



STATE MARINE ACCIDENT INVESTIGATION COMMISSION

FINAL REPORT 46/15

Very serious marine casualty

TUG BOAT *ZEUS*

The fire of the tug boat berthed in the port of Sölvesborg
on the day of 23 September 2015

February 2017

The investigation of a very serious marine casualty of the tug boat *Zeus* was conducted under the State Commission on Maritime Accident Investigation Act of 31 August 2012 (The Journal of Law of 2012 item 1068 and of 2015 item 1320) as well as norms, standards and recommended procedures agreed within the International Maritime Organisation (IMO) and binding the Republic of Poland.

The objective of the investigation of a marine casualty or incident under the above-mentioned Act is to ascertain its causes and circumstances to prevent future accidents and incidents and improve the state of marine safety.

The State Marine Accident Investigation Commission does not determine liability nor apportion blame to persons involved in the marine casualty or incident.

The following report shall be inadmissible in any judicial or other proceedings whose purpose is to attribute blame or liability for the accident referred to in the report (Art. 40.2 of the State Marine Accident Investigation Commission Act).

The parts of the report concerning the entities and rescue actions (paragraphs 2.3, 6.1 and 8) have been developed by the Swedish Accident Investigation Authority (*Statens haverikommission* – SHK), together with which the State Marine Accidents Investigation Commission conducted the inspection after the fire in the port of Sölvesborg on 24 September 2015. This paragraphs are also available in Swedish.

State Marine Accident Investigation Commission
Chalubińskiego 4/6
00-928 Warszawa, Poland
tel. +48 22 630 19 05, mobile +48 664 987 987
e-mail: pkbwm@mgm.gov.pl
www.pkbwm.gov.pl



Table of Contents

1. Facts	5
2. General Information	5
2.1. Ship Particulars	5
2.2. Voyage	7
2.3. Accident Information	7
2.4. Shore Services and Rescue Action Information.....	7
2.4.1. Rescue Action	7
2.4.1.1. General Information	7
2.4.1.2. Description of Events	8
2.4.1.3. Protection of Natural Environment	12
2.4.1.4. Organisation of Rescue Services During the Action.....	12
2.4.2. Analysis of the Rescue Action	13
2.4.2.1. Technical Support	13
2.4.2.2. Organizational Issues	14
2.4.2.3. Additional Actions	14
3. Circumstances of the Accident.....	15
4. The Analysis and Comments about Factors Causing the Accident with Regard to Examination Results and Expert Opinions	19
4.1. Mechanical Factors	28
4.2. Human Factors (errors and omissions).....	29
4.3. Organizational Factors	32
5. Description of Examination Findings Including the Identification of Safety Issues and Conclusions	32
6. Actions taken.....	34
6.1. Actions Described in the Report of the Swedish Authority SHK	34
6.2. Actions taken by the Operator of the Tug Boat Zeus.....	35
7. Safety Recommendations	36
7.1. The Ship Operator - Zakład Usług Żeglugowych	36
7.2. Polish Register of Shipping SA.....	36
8. Recommendations of the Swedish Accident Investigation Authority (SHK).....	37
8.1. Municipal Rescue Service (Räddningstjänsten Västra Blekinge).....	37



8.2.	Dispatch Centre (SOS Alarmcentral) Växjö	37
8.3.	Swedish Civil Contingencies Agency (MSB).....	37
9.	List of Photographs	37
10.	List of Figures	38
11.	Glossary and Abbreviations	39
12.	Information Sources	39
13.	Composition of the Accident Investigative Team.....	39
	Appendixes	40



1. Facts

On the day of 23 September 2015 the tug boat *Zeus* was moored at the berth belonging to the galvanizing plant in the port of Sölvesborg (Sweden) waiting for the completion of unloading of the barge with timber towed to the port.

At ca 22:00 after dinner at which the crew was celebrating the completion of the six-weeks-long voyage and their return home, the crew members went to their cabins for the night's rest. The deck and engine watches were canceled.

Before 23:00 one of the crew members left his cabin for a certain time. Upon his return he noticed fire in the cabin. Standing on the front steps at the entrance to his cabin he started to shout in order to warn his sleeping colleagues about the fire. Two other crew members heard the scream. The 3 of them left their living quarters and went out on the deck.

Two of them made an attempt to extinguish the fire with water from the hose connected to the ship's fire-extinguishing system. The third member of the crew suffered a head injury while leaving the staircase and lost consciousness after going out to the quay.

The fire was spreading rapidly which forced the men extinguishing it to withdraw and call the fire brigade. The first rescue unit arrived two minutes after midnight on 24 September 2015, 8 minutes after receiving the information about the fire. Another two units - after further 6 minutes, and the last arrived to the tug boat at the wharf at 0:19.

The fire was extinguished at 2:50 and the rescue operation ended at 4:20. The firefighters carried four bodies of the crew members who remained in the living quarters. The doctor at the scene pronounced them dead.

The wounded crew member with head injury was taken to hospital where he was taken care of and after necessary examinations transported to the hotel where the other two crew members were lodged.

Once the Commission had conducted hearings and the local police their interrogations, all crew members were transported to Poland by the operator's services.

2. General Information

2.1. Ship Particulars

Ship's Name:	Zeus
Flag:	Polish



Shipowner:	Otto Wulf GmbH & Co. KG, Cuxhaven (Germany)
Operator:	Zakład Usług Żeglugowych Sp. z o.o. & Co. in Szczecin
Classification Society:	PRS S.A.
Vessel's type:	tug boat
Call signal:	SQLH
IMO number:	6605503
Gross tonnage:	186
Year of built:	1966
Power:	1214 kW (2 x BW D526MTB-40)
Width:	8.00 m
Length overall:	28.43 m
Hull material:	steel
Minimum crew:	6 men



Photograph 1: The tug boat Zeus



2.2. Voyage

Ports en route:	Skulte (Latvia)
Port of destination:	Ueckermünde (Germany)
Type of navigation:	international
Manning:	7 Poles

2.3. Accident Information

Kind:	very serious marine casualty
Date and time of the event:	23.09.2015 around midnight
Geographical position of the accident:	$\varphi = 56^{\circ} 02' 39''$ N; $\lambda = 014^{\circ} 34' 31''$ E
Geographical area of the accident:	South Sweden, the port of Sölvesborg
Nature of the water region:	internal waters, port basin
Operating state of the vessel during the event:	a tug boat moored at the berth waiting for the barge to be unloaded
Place of the accident on board:	living quarters of the crew under the main deck
Effects of the accident on people:	death of four members of the crew as a result of poisoning
Effects of the accident on the vessel:	fire and thermal destruction of elements of the construction, equipment and installations in the accommodation of the crew, entrance alleyway, and social premises

2.4. Shore Services and Rescue Action Information

2.4.1. Rescue Action

2.4.1.1. General Information

Provisions on rescue services in Sweden are found primarily in the Civil Protection Act (2003:778) and the Civil Protection Ordinance (2003:789), in the following referred to by use of their acronyms in Swedish, LSO and FSO respectively.



According to Chapter 1, Section 2, first paragraph of LSO, the term “rescue services” denotes the rescue operations for which central government or municipalities shall be responsible in the event of accidents or imminent danger of accidents, in order to prevent and limit injury to persons and damage to property and the environment. Central government is responsible for mountain rescue services, air rescue services, sea rescue services, environmental rescue services at sea and rescue services in case of the emission of radioactive substances, as well as for searching for missing persons in certain cases. In other cases, the authorities of the municipality concerned are responsible for the rescue services (Chapter 3, Section 7, LSO).

On a national basis, the Swedish Civil Contingencies Agency, MSB, is responsible for coordinating municipal rescue services. Since the vessel in question was berthed in the port of Sölvesborg the Municipal Rescue Service, in this case Räddningstjänsten Västra Blekinge, is responsible for the rescue operations.

2.4.1.2. Description of Events

At 23:51 a man called SOS Alarmcentral (dispatch centre) in Växjö via the alarm number 112. He informed the SOS that a vessel in the port of Sölvesborg was on fire and that he could see a member of the crew trying to put the fire out. He gave SOS the address "Thure Carlssons väg 5" and the company name "JIWE Galv", where he was working and from where he could see the vessel. He also ensured the alarm operator that he would see to that the gate to the port was opened for the rescue services. He reported that the whole vessel seemed to be on fire and that he also could see an injured, bleeding person on the quayside. It was at this state unclear if there were two or three persons injured and what kind of vessel it was.

SOS started to alarm the Municipal Rescue Service (fire department) using a predetermined plan for “boat accident in municipality waters”, but was shortly thereafter changed to “fire on vessel”. In addition, SOS alerted ambulances, initial three units, and the police to the port.



Figure 1: Location plan. The distance from the fire station (black arrow) to the berth (green arrow) is approx. 1,6 km by the main road. Photograph: © Lantmäteriet Dnr R61749-13002

At 00:02 the first unit from the Municipal Rescue Service, which in Sölvesborg is Räddningstjänsten Västra Blekinge, arrived to the scene of the fire. The officer of this unit reported to SOS that the vessel was extensively on fire and that he could see two crew members trying to put the fire out and that another of the crew members was hurt and lying down on the quay.

The officer gave orders that the fire fighters should prepare for smoke diving. They found that due to the heat and heavy smoke it was at this stage not possible for the smoke divers to get inside the vessel in order to search for other crew members and to put the fire out. One of the rescue units was carrying a cold cutting extinguisher¹, but since it was out of order the technique couldn't be used. Hence, the Rescue Service started to extinguish the fire with water from the outside of the vessel, from the door down through to the living accommodation. Since the effect was limited, order was given to add foam into the extinguishing water. A back draft occurred during the period when the type of extinguishing system was changed. During this phase the Rescue Service looked for a fire protection plan but such a plan was not found where they expected to find it.

¹ When using a cutting extinguisher, the fire extinguishing technique is combining abrasive waterjet cutting with water spray extinguishing. The fire-fighter approaches the fire from outside the main fire area, then uses the cutting action to drill a small hole through a door or wall. Switching to a water spray then allows the fire to be fought, as with a conventional fog nozzle.



Photograph 2: Starboard side of the vessel. The door in the centre of the image is the door through which the rescuers reached the accommodation

Meanwhile SOS called JRCC (Joint Rescue Coordination Centre) to investigate if there were units from the Coast Guard in the area that could support the Rescue Service. The closest unit was two hours away from the scene of fire, outside the port of Åhus. The officer in command from the Rescue Service was given this information and at 00:01 the officer required that the Coast Guard should join the rescue operation. Also a pilot boat from Karlshamn (a city nearby) was called out to participate in the operation. During the telephone and radio calls, some operational problems occurred concerning connecting different calls.

Two additional units arrived six minutes after the first unit and the Senior Officer in command arrived shortly thereafter. The order to continue extinguishing the fire using foam and to find alternative ways to get inside the vessel's accommodation was given. At this stage another attempt to enter the accommodation was made as the level of foam was waist high. However, due to high temperature, the smoke divers were forced to retreat.

At 00:26 an ambulance crew reported to SOS that they were on their way to hospital with one injured crew member. There were still two crew members at the scene of the accident and it was during this stage unclear if, and how many, crew members still were inside the vessel.

At 00:34 information was given to SOS that there might be four crew members still inside the vessel but, due to the heat, the rescue team had not yet been able to come inside



the accommodation.

At 01:13 the Senior Officer in command reported to SOS that the fire was still ongoing and that the vessel was a tugboat. Due to the heat the fire was still difficult to extinguish. It was now clear that there were three crew members on the quayside and probably four deceased crew members inside the vessel. The units from the Rescue Service estimated to stay at the scene of the fire for at least two hours more.

After discussions with the Senior Officer in command, JRCC also alerted the Swedish Transport Agency (which is the Inspectorate). A ship's inspector would arrive before 4 o'clock to investigate the stability of the vessel.

At 02:00 a unit from the Coast Guard arrived. They were given the task to search the water in the port to confirm that no person had fallen over-board. At this time three persons had been found on-board, deceased. 10 minutes later, at 02:10, the fourth deceased person was found in one of the cabins.

The fire was extinguished at 02:50².

The bodies of the deceased were moved from the vessel between 03:00 till 04:10 and officially declared deceased by a medical doctor before they were transported away by the police.

The rescue operation ended at 04:20. At this time there was no representative from the vessel owner at site, so no formal written handover and transfer of responsibility for the remaining work could be made. Efforts had been made to reach the ship's agent, but no contact had been established. It was considered unnecessary to leave any fire guard at the site to prevent the fire to start again. The police sealed the area at the quayside and left.

The Senior Officer in command left at 05:30 and was the last person leaving the site.

At 06:00 the Senior Officer had contact with the stevedoring company "Sölvesborgs Stuveri och Hamn". They ensured that the ship's agent would contact the shipping company and that the relatives to the crew would be informed about the accident. A decision was made by the Rescue Service not to engage the POSOM³ team for the remaining crew of the vessel. Reasons for this were that the crew members were either taken to hospital or being interrogated by the police. The Senior Officer also had the understanding that POSOM activities was meant for next of kin only. Debriefing was however carried out for the rescue team.

² At 02:48 JRCC contacted MRCC Gdynia and was able to inform the shipping company about the occurrence.

³ POSOM (Psykologiskt och socialt omhändertagande) is an acronym for taking care of individuals that have been exposed for extremely stressful situations. The aim is to offer support to individuals in need.



2.4.1.3. Protection of Natural Environment

The water used for extinguishing the fire was contaminated and had to be collected and sent for destruction. Monday 5th of October the ship's agent consulted the Rescue Service and was recommended to contact "Miljöförbundet Blekinge Väst" (the municipal environmental authority) for support and equipment. The responsibility for destructing the foam and water mix was now at the vessel owner (i.e. the ship's agent).

2.4.1.4. Organisation of Rescue Services During the Action

A command centre was organized about 80 meters from the vessel for the Senior Officers from the different organisations (rescue service, ambulance and police).

The tactics was to extinguish the fire in an efficient and quick way as possible from the entrance to the accommodation. When possible the smoke divers should enter the vessel and extinguish fires in the cabins. Assessing the situation in an early stage, it was stated that there were no persons that could be alive inside the vessel.

The rescue team was divided into two sectors. The task for team in sector 1 was to extinguish the fire and enter the vessel when possible. The task for team in sector 2 was to secure the foam and water feeding system and to search areas on board that were not affected of fire and smoke. During this search a fire protection plan over the vessel was found. A hatch was also found in the forward deck of the vessel (the emergency exit) that could be used for reaching the fire with water.



Photograph 3: The hatch in the forward deck through which the accommodation could be reached



Smoke divers tried to search the vessel when the foam reached approximately the height of one meter inside the cabins, but due to heat they had to retreat. More foam was used in order to reduce the heat further.

When the smoke divers were able to get inside the vessel again they could confirm that there had been a fire inside the first cabin to the right (i.e. the starboard side). One additional group of smoke divers reached the mess room. Since there was a noise that could originate in a gas leakage the two groups of smoke divers had to evacuate. According to the vessel's crew there was no flammable gas, only breathing apparatus and handheld fire extinguishers. Due to the risk of a pressurized tank to explode the Senior Officer in command decided that the personnel in the ongoing rescue operation had to be moved to a safe area.

During the operation, it was clear that lack of knowledge of how a vessel was built and organised hampered the operation.

2.4.2. Analysis of the Rescue Action

The occurrence has initiated a further look into a few details concerning the rescue service operation, namely technical support as cutting extinguisher and telephone equipment, as well as the organisational issue how to prepare a rescue service to handle a fire on a vessel. Additionally, a reflection about decisions how to deal with persons afflicted by a traumatic situation is assessed.

2.4.2.1. Technical Support

The equipment of one of the rescue units included a cutting extinguisher. This kind of equipment is very efficient and could most likely have made the rescue operation smoother and quicker, if it had been in operational status. However, the outcome, considering the possibility to save the persons inside the vessel, is not likely to be different. The municipal rescue service has argued that a cutting extinguisher is not part of their basic equipment and pointed out that the functioning of basic equipment is always checked upon. Nevertheless, SHK considers it being essential that all pieces of equipment in rescue units should be in good operational order or replaced with a back-up.

When the alarm dispatch centre, SOS Alarmcentral Växjö, operated the telephone and radio calls from different concerned parties, problems occurred connecting these calls, according to the dispatch log. SHK is of the opinion that it is of utmost importance that



operational problems and difficulties should not be allowed to take place since it may seriously hamper any rescue operation.

2.4.2.2. Organizational Issues

Even though Sölvesborg has a port, knowledge of shipping and the special circumstances about ships is not commonly spread within the rescue service personnel and may be a problem for many ports in Sweden. The problem in this very case has been shown as lacking of familiarization about stability and how it may be affected by a rescue operation, and understanding of the architecture of a vessel's accommodation. Such knowledge would certainly make it easier and safer for the rescue service to take action and would improve the ability to reduce damage.

The problem could be solved either by information and training of rescue service personnel, but also by assistance from other authorities or organisations that have relevant experience. In this case a pilot boat was used in the operation, the Coast Guard was assisting the rescue service. Furthermore, after some time, a ship's inspector from the Swedish Transport Agency arrived. Another resource, not used in this case, are pilots, which are available 24/7 around the country.

Contact to officials on duty for different authorities is available through SOS, but experiences from this investigation indicate that knowledge about this and about the capacity of these authorities may be restricted within the municipal rescue services.

On a national basis, Swedish Civil Contingencies Agency, MSB, is the authority coordinating rescue services. Hence, SHK finds it natural for MSB, in cooperation with the Swedish Maritime Administration (responsible for piloting), the Swedish Transport Agency and the Coast Guard, to see to that knowledge about how to contact other authorities as well as knowledge about other authorities capacities is spread to municipal rescue services.

2.4.2.3. Additional Actions

As POSOM management group was not contacted, any activities by the group were never started. This led to that two persons (the third being on hospital), being exposed for a stressful and traumatic situation, were left on their own in a foreign country without any offer of support from the society.



3. Circumstances of the Accident

The tug boat *Zeus* left the port of Szczecin on 8 August 2015 with 7 crew members on board and went to the port of Ueckermünde. There, the tug boat took on tow an unpowered Swedish barge *Bagge* loaded with timber, and went to the port of Sölvesborg.



Photograph 4: The tug boat „Zeus” with the barge „Bagge” on the tow-line (Photograph by Robert Stachnik)

After unloading the timber, the tug boat started a series of short towages of the barge between different Baltic⁴ ports, by turns empty or loaded with timber. After more than a month of towing *Zeus* sailed back to the port of Sölvesborg on 18 September 2015 with the barge full of timber.

On that day, due to a stormy weather, the pilot services were suspended and the towing unit remained for a couple of days in a safe, sheltered anchorage.

On 21 September 21 2015 at ca. 8:00 a Swedish pilot led the tug boat with the barge on tow to the port. According to local harbour regulations the tug boat had to let go the towline and leave the barge at the wharf for the time of her unloading. The tug boat berthed 1000 m away at the quay belonging to the galvanizing plant.

⁴ Among others there were such ports as: Rigge, Skulte (Latvia), Sölvesborg (Sweden), Parnu (Estonia) and Kotka (Finland).



During the unloading of the barge, tug boat crew members took turns at entering the barge to ballast her and adjust the length of mooring ropes.

It was planned to complete the unloading of the barge on 24 September 2015. According to the instructions received from the operator, after the unloading, the tug boat was to tow the barge to the port of Ueckermünde and return to Szczecin.



Photograph 5: The unloaded barge "Bagge" at the wharf in Sölvesborg

Since the unloading of the barge in Sölvesborg ended a six-weeks-long absence from home, the master invited the crew members for dinner on 23 September at 18:00. He informed the crew that he had cancelled the night watches. During the meal he gave the permission to drink alcohol and so all members of the crew consumed it in varying amounts.

Between 21:00 and 22:00 individual members of the crew were successively leaving the mess room and going to their cabins for the night's rest.

Before 23:00 the watch officer⁵, who occupied the cabin on the starboard next to the steps (Figure 3), woke up, lit a little lamp above the berth (a bunk lamp), rose from his bunk (the upper one of the two bunks in the cabin) and went to the toilet. Leaving the cabin he left the cabin door opened. When he returned he noticed fire inside the cabin. He started shouting: "It's burning" and "Fire" in order to alert his mates.

⁵ The crew was composed of the master, watch officer, chief engineer, second engineer, two ABs and the ordinary seaman (acting as a cook).



The noise woke up two other crew members. The first one, a second engineer, who was sleeping in the central cabin on the port side, dashed out of the cabin half-dressed, passed by the watch officer standing at the steps and went into the engine room of the tug boat by internal passageway. There, he switched on the fire pump, went to the main deck by the emergency exit and started to connect to the fire-plug a rubber hose used for cleaning.



Photograph 6: Emergency exit from the engine room at the stern of the tug boat



Photograph 7: A working rubber hose which was used by the crew to extinguish fire

He was followed by the watch officer who had warned the others of the fire, but when he was leaving the staircase leading from the accommodation, he hit his head on a fire extinguisher hanging above the stairs. He managed to go out on the outside deck and there he lost consciousness.

Another woken up member of the crew, an AB living in the fore cabin on the starboard side, ran to the deck and saw his colleague lying on the quay, unconscious with his head covered with blood. He ran up to him to see if he was alive. Then, urged by the second engineer, he left the watch officer and started to help the engineer to unroll the rubber hose under the pressure of water and drag it to the stairs leading to the cabins.

Then both crew members were trying to approach the burning rooms on the main deck which had already been full of smoke. However, high temperature and hot, thickening smoke forced them to withdraw. The engineer who was aiming a water jet asked the seaman to find someone ashore who could call for help. A forklift driver met on the quay immediately notified the fire department.

Until the arrival of the fire brigade, the fire on board was spreading and the smoke was increasing which forced the second engineer who was trying to extinguish fire inside the superstructure to retreat to the deck outside.



The first unit of the fire brigade reached the tug boat 2 minutes after midnight on the day of 24 September 2015. Next firefighting units arrived after 6 and 17 minutes, respectively. Firefighters began extinguishing the fire. The members of the crew were taken to the premises of the galvanizing plant located at the quay, where they were questioned by the police. The injured crew member was taken to hospital by medical services.

Firefighting lasted more than two and a half hours. The fire enveloped part of accommodation and part of the superstructure containing the galley, mess room, and the entrance alleyway to the tug boat.

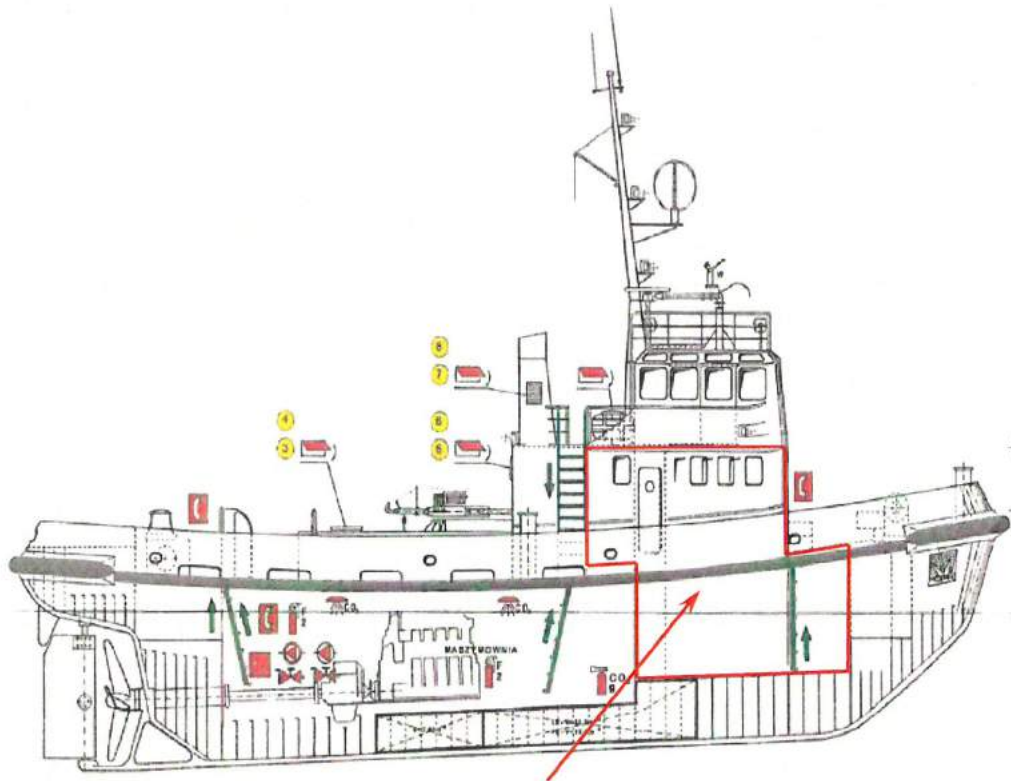


Figure 2: The area enveloped by the fire

The possibility of reaching the accommodation where the remaining crew members were staying was delayed by dense smoke, heat and the fact that the fire fighters were not familiar with the layout of premises. The attempts to reach the premises in the initial phase of the fire was stopped due to the safety of the firefighters and the belief that the people remaining there had already been dead.

The fire was extinguished at 02:50. Between 03:00 - 4:10 the bodies of the deceased crew members were taken by the firefighters to the quay, where the doctor coming to the scene pronounced them dead.

The rescue operation was completed at 04:20 on 24 September 2015.

4. The Analysis and Comments about Factors Causing the Accident with Regard to Examination Results and Expert Opinions

The tug boat *Zeus* was built in 1966 in the Danish shipyard Svendborg Skibsværft.

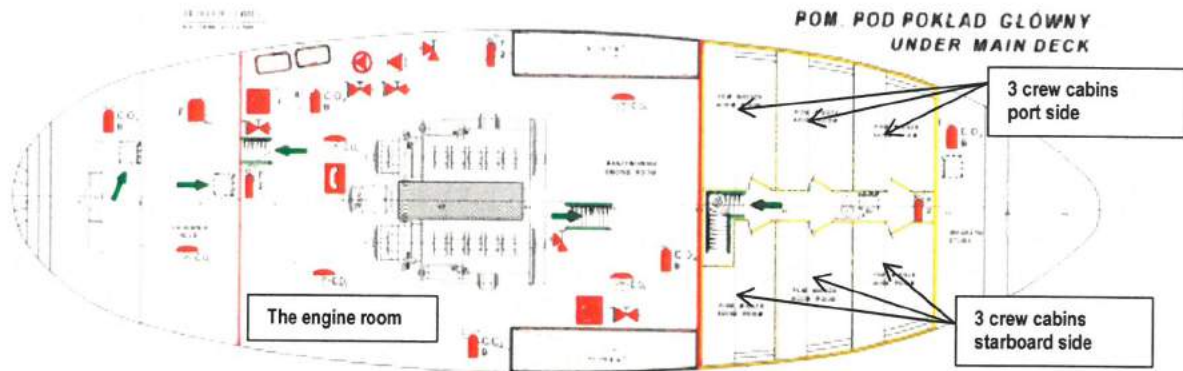


Figure 3: The layout of premises under the main deck of the tug boat

The accommodation premises of the crew were under the main deck of the tug boat which could be reached through a narrow staircase with a platform turning to the right at an angle of 90° in the lower part of the stairs (Figures 3 and 4, and Photograph 8).

The crew cabins were arranged symmetrically - 3 on each side - on both sides of the tug boat; each of them having exit to the alleyway situated in the central line of the tug boat, leading to the staircase. All cabins were similarly equipped and constructed of the same flammable materials⁶. The walls between the cabins, linings, furniture and decorations were made of wood and wood-like materials.

⁶ The materials used for elements of construction and equipment of the cabins did not fulfil current standards of fire resistance.

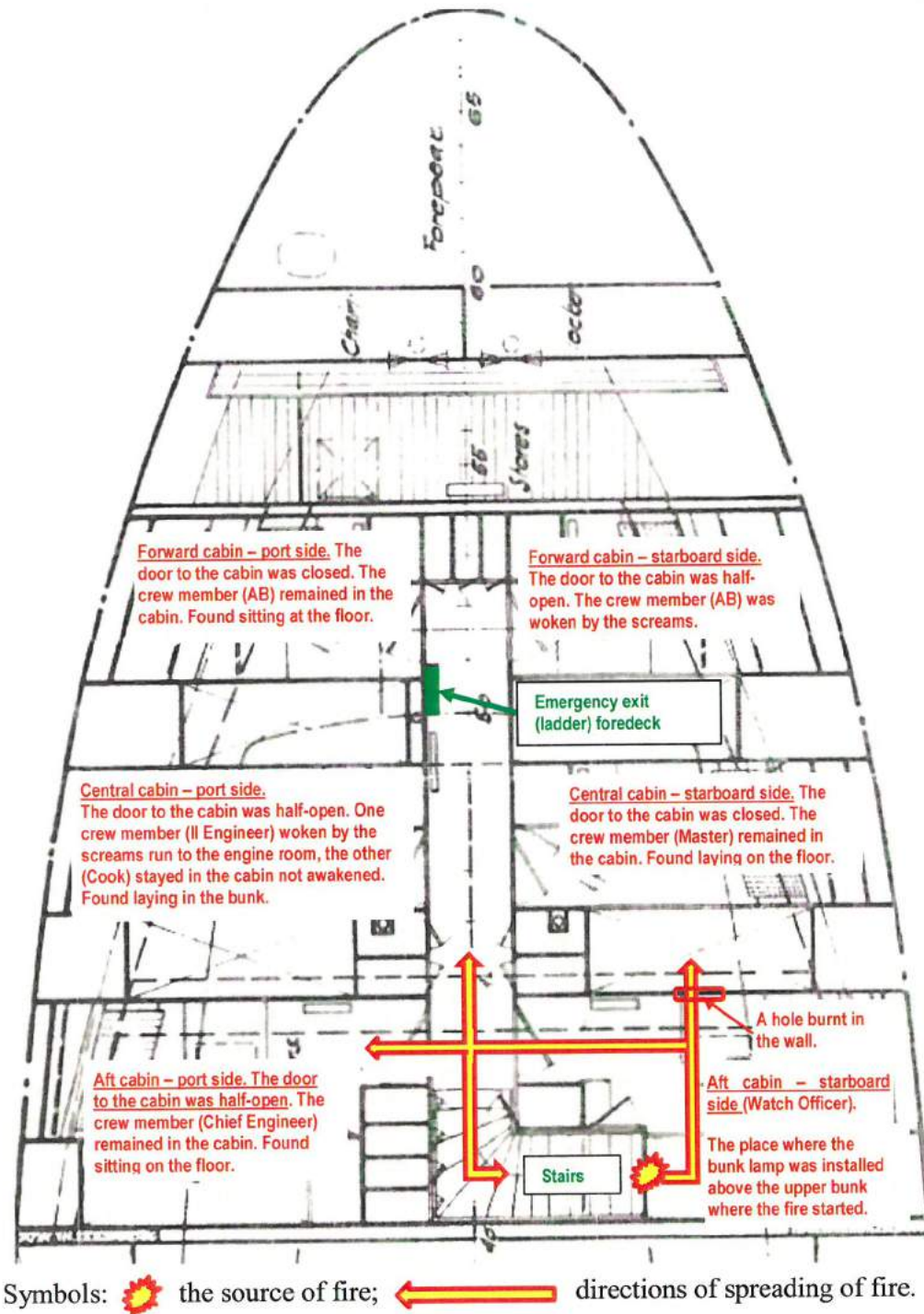


Figure 4: Accommodation of the crew members of the tug boat „Zeus”

There were two escape routes from the accommodation. One - up the stairs in the aft part of the alleyway (Figures 3 and 4, and Photograph 8) to the alleyway on the main deck, with the exit door to the open deck, and the other - from the fore part of the alleyway up the exit trunk with a steel ladder through the hatch directly onto the foredeck (Figure 4 and Photograph 9).



Photograph 8: Stairs leading from the main deck to the crew accommodation



Photograph 9: Escape exit from the alleyway to the foredeck; view from the deck

During the examination of the alleyway and cabins, the Commission ascertained that the biggest patches of scorched substance occurred inside the cabin located on the right side of the stairs, belonging to the watch officer. This is the place where the fire broke out. There, the fire was noticed by the watch officer who returned to his cabin at night after some undefined time⁷.

It was from that cabin the fire spread through the open door to the alleyway (Photograph 10),



Photograph 10: The alleyway between the crew cabins

⁷ The analysis of the process of breaking out of the fire and a layer of charred flammable materials show that the fire was developing freely for at least 20 – 30 minutes. That means that in order for the fire to develop in this way, the watch officer must have stayed out of the cabin at least 20 minutes.



and earlier smoke had escaped through the grate to the ventilating duct leading to other cabins (there was one common steel ventilating channel on the tug boat) causing asphyxiation or suffocation with carbon monoxide of the crew members who stayed in the cabins.

Patches of deeply scorched flammable materials located in the cabin of the watch officer, significantly larger than in the other cabins and in particular in the adjacent ones, indicate that the duration of the combustion process in that cabin was the longest.

In order to determine what could have been the cause of the fire, the Commission inspected the cabin of the watch officer thoroughly. In the cabin, the partition wall separating it from the adjacent cabin (belonging to the tug boat master), wood lining, furniture and the whole equipment were burnt. The inspection showed extensive scorch-marks on the right side of the cabin, looking from the entrance, in the area of the bunk beds⁸ (Photographs 11, 12 and 13).



Photograph 11: The watch officer's cabin – a part with bunk beds

The wooden frame of the upper bunk bed was completely burned. Photograph 11 shows traces of the place where the bunk bed was mounted to the wall. The polyurethane foam mattress of the top bunk bed put on the frame with steel springs, was burned (melted) and fell down on to the bottom bunk bed (Photographs 11 and 12).

⁸ There were two berths (one above the other) in all six cabins, however only one, central cabin on the port side was shared by two crew members. The remaining cabins were occupied by individual crew members.



Photograph 12: Burned top mattress on the bottom bunk bed and remaining of the upper bunk lamp

The falling metal frame with a mattress from the upper bunk probably hit and broke off the mounted to the wall the lower bunk lamp. This bunk lamp was found in the conflagration on the floor of the watch officer cabin⁹ (Photograph 13).



Zdjęcie nr 13. The lower bunk lamp in the conflagration of the cabin floor

⁹ The Commission concluded that this bunk lamp was put back over there by the firemen, after taking it ashore in order to get examined by the police experts, who decided it was not a source of a fire.



There remained a burned out place with protruding burned electric cables¹⁰ (Photograph 11 and 14) where the night-lamp (bunk lamp) socket was mounted with incandescent source of light above the level of the top bunk bed, on the wall closer to the cabin door.

Deep, local patches of scorched wall of the watch officer's cabin where the incandescent socket was mounted indicate that the cause of the fire was most likely the direct contact of the flammable material (e.g. clothing or bedding) with a heated up glass lamp bulb¹¹.



Photograph 14: A hole after burning of the bunk lamp over the top bunk bed in the watch officer's cabin



Photograph 15: The bunk lamp with a bulb; picture taken in the another crewmember cabin

Given that the wall on which the night-lamp (bunk lamp) was mounted was built of flammable laminated chipboard, it could catch fire in about 20 minutes¹².

Following the analysis of the directions of spreading of fire in the watch officer's cabin, the Commission accepted that when the flames reached the ceiling which was made of and covered with flammable materials (chipboard and wooden slats), the dust and combustible dirt (remnants of sawdust) found in the space above the ceiling over the crew cabins caught fire and caused that it quickly spread onto the ceilings in all the remaining cabins completely consuming the ceiling in the watch officer's cabin (Photograph 16) and the ceiling over the alleyway (Photograph 10); most of the ceiling over the central cabin on the starboard side (Photograph 17) and a part of the ceiling above the last (stern) cabin on the port side.

¹⁰ The Commission concluded that the upper bunk lamp parted from the wall and dropped down to the lower bunk. The upper mattress fell down on top of the lower bunk afterwards. The bunk lamp was taken ashore by the fireman in order to examine it.

¹¹ There could have been a direct contact of the flammable substance with a heated up filament, yet that possibility was excluded by the Commission because the bunk lamp was examined ashore by the police and the Swedish rescue services which established that the filament of the bulb had not been damaged.

¹² Taking the above into regard the Commission took into consideration the results of experiments which had been done in the Main School of Fire Service in Warsaw which showed that the bulb of 40W covered with a piece of cloth (with no air) could heat up to the temperature of ca 150°C in 20 minutes and ignite a flammable fabric.



The fire of the ceiling in the watch officer's cabin was facilitated by direct access of air from the ventilation duct. It is manifested by the lack of soot in the vicinity of the ventilation duct outlet grate (Photograph 16).



Photograph 16: Burned soot around the air inlet in the ceiling ventilation duct



Photograph 17: Completely burned out ceiling in the central cabin on starboard side

Through the open door of the cabin where the fire started, open fire spread to the alleyway and the staircase and set the door on fire and it burned part of the door frame in the cabin on the opposite side of the alleyway, belonging to the chief engineer (Photograph 18). However fire destruction in that cabin was moderate. Apart from the door, it was limited to the upper part of the cabin and came from the flames of the burning ceiling.

The greatest damage, apart from the cabin where the fire originated, occurred in the central cabin (belonging to the tug boat master) situated on the starboard side (Photograph 19) adjacent to the watch officer's cabin.



Photograph 18: The cabin of the chief engineer

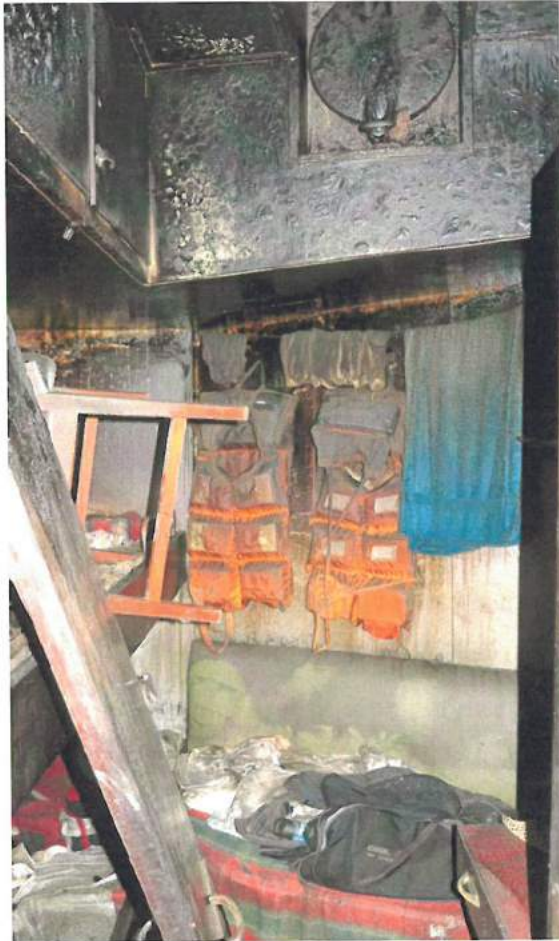


Photograph 19: The cabin of the tug boat master

There are significant differences as far as damage is concerned, between the cabin where the fire started and other cabins. Moving away from the watch officer's cabin, thermal



destruction of the same flammable construction materials is clearly declining. Large amounts of smoke emitted from burning ceilings resulted in the formation of sediment.



Photograph 20: Central cabin – port side



Photograph 21: Forward cabin – starboard side

Fire from the ceiling over the alleyway located between the residential cabins moved to the staircase leading to the main deck of the superstructure and caused ignition of the ceiling in the alleyway and in the space connected with the galley and the mess room. The main deck over the cabin where the fire started - heated to a high temperature by burning framework and the ceiling cover - was deformed. In the galley, the ceramic tiles cracked and the carpet lying in the mess room melted. Walls, furniture, as well as kitchen and mess room equipment suffered thermal destruction (Photographs 22 and 23).



Photograph 22: Thermal destruction in the galley



Photograph 23: Thermal destruction in the mess room

The high temperature destroyed the side scuttle of the watch officer's cabin and deformed the main deck above it. Fire flames burnt out the inner wooden door leading to the tug boat and get out through the outer steel doors (Photograph 24).



Photograph 24: Effects of high temperature



Photograph 25: Destroyed fire locker

The fire consumed the equipment deposited in the storage situated in the alleyway in the superstructure on the main deck (Photograph 25). Two sets of firefighter's outfits composed of a breathing apparatus with a set of spare bottles, helmets and protective clothing including the fire-belts were stored at the mess room.



Since the door to the bridge and the engine room of the vessel were closed, the fire did not reach these premises¹³ despite the surface of the entrance doors being partly burned.



Photograph 26: A part of the bridge



Photograph 27: The entrance to the engine room

The fire consumed the fire-fighting equipment deposited in the storage situated in the alleyway in the superstructure on the main deck (Photograph 24) including two sets of firefighter's outfits composed of a breathing apparatus with a set of spare bottles, helmets and protective clothing including the fire-belts.

4.1. Mechanical Factors

Since the construction of the tug boat *Zeus* in 1966 her accommodation and service spaces have not been modernized. Partition walls of rooms, doors, ceilings, linings and finishing elements were made of flammable materials.¹⁴

¹³ The engine compartment was separated from the accommodation and operational premises by a steel bulkhead (class A fire bulkhead with insulation).

¹⁴ The regulations on maritime safety in the scope of construction and equipment of vessels are contained in the act of 18 August 2011 on maritime safety (Journal of Laws of 2016, item 281). The act allows in the art. 12 to use a vessel that is not subject to the SOLAS Convention (such as *Zeus*) if her construction and equipment ensure safety of life and health of the users and they are consistent with the requirements defined in the technical regulations of a recognized organization, which supervises the vessel. Regulations for Classification and Construction of Sea-going Vessels issued by PRS, in Part V (Fire Protection) define specific requirements for construction and fire protection of accommodation and service (including social) spaces. Current regulations, which entered into force after 1986 and include the provisions of the SOLAS Convention, require the tug boats built after that date to have all structural elements and materials for equipment of accommodation and service spaces non-flammable and meeting the requirements of fire resistance (flammability, toxicity, smoke production, fire spreading), in accordance with the standards used in shipbuilding, and being confirmed by an appropriate certificate. In addition, accommodation and service spaces should be fitted with a fixed fire detection and fire alarm system, suitable for the sea-going vessels. Existing tug boats, built before 1986 and still in operation, do not need to meet the above requirements. This means that structural elements and materials for equipment of accommodation and service spaces of such tug boats are (or may be) flammable (they do not meet the requirements of fire resistance), and that the accommodation spaces are not equipped with the fire detection and fire alarm system. It makes them much more susceptible to fire than tug boats built after that date.



Due to the size of the tug boat the premises for the crew which could accommodate 12 people were small and therefore in that limited space there were a lot of upholstery materials covering leisure furniture and mattresses filled with flexible polyurethane foam, which after ignition would produce large amounts of smoke and poisonous gas - hydrogen cyanide.

According to the Commission all these elements have increased rapid development and easy spread of the fire and the severity of its effects.

Accommodation and social spaces of the tug boat were not equipped with the fire detection and fire alarm system.

4.2. Human Factors (errors and omissions)

The master of the tug boat *Zeus*, in spite of the provisions contained in the shipowners' Rules of Work Procedure¹⁵, allowed the crew to bring the alcohol on board and then to consume it at dinner¹⁶. The number of empty bottles which the Commission found on the site of the fire in the mess room and in the galley proves that significant quantity of alcohol had been consumed.¹⁷

The operator of the tug boat have stipulated in the master's working instructions his authority to "regulate the way the duties are performed by the crew".¹⁸ However the operator has not stipulated that the master would give up the watch-keeping in the port and leave the tug boat unattended.¹⁹ When calling off the port watch the master violated the provisions of the Rules of Work Procedure and Stay on Board a Vessel, which in paragraph 12 imposes on

¹⁵ "The Rules of Work Procedure of the Company Zakład Usług Żeglugowych Spółka z ograniczoną odpowiedzialnością & Co. Sp. K. headquartered in Szczecin". The provision of par. 13 of the Rules of Work Procedure on the day of the event was the following: "1. The alcohol is strictly prohibited by the employer. 2. The employees are prohibited from bringing and consuming alcoholic beverages and drugs in the workplace (including the vessels navigated by the employer) or staying in the workplace under the influence of such beverages or drugs. Violation of this prohibition constitutes a serious breach of basic duties of an employee".

¹⁶ According to the regulation of paragraph 8.3 of the Rules of Work Procedure and Stay on Board a Vessel of the Operator Zakład Usług Żeglugowych Spółka z ograniczoną odpowiedzialnością & Co. Sp. K. headquartered in Szczecin: "It is a gross misconduct for a member of the crew to stay on board a vessel in a state indicating alcohol consumption and may be the basis for the shipowner to terminate the employment contract through the employee's fault".

¹⁷ The confirmation of the fact that the alcohol had been consumed in large amounts are high alcohol content results in the bodies of the deceased seamen found during the autopsy and in the organism of the watch officer, who was attended at the hospital in the port of Sölvesborg. These results varied between 1.47 ‰ to 3.2 ‰ of alcohol in the blood. Two crew members, who had attempted to extinguish fire on the tug boat in its first phase were not examined for the content of alcohol in the body, but the Swedish firefighters who arrived on the scene of the fire reported that they smelled of alcohol.

¹⁸ Zakład Usług Żeglugowych Szczecin. *Working Instructions for the Employees working on the Vessels. The Master*, p. 6.

¹⁹ The tug boat was not connected to the power supply from the shore. The outdoor lighting of the tug boat and the lighting in the accommodation was supplied by a power generator working in the engine room of the tug boat.



port watch the duty of looking after the vessel to be safely berthed, as well as the provisions of his own working instructions.²⁰

Neither the watch officer nor the two crew members who had woken up acted according to the procedures applicable on the vessel and contained in the Risk Management Instruction²¹, as to the activation of the general emergency alarm on board of the vessel. The second engineer, who ran to the engine room and started the fire pump, acted though according to his duties described in the muster list when doing so.

No fire-fighting equipment located in close proximity of the cabins and the source of fire had been used to extinguish the fire²². The fire extinguisher which was fixed by the stairs leading to the crew cabins was left untouched in its bracket (Photograph 30). The second extinguisher, fixed on the wall between the first and the second cabin at the port side (Photograph 29) had been found by the firemen inside the first cabin on the floor (Photograph 28). It means that the crew member who occupied this cabin probably went outside the cabin, grabbed the extinguisher, which was nearby, but was not able to use it, as he was forced by smoke or flames to return to his cabin.



Photograph 28. Fire extinguisher found in the first cabin (from the bow) at the port side.



Photograph 29. Fire extinguisher holder at the corridor between the crew cabins.

The part of the crew left quickly the accommodation without using the press-button activating the fire alarm signal. One of the alarm-bells was situated in the hallway in the

²⁰ Two named members of the crew (one of the deck crew, the other of the engine crew) had been designated to take the port watch during berthing in the port of Sölvesborg. Both seamen of the watch remained in their cabins and died in the fire.

²¹ In the "Risk Management Instruction for the Master" posted in the alleyway of the tug boat at the entrance to the bridge, among several types of alarms anticipated on the vessel, the operator determined that: "The fire alarm must be announced immediately after noticing the fire or after receiving a notification of the fire on board, and then the extinguishing action must be controlled. When in port, the master must notify the fire department."

²² Using a portable fire extinguishers in such a developed stage of a fire would not probably help to extinguish a fire in the watch officer's cabin.



accommodation (Photograph 31), but the button activating alarm-bells was on the bridge. The investigation shows that the fire developed very quickly. It can therefore not be concluded with certainty that the crewmembers that remained in their cabins (see Figure 4) would have had a better possibility to get out in time if someone had gone to the bridge and activated the alarm-bell instead of directly yelling in the corridor. It can though be concluded that the crewmembers that did wake up had their doors open. The fact that they had their doors open may have made it easier for them both to hear the screams and to get out quickly enough.



Photograph 30: Fire extinguisher at the stairs



Photograph 31: The alarm-bell on the wall of the alleyway near the crew cabins; a photograph from a sister tug boat "Cyklop"

The short time available for saving the crew members of the tug boat sleeping in their cabins was due to the fact that highly toxic gases produced during the combustion and melting of the equipment of the tug boat posed a much greater risk than the fire itself for those who remained in the cabins. Hydrogen cyanide which is forming in the process of combustion of the polyurethane foam causes a fatal poisoning within a few breaths. There was one common steel ventilation duct leading to all cabins therefore the penetration of toxic gases was facilitated.²³

²³ During the autopsy it was found that the cause of death of those who remained in the cabins was poisoning by a mixture of toxic gases (carbon monoxide and hydrogen cyanide) which were being emitted during pyrolysis and combustion of materials located in the accommodation of the tug boat.



4.3. Organizational Factors

The Commission has found out that customarily fire alarm drills were conducted on the tug boats of the operator at the beginning of each month. The Commission has also found out that not always the whole crew participated in these drills due to other operational activities being performed at the same time. It resulted in the fact that not all members of the crew, even those who had years of experience of working on tug boats of ZUŻ were able to correctly determine the firefighting equipment storage location on the tug boat.

5. Description of Examination Findings Including the Identification of Safety Issues and Conclusions

The effects of fire on the tug boat *Zeus* turned out to be tragic. The fire killed 4 crew members, the fire entailed substantial material loss. All accommodation and social spaces on two levels were destroyed. The construction of premises made of flammable materials contributed to the rapid development of the fire onto the whole area of accommodation and social spaces.

The Commission has determined that the fire started in the cabin which belonged to the watch officer, located in the aft part of the accommodation, on the starboard side, next to the stairs. Most likely the fire started because the watch officer inadvertently left a piece of clothing or bedding on a hot light bulb of the upper bedside lamp (bunk lamp) before going out of the cabin at night²⁴.

The Commission has also considered other possible causes of the fire on the tug boat: the state of emergency of the electrical installation; malfunctioning heating equipment and a cigarette butt being the source of the fire.

After the analysis of the state of electrical installation in the watch officer's cabin, the Commission has found no evidence that would indicate the occurrence of the failure, or

²⁴ Among the materials collected by the Commission in the case of the fire on *Zeus* there are several expert opinions on the reasons of the fire, prepared by Polish and Swedish experts (see the point 13 of the report: *Information sources*, page 37). All of them agree that the fire started in the starboard stern cabin and in the vicinity of the bunks. However a few different conclusions have been drawn as to the exact location of the source of fire. Some of them indicate that it was in the lower bunk and some that it was in the upper bunk where the fire started. The Commission took as the most probable that the fire started from the contact of some flammable material laying against the hot bulb of the bunk light on the wall above the upper bunk in this cabin. On the base of the evidence materials received from the Swedish police the Commission deemed that it cannot be excluded that the crew members who were able to evacuate from the burning tug boat had not gone asleep, but remained longer than the others in the mess room.



a short circuit in the electrical system, as possible factors initiating the fire. In addition, it results from the resistance tests of the electrical installation on the tug boat (of 8 October 2014 – Annex 4) submitted by the operator to the Commission that had been was technically efficient.

The heating system of the cabins consisted of panel radiators heated up with hot water. So, they could not have started the fire. The Commission has not found in the watch officer's cabin any of residues of an electric heater with an open coil or some similar heating device that would have had an impact on the creation of the fire.

The Commission has found no evidence that fire started from a cigarette. No cigarette butts or other traces of cigarettes were found in the cabin. Additionally the crew member living in the cabin claims that he did not smoke cigarettes²⁵.

The Commission has concluded that no fire-fighting equipment located in close proximity of the cabins and the source of fire were used to extinguish fire and that the fire alarm signal was not used to wake up sleeping colleagues. This can be explained by the fact that they all were in a state of shock or panic and under the influence of alcohol, which may have affected their judgement and ability to think clearly and act according to instructions in the current situation. However, as already stated above, it cannot be concluded with certainty that it would have changed the outcome if the crew had taken these actions.

The fact, that the firemen found three out of four dead crew members sitting or lying on the cabin floor indicates that they were awoken but the spreading of fire and toxic gases was so fast, that they were not able to get outside and got poisoned.

The fire extinguishing action initiated by the firefighting units which arrived at the scene, slowed down and then stopped spreading of the fire.

Lack of access to the fire protection plan of the tug boat²⁶ had initially (it was not until later that they found the fire protection plan of the tug boat which was posted on the wall of the hallway leading to the wheelhouse) hampered the action of extinguishing the fire by the firefighting and rescue units which had arrived at the scene. The firefighters leading the rescue action had little experience in extinguishing fire on vessels and the tug boat *Zeus* – not being the subject of the SOLAS Convention – was not obliged to keep a container with an

²⁵ On the other hand, remnants of cigarettes or cigarette butts may be hard to find in a burnt out space since they easily may have been completely consumed by the fire. Although not likely, the possibility of the fire starting from a cigarette cannot therefore be totally excluded.

²⁶ The obligation to develop a fire protection plan for such a vessel as the tug boat *Zeus* results from the provision of §19.1.3 of the Ordinance of the Minister of Infrastructure and Development of 9 December 2014 on detailed conditions of safe navigation of the sea-going vessels (Journal of Laws of 2015, item 48).



additional copy of the fire protection plan of the tug boat on the open deck where it would be accessible for firefighting units.²⁷

According to the Commission, if the tug boat had been equipped with a fire detection and alarm system with smoke detectors in the cabins, the scale and effects of the fire would have been much smaller, and the crew could have been warned in time about the danger of fire.

6. Actions taken

Upon the occurrence of the fire on the tug boat *Zeus* in the port of Sölvesborg, a number of corrective actions have been undertaken both by the Swedish rescue services and the authorities of the city of Sölvesborg, as well as by the operator of the tug boat.

6.1. Actions Described in the Report of the Swedish Authority SHK

After the accident, the Rescue Service (Räddningstjänsten Västra Blekinge) prepared a report which assessed the activities carried out and highlighted the experiences and suggestions for further development. The report confirms, inter alia, the lack of knowledge within the organization about shipping and ships, and contains proposals to improve the organization in order to enhance opportunities for action related to shipping and dealing with conducting the initial stage of the rescue operation of such a great importance. A program concerning “Fire on vessel in port” started in 2016 and will continue during 2017, where activities have been identified for further implementation, including education and training. Furthermore, the Rescue Service has purchased another cold cutting extinguisher as a back-up.

The authorities of the city of Sölvesborg updated the procedures for POSOM actions. They decided that the POSOM management group, not the rescue services, will decide about activating POSOM. The rescue services will contact the POSOM management group when making such decisions.

²⁷ The obligation to have such a container results from the provision of §19.2.2 of the Ordinance of the Minister of Infrastructure and Development of 9 December 2014 on detailed conditions of safe navigation of the sea-going vessels (Journal of Laws of 2015, item 48) but it applies only to the vessels which are subject to the SOLAS Convention.



6.2. Actions taken by the Operator of the Tug Boat *Zeus*

The operator of the tug boat *Zeus* has equipped the two of three operated tug boats (*Zeus* and *Amon*) in the fire detection systems. The systems were specifically designed for the individual vessels. Components of the system were approved by the classifier (PRS). Both the company that prepared the design and the producer of the system were accepted by the classifier. The operator has informed the Commission of plans to mount a similar detection system on the last vessel of ZUŻ, the tug boat *Cyklop*, at the upcoming review of the class.

The operator equipped all his tug boats in a labeled containers, placed in a conspicuous and publicly accessible place, outside the superstructure, contained the additional copy of the fire protection plan in Polish and English.

The operator of the tug boat has implemented changes to the Rules of Work Procedure by introducing a new Chapter IV “The policy preventing the use of alcohol with the Employer.” In these Rules there were set out in detail the duties and rights of both employers and employees related to the matters connected with carrying and consuming alcohol in the workplace, including the tug boats. In particular, there was introduced a system of periodic employees’ sobriety tests and there were introduced certain rights of the employer in cases where the results of the test indicate the state under the influence of alcohol.

Following the changes in the Rules of Work Procedure the operator has introduced amendments to the Rules of Work Procedure and Stay aboard a Vessel, where, among others, it made it mandatory for the master to ensure “that no alcoholic beverages are brought on board a vessel.”

In addition, the operator has prepared a document called the “Information for the Master of a Vessel”, which is presented to the master of a tug boat prior to the voyage for his guidance with request to sign it as a proof of taking note of it. The document, which forms a kind of compendium of knowledge of the duties of the vessel’s master, includes the principles for the alarm drills and alcohol policy of the operator. This document reiterates after the Rules of Work Procedure and the Rules of Work Procedure and Stay Aboard a Vessel that the master is obliged to take care that no alcoholic beverages are taken to the vessel, to enforce the ban on alcohol consumption on board and is authorised to conduct sobriety tests.



7. Safety Recommendations

The State Marine Accident Investigation Commission has deemed reasonable to refer to the following entities safety recommendations representing the proposals of measures that may contribute to the prevention of similar accidents in the future.

7.1. The Ship Operator - Zakład Usług Żeglugowych

In relation to the corrective actions taken by the operator of the tug boat *Zeus* in the period from the occurrence of the fire until the date of the report, as to tug boat fire-fighting equipment and the anti-alcohol policy, which largely fulfil the recommendations made by the Commission during the accident investigation, the Commission decided not to issue any recommendations in these matters.

Nevertheless the State Marine Accident Investigation Commission has recommended that the company Zakład Usług Żeglugowych Sp. z o.o. & Co. in Szczecin should:

- 1) create a mechanism of control of alarm drills organized and carried out by the masters of tug boats, which would ensure verification that the drills are attended by the whole crew regardless of their individual tasks and functions performed on a tug boat;
- 2) correct the fire control plan of the tug boat “Zeus” as to correctness of the symbols used on it; the Commission found out that there was no manually operated call point installed on board of the tug boat, but the fire control plan contains symbol of such an installation.

7.2. Polish Register of Shipping SA

The State Marine Accident Investigation Commission has recommended that the Polish Register of Shipping SA should upgrade Part V “Fire Protection” of the “Rules for the Classification and Construction of Sea-going Vessels” by introducing an obligation to make the modernization, involving the installation of the fire detection and alarm systems in the accommodation and working spaces of tug boats flying Polish flag, built before 1986 with more than 5 crew members. The deadline for modernization should be adjusted to the date of the nearest class survey but not later than the end of 2018.



8. Recommendations of the Swedish Accident Investigation Authority (SHK)

8.1. Municipal Rescue Service (*Räddningstjänsten Västra Blekinge*)

Since Räddningstjänsten Västra Blekinge (Municipal Rescue Service) has taken due action from experience of the rescue operation (see 6.1) SHK refrains from issuing any recommendations.

8.2. Dispatch Centre (*SOS Alarmcentral*) Växjö

SOS Alarmcentral Växjö (the alarm dispatch centre) is recommended to ensure that operational personnel at all times are able to handle the equipment needed for their task.

8.3. Swedish Civil Contingencies Agency (MSB)

Swedish Civil Contingencies Agency, MSB, in cooperation with SMA, STA and the Coast Guard, is recommended to enhance knowledge within municipal rescue services about the possibility to get in contact with administrations and authorities with shipping knowledge when needed.

9. List of Photographs

Photograph 1: The tug boat Zeus	6
Photograph 2: Starboard side of the vessel. The door in the centre of the image is the door through which the rescuers reached the accommodation.....	10
Photograph 3: The hatch in the forward deck through which the accommodation could be reached	12
Photograph 4: The tug boat „Zeus” with the barge „Bagge” on the tow-line (Photograph by Robert Stachnik).....	15
Photograph 5: The unloaded barge “Bagge” at the wharf in Sölvesborg.....	16
Photograph 6: Emergency exit from the engine room at the stern of the tug boat.....	17
Photograph 7: A working rubber hose which was used by the crew to extinguish fire	17
Photograph 8: Stairs leading from the main deck to the crew accommodation.....	21
Photograph 9: Escape exit from the alleyway to the foredeck; view from the deck.....	21
Photograph 10: The alleyway between the crew cabins	21



Photograph 11: The watch officer's cabin – a part with bunk beds	22
Photograph 12: Burned top mattress on the bottom bunk bed and remaining of the upper bunk lamp	23
Zdjęcie nr 13. The lower bunk lamp in the conflagration of the cabin floor	23
Photograph 14: A hole after burning of the bunk lamp over the top bunk bed in the watch officer's cabin	24
Photograph 15: The bunk lamp with a bulb; picture taken in the another crewmember cabin	24
Photograph 16: Burned soot around the air inlet in the ceiling ventilation duct.....	25
Photograph 17: Completely burned out ceiling in the central cabin on starboard side.....	25
Photograph 18: The cabin of the chief engineer	25
Photograph 19: The cabin of the tug boat master.....	25
Photograph 20: Central cabin – port side.....	26
Photograph 21: Forward cabin – starboard side.....	26
Photograph 22: Thermal destruction in the galley	27
Photograph 23: Thermal destruction in the mess room.....	27
Photograph 24: Effects of high temperature	27
Photograph 25: Destroyed fire locker	27
Photograph 26: A part of the bridge.....	28
Photograph 27: The entrance to the engine room	28
Photograph 28. Fire extinguisher found in the first cabin (from the bow) at the port side.	30
Photograph 29. Fire extinguisher holder at the corridor between the crew cabins.	30
Photograph 30: Fire extinguisher at the stairs	31
Photograph 31: The alarm-bell on the wall of the alleyway near the crew cabins; a photograph from a sister tug boat "Cyklop"	31

10. List of Figures

Figure 1: Location plan. The distance from the fire station (black arrow) to the berth (green arrow) is approx. 1,6 km by the main road. Photograph: © Lantmäteriet Dnr R61749-13002 9	
Figure 2: The area enveloped by the fire.....	18
Figure 3: The layout of premises under the main deck of the tug boat	19
Figure 4: Accommodation of the crew members of the tug boat „Zeus”	20



11. Glossary and Abbreviations

MSB – Swedish Civil Contingencies Agency

PRS – Polish Register of Shipping

SHK (*Statens haverikommission*) – Swedish Accident Investigation Authority

SMA – Swedish Maritime Administration

STA – Swedish Transport Agency

12. Information Sources

Notification about the accident

Documents of the tug boat

Hearing of the crew members of the tug boat

Materials and documents received from the ship's operator

Expert opinion made by S. Affek – the individual expert of the SMAIC

Expert opinion made by the „Anfire” company, Warsaw

Expert opinion made by SP Technical Research Institute of Sweden, Department of Fire Research

Opinion of the rescue action made by the Swedish Rescue Services *Region Västra Blekinge*

13. Composition of the Accident Investigative Team


The team conducting the examination was composed of:

the Team Leader – Marek Szymankiewicz, the Secretary of the SMAIC

the Team Member – Tadeusz Gontarek, the Member of the SMAIC

the Team Member – Cezary Łuczywek, the Chairman of the SMAIC

Safety Card of the tug boat Zeus



RZECZPOSPOLITA POLSKA
KARTA BEZPIECZEŃSTWA
 Nr: 403/KB/SZC/14
 wydana na podstawie
 art. 23 ust. 1 ustawy z dnia 18 sierpnia 2011 r. o bezpieczeństwie morskim (Dz. U. nr 228 poz.1368, z późn. zm.)
W IMIENIU RZĄDU RZECZYPOSPOLITEJ POLSKIEJ
 przez Dyrektora Urzędu Morskiego w **SZCZECINIE**

KOPIA

Nazwa statku:	ZEUS		Sygnal rozpoznawczy:	SQLH	
Armator:	Zakład Usług Żeglugowych Sp. z o.o. & Co. Sp.k.				
Port macierzysty:	Szczecin	Nr rejestru:	ROS/S/418	Klasa statku:	KM TUG I (L2)
Typ statku:	holownik	Materiał:	Stal		
Rek. budowy:	1966	Stocznia:	Svendborg Skibsvaerft		
Pojemność brutto:	186,00	Pojemność netto:	55,00	Nośność:	-
Długość całkowita:	28,43	Długość pomiędzy pionami:	26,76		
Ważna burtą:	-	Wysokość boczna:	4,00	Zanurzenie maks:	3,34
Szerokość:	8,00	Ilość grodzi wodoszczelnych:	4		

Napęd: (liczba typ, moc [kW], nr fabryczny, powierzchnia i rodzaj ozaglowania):
 2 silniki spalinowe typ BW D526MTB-40 o łącznej mocy 1214 kW

Urządzenia radiokomunikacyjne i radionawigacyjne:
 radiotelefon VHF, radiotelefon VHF+DSC, radiotelefon MF+DSC, 2 przenośne radiotelefony dwukierunkowe,
 radar, transponder radarowy, GPS, AIS, EPIRB 406, NAVTEX

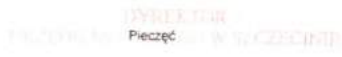
Załoga liczba dyplomy	Dyplomy lub certyfikaty / Liczba osób		Środki ratunkowe (liczba sztuk / osób)	
	Krajowa	międzynarodowa		
Kapitan:	sztyper 2 kl. żegl. krajowej	patrz Certyfikat Bezpiecznej Obsługi	- łodzie ratunkowe	- szt. dla - osób
Oficerowie pokładowi:	*sztyper 2 kl. żegl. krajowej		- łodzie ratownicze	- szt. dla - osób
Starszy mechanik:	of.mech.wacht. na statkach o mocy 750 kW i powyż.		- tratwy pneumatyczne	2 szt. dla 10 osób
Oficerowie mechanicy:	*of.mech.wacht. na statkach o mocy 750 kW i powyż.		- tratwy sztywne	- szt. dla - osób
Radiooperator:			- koła ratunkowe	4 szt. dla - osób
Marynarze pokładowi:	starszy marynarz marynarz wachtowy		- pasy ratunkowe	10 szt. dla 8 osób
Motoryści:			- kombinezony ratunkowe	8 szt. dla 8 osób
Inni:			łącznie dla:	8 osób
Minimum / Maksimum	4 / 8	6 / 8	wyrzutnia linki ratunkowej:	1 kpl. szt.
Inne wymagania i warunki:	* Nie wymagany przy pracy zmianowej 12/12 h.			

STWIERDZA SIĘ ze wyżej wymieniony statek został poddany inspekcji i dopuszczony do uprawiania żeglugi jako **holownik**
 w żegludze międzynarodowej przy sile wiatru **b.o. "B"** i stanie morza **b.o. "B"** (wysokość fali - m.)
 w żegludze - przy sile wiatru **"B"** i stanie morza **"B"** (wysokość fali - m.)
 Został wydany certyfikat zwolnienia nr: **404/Z-N/SZC/14**


Niniejsza Karta jest ważna do dnia: **2018-10-13**
 Niniejsza karta traci ważność, jeżeli statek zostanie uszkodzony lub nastąpią zmiany konstrukcyjne zagrażające jego bezpieczeństwu lub w przypadku braku
 skutecznego potwierdzenia w okresie od 3 miesięcy przed upływem daty rocznicowej karty do 3 miesięcy po upływie tej daty
 W. J. J. J. J.

Szczecin, 2014-10-14

Miejscowość, data



Pieczęć



Podpis

Wzrost 1,70m, PGR 00-26, Kopia, 119,0, ODWAZEJ 00 01-04-2014, STR. 1/3

Certificate of Class of the tug boat Zeus

1
COPY



Polski Rejestr Statków

CERTIFICATE OF CLASS

ŚWIADECTWO KLASY

No
 Nr M - 36530/14

Name of ship <i>Nazwa statku</i>	ZEUS	PRS Register No. <i>Nr Rejestru PRS</i>	210064
IMO No <i>Nr IMO</i>	IMO 6605503	Distinctive number or letters <i>Sygnal rozpoznawczy</i>	SQLH
Flag <i>Bandera</i>	Polska	Official No. <i>Nr urzędowy</i>	ROS/S/418
Port of registry <i>Port macierzysty</i>	Szczecin		

THIS IS TO CERTIFY, on the basis of the survey performed, that the ship and her equipment comply with the requirements of the Rules for the Classification and Construction of Sea-going Ships. As a result the Class was renewed with a symbol:

ZAŚWIADCZA SIĘ, na podstawie przeprowadzonego przeglądu, że statek, jego urządzenia i wyposażenie odpowiadają wymaganiom Przepisów klasyfikacji i budowy statków morskich. W wyniku tego odnowiono klasę z symbolem:

KM
TUG I (L2)

Completion date of the survey on which this Certificate is based <i>Data zakończenia przeglądu, na podstawie którego niniejsze Świadectwo zostało wydane</i>	2013-10-14
Kind of the survey <i>Rodzaj przeglądu</i>	Class renewal / Odnowienie klasy
This Certificate is valid until <i>Niniejsze Świadectwo jest ważne do</i>	2018-10-13

subject to periodical surveys of the ship in accordance with the requirements of the Rules
pod warunkiem poddawania statku przeglądom okresowym zgodnie z wymaganiami Przepisów

Issued at
Wydano w

Gdańsk, 2014-02-24






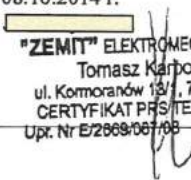
Signature/Podpis

PRS/OI 2008-07-01 ver. 2.11
1/4

Record of the measurement of insulation 3 x 380

 <p style="font-size: small; margin-top: 5px;">Tomasz Karbowiczek tel kom: +48 501 140 249 e-mail: zemit.nig@wp.pl</p>	<p>ELEKTROMECHANIKA OGÓLNA Tomasz Karbowiczek 71-696 Szczecin ul. Kormoranów 13 m 1 tel. + 48 501-140-249 fax. + 48 091 88 08 221 email: zemit.mg@wp.pl P.R.S. Recognition certificate TE/231/883995/13 SEP E/2669/087/09</p>			
<p>Pomiar stanu izolacji elektrycznej</p>				
<p>Przedmiot pomiarów : pomiar stanu izolacji 380V,220V i 24 V</p>				
<p>Zleceniodawca: Zakład Usług Żeglugowych Sp z o.o. & Co.SP.k na holowniku „ ZEUS „ Kartę sporządził : w obecności przedstawiciela zleceniodawcy : I Mechanika Data:08.10.2014r. Miejsce: Szczecin</p>				
<p>Pomiar stanu izolacji 3x380V</p>				
Lp	Nr obwodu	Nazwa zasilanego urządzenia	Oporność izolacji [MΩ]	Uwagi
1		Zasilanie z łądu	30	Bez uwag
2		Urządzenie sterowe I	50	Bez uwag
3		Transformator III	50	Bez uwag
4		P-pa ogólnego użytku	40	Bez uwag
5		Winda kotwiczna - stojan	40	Bez uwag
6		Winda kotwiczna - wirnik	40	Bez uwag
7		Winda holownicza - zasilanie	40	Bez uwag
8		Winda holownicza - silnik p-py hydraulicznej głównej	40	Bez uwag
9		Winda holownicza – silnik p-py hydraulicznej pomocniczej	40	Bez uwag
10		Winda holownicza – silnik wentylatora	50	Bez uwag
11		P-pa oleju smarnego - zapasowa	50	Bez uwag
12		P-pa olejowa przekładni nr II	50	Bez uwag
13		Wentylator maszynowni PB	40	Bez uwag
14		Sprężarka nr I	50	Bez uwag
15		P-pa zęzowa	50	Bez uwag
16		Transformator nr II	50	Bez uwag
17		P-pa pożarowa - stojan	40	Bez uwag
18		P-pa pożarowa - wirnik	40	Bez uwag
19		Wentylator pomieszczeń	50	Bez uwag
20		Wentylator maszynowni LB	50	Bez uwag
21		P-pa olejowa przekładni nr I	50	Bez uwag
22		Sprężarka nr II	50	Bez uwag
23		Transformator nr I	50	Bez uwag
24		Chłodnia	50	Bez uwag
25		P-pa fekalii	50	Bez uwag
26		Pompa steru	50	Bez uwag
27		Podgrzewacz paliwa	50	Bez uwag
28		Hydrofor wody słodkiej	50	Bez uwag
29		Podgrzewacz oleju smarnego	40	Bez uwag
30		Palnik CO	50	Bez uwag
31		Rezerwa		
32		P-pa transportu paliwa nr I	50	Bez uwag
33		P-pa transportu paliwa nr II	50	Bez uwag

34		P-pa żezowa nr II	50	Bez uwag
35		Hydrofor wody morskiej	50	Bez uwag
36		Wirówka oleju	50	Bez uwag
37		Wirówka paliwa	50	Bez uwag
38		Prądnica nr I	40	Bez uwag
39		Prądnica nr II	40	Bez uwag
40		Prądnica nr III	40	Bez uwag
41		Prądnica portowa	50	Bez uwag
Pomiar stanu izolacji 24V DC				
43	41	Oświetlenie awaryjne pomieszczeń	50	Bez uwag
44	42	Sygnalizacja alarmowa, TSN, rozgłośnia manewrowa	50	Bez uwag
45	44	Oświetlenie awaryjne tratw ratunkowych, lampy awaryjne	50	Bez uwag
46	45	Oświetlenie awaryjne sterówka-kuchnia	50	Bez uwag
47	46	Zasilanie Decca Navigator	50	Bez uwag
48	47	Zasilanie GPS Koden	50	Bez uwag
Rozdzielnica S-1 na mostku				
49		Światła na lince	40	Bez uwag
50	S1	Oświetlenie sterówki	40	Bez uwag
51	S2	Oświetlenie pokładu dziób-rufa PB i LB	40	Bez uwag
52	S3	Reflektor LB	30	Bez uwag
53	S4	Reflektor PB	30	Bez uwag
54	S5	Radar LB	50	Bez uwag
55	S6	Tyfon	50	Bez uwag
56	S7	Zasilanie szyb wirujących	20	Bez uwag
57	S8	Sterowanie silnika głównego PB	50	Bez uwag
58	S9	Sterowanie silnika głównego LB	50	Bez uwag
59	S10	Telegraf awaryjny	50	Bez uwag
60	S11	Oświetlenie kompasu i wskaźników + radiotelefon VHF	50	Bez uwag
61	S12	Zasilanie echosondy	50	Bez uwag
62	S13	Zasilanie radiotelefonów VHF	50	Bez uwag
63	S14	Tablica świateł nawigacyjnych – zasilanie II	30	Bez uwag
Pomiar stanu izolacji 220V w polu GTR				
64	1	Oświetlenie pomieszczeń załogi PB	40	Bez uwag
65	2	Oświetlenie pomieszczeń załogi LB	50	Bez uwag
66	3	Oświetlenie pokładu głównego PB	40	Bez uwag
67	4	Oświetlenie pokładu głównego LB	40	Bez uwag
68	5	Oświetlenie maszynowni PB	40	Bez uwag
69	6	Oświetlenie maszynowni LB	40	Bez uwag
70	7	Tablica świateł nawigacyjnych – zasilanie I	30	Bez uwag
71	8	Radio + urządzenia radiowe GMDSS	50	Bez uwag
72	9	Ładowanie akumulatorów	50	Bez uwag
73	10	Telegraf awaryjny	40	Bez uwag
74	11	Alarm CO ₂	40	Bez uwag
75	12	Tablica alarmowa	50	Bez uwag
76	13	Radar	50	Bez uwag
77		Szlifierka	50	Bez uwag
78	14	Kuchnia elektryczna	50	Bez uwag
79	21	Tablica rozdzielcza w sterówce S-1	40	Bez uwag
80	22	P-pa cyrkulacyjna CO	50	Bez uwag
81	23	Gniazdo podgrzewacza wody sanitarnej	40	Bez uwag
82	24	Pralka	50	Bez uwag
Rozdzielnica S-1 na mostku				
83		Światła na lince	40	Bez uwag
84	S1	Oświetlenie sterówki	40	Bez uwag
85	S2	Oświetlenie pokładu dziób-rufa PB i LB	40	Bez uwag
86	S3	Reflektor LB	30	Bez uwag
87	S4	Reflektor PB	30	Bez uwag
88	S5	Radar LB	50	Bez uwag

89	S6	Tyfon	50	Bez uwag
90	S7	Zasilanie szyb wirujących	20	Bez uwag
91	S8	Sterowanie silnika głównego PB	50	Bez uwag
92	S9	Sterowanie silnika głównego LB	50	Bez uwag
93	S10	Telegraf awaryjny	50	Bez uwag
94	S11	Oświetlenie kompasu i wskaźników + radiotelefon VHF	50	Bez uwag
95	S12	Zasilanie echosondy	50	Bez uwag
96	S13	Zasilanie radiotelefonów VHF	50	Bez uwag
97	S14	Tablica świateł nawigacyjnych – zasilanie II	30	Bez uwag
Tablica świateł nawigacyjnych				
98	1	Latarnia masztowa dziobowa	40	Bez uwag
99	2	Latarnia masztowa rufowa	40	Bez uwag
100	3	Latarnia PB	40	Bez uwag
101	4	Latarnia LB	40	Bez uwag
102	5	Latarnia rufowa	40	Bez uwag
103	6	Latarnia topowa	40	Bez uwag
104	7	Latarnia holownicza żółta	40	Bez uwag
105	10	Latarnia kotwiczna	40	Bez uwag
Pomiary wykonano miernikiem rezystancji izolacji typ KWE 3021 nr fabr. W0175990 Data pomiaru 08.10.2014 r.				
Uwagi i wnioski: pomierzone wartości rezystancji izolacji poszczególnych obwodów mieszczą się w przedziale wartości dopuszczalnych zgodnie z Przepisami Klasyfikacji i Budowy Małych Statków Morskich, część VII, Urządzenia Elektryczne.				
Data: 08.10.2014 r. Podpis: 		Odpis karty odbioru otrzymałem: Data _____ Zleceniodawca _____ Otrzymała załoga _____		
"ZEMIT" ELEKTROMECHANIKA OGÓLNA Tomasz Karbowiczek ul. Komoranów 13/1, 71-696 Szczecin CERTYFIKAT PRS/TE/196/883995/09 Upr. Nr E/2868/067/08 tel. 501 140 249				