter of the filter element is 0.30 m, so this pressure rises a force of about 3 tones, pushing the filter element upward in a vertical direction. In the normal operation of the oil system, after the oil pump has stopped, the oil pressure drops in about 1 to 3 minutes. Due to the fact that the liquids are incompressible, even in the presence of any residual pressure, when the system is depressurized, this pressure would fall instantly without a substantial spill of liquid. This effect had been observed during the previous system's openings.

When the oil pump is switched off, the high residual pressure at the opening of the left section of the filter as well as spillage of a large amount of oil occured due to the presence of air in the system. What are the reasons: After removing, cleaning and installing the right filter element, its

filter box had not been deaerated by the intended air vent valve. But the residual air, remaining in the right section, was gradually captivated and retained in the left section of the paired oil filter and the inlet of the oil pipeline L (**Fig. 2**) where, by forming an air cushion, it was compressed to the working pressure of the oil system, about 4 kg/cm^2. In an attempt to open the left section, the crew did not wait for a full drainage of the oil and pressure drop, which was further hampered by the drain valve plugging and the completely clogged left filter element. Namely this increased pressure of the present air in the filter body tried to push the filter element upwards with the cover, if it was released by the retaining nuts.

- Reason for the retaining the lid on the left section of the filter.

The retaining of the cover to the filter body was due to the sticking of the gasket and the curvature of a part of the studs.

4. CONCLUSIONS

4.1. MAIN CAUSE OF THE ACCIDENT.

The main cause of the very serious casualty was the failure to comply with the safety measures when handling equipment working under pressure, due to nervousness and the desire to solve the breakdown more quickly. No attention had been paid to the differential oil pressure gauge indications of the MAX filter. No account had been taken to the chief engineer's warning that workers should move away from the filter. The elementary safety precautions for the removal of the filter cover were not met - preliminarily partial unscrewing of the nuts holding the cover.

4.2. CONTRIBUTING CAUSES LEADING TO THE ACCIDENT.

The main contributing cause of the accident was the poor maintenance of the main engine luboil system, expressing in:

- an inoperative oil centrifugal separator and, as a result, heavily contaminated oil in the main engine sump tank, with a heavy sludge, that could cause rapid contamination and clogging of the luboil filters.

- deformed studs holding the MAX-filter left section cover.

An additional contibuting cause of the accident was related to the design of the main oil filter. The filter was mounted under a pipeline system and its relatively big height calls into question the rapid and safe opening and removal of the filter elements for cleaning purposes. There was no other way to quickly lift and remove the items except by hand and by stepping on the filter housing.

5. ACTIONS UNDERTAKEN.

After the accident, in accordance with SMS adopted by the company, measures had been taken to prevent such accidents:

- The case was discussed at the Onboard Safety Committee Meeting.

- Notes on the oil system were rectified. The oil from sump tank ***1*** (**Fig. 2**) was transferred to another tank, after which the tank was opened and cleaned by the crew. The oil cooler ***5*** (**Fig. 2**) was cleaned using a reagent chemical. The oil separator was repaired. Mechanical cleaning of MAX-filter ***6*** (**Fig. 2**) was performed and the drainage valve ***12*** was unclogged (**Fig. 2**).

6. SAFETY RECOMMENDATIONS

Based on the investigation carried out and the analysis of the very serious casualty, as well as the conclusions reached on the main and contributing causes for its occurrence, in view of the actions taken by the ship-owner and the crew after the accident, to avoid similar marine casualties in the future the Commission recommended:

6.1. The ship-owner and manager of *m/v "INDRA II"*, BULCOM LTD, to organize a thorough inspection and diagnostics of the main ship's machines and mechanisms, extra to the regular inspections made by the classification organization. To introduce a schedule for oil samplings and sending them for analysis as is the normal practice for ship's engines in service.

6.2. The ship-owner and manager of *m/v "INDRA II"*, BULCOM LTD to organize additional briefings on compliance with crews' personal safety regulations in accordance with the instructions for a proper and safe operation of all ship's machin and mechanisms and systems. To focus attention to informal implementation of occupational safety briefings prior to commencing a work or a repair, especially when dealing in extreme situations.