



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

9 Dyakon Ignatiy str., Sofia 1000
tel.: (+359 2) 940 9317
fax: (+359 2) 940 9350

mail@mtitc.government.bg
www.mtitc.government.bg

FINAL REPORT

from
Technical investigation of railway accident–
fire occurred during movement in electrical locomotive No 44141.0, which serviced
fast train No 4681 in Mihaylovo – Svoboda interstation on 08.07.2016



November 2016.

FINAL REPORT

from

Technical investigation of railway accident – fire occurred during movement in electrical locomotive No 44141.0, which serviced fast No 4681 in Mihaylovo – Svoboda interstation on 08.07.2016 at approximately 12:10 p.m.

Objective of the report and extent of responsibility

As per Directive 2004/49/EC of the European Parliament and the Council on safety of the rail transport in the Community, Rail Transport Act (RTA) of the Republic of Bulgaria and Ordinance No 59 dated 5.12.2006 on the safety management in the rail transport, the investigation of railway events aims: to find the causes for their occurrence in order to eliminate and avoid such in future, **without searching personal fault and responsibility.**

The investigation was performed in accordance with art. 115 k of RTA, art. 76 of Ordinance No 59 dated 5.12.2006, and by Order No RD-08-348/20.07.2016 of the Ministry of Transport, Information Technology, and Communications was assigned a Commission for investigation of railway accident.

The Commission for investigation performed several inspections to the locomotive in Gorna Oryahovitsa locomotive depot, and conducted an interrogation with the persons directly involved in the accident. In order to achieve the fast clarification and to find the circumstances and causes that led to the accident occurrence, external experts were also involved in the Commission of technical investigation. In the course of the investigation there were analysed the report, observation protocols and documents, submitted by the Task Force, and additionally requested materials as well. Experts of the Centre for Researches and expertise to the Chief Directorate Fire Safety and Civil Protection (CDFSCP) at the Ministry of Interior (MoI) prepared Complex Fire technical and Electro technical expertise after performed inspections to the burned locomotive No 44.141.0 in Gorna Oryahovitsa locomotive depot.

In parallel there were discussed, and the Chairman of the Commission accepted the submitted statements of the appointed external experts in performance of their assigned tasks.

1. Established facts and circumstances in the investigation process.

On 08.07.2016 fast train (FT) No 4681 in composition of 3 passenger coaches (2 second class and 1 first class coach), serviced by electrical locomotive No 44141.0, departed from Varna station at 4:40 a.m. in Gorna Oryahovitsa – Stara Zagora – Plovdiv direction as per the Train operation schedule (TOS).

The locomotive was operated from the Ist cabin with locomotive crew in composition of locomotive driver and assistant locomotive driver, employees of Gorna Oryahovitsa locomotive depot at BDZ -Passenger Services Ltd. The traffic crew that serviced the train was composed of train-master, conductor and a trainee train-master, all of them employees of Territorial centre for passenger services – Gorna Oryahovitsa at BDZ – Passenger Services Ltd.

The train arrived in Gorna Oryahovitsa station at 08:20 a.m. following the TOS. The train stopping time in Gorna Oryahovitsa station was 18 minutes in order to shift the traffic crews servicing the train. During the stopping time, the newly come locomotive crew performed a visual inspection to the locomotive. After an information exchange between the old and the new locomotive crews on the locomotive technical condition, there was found that the locomotive was with reduced power due to an insulated third traction engine. The train departed from Gorna Oryahovitsa station at 08:38 a.m. as per the TOS.

Upon arriving at Tulovo station the traffic manager on duty informed the locomotive crew that there was expected to meet with another train. During that stopping time, the locomotive crew performed again an inspection without finding any irregularities. The train departed from Tulovo station and smoothly arrived in Mihaylovo station. Upon entering in the station area, the locomotive driver performed a gradual detention with the train brake in order to reduce the speed, and after a followed release of the brakes, he heard a stroke, however it was difficult to him to understand from where it was (evident from the explanation). After the train stopping in the

station, the locomotive driver together with the assistant locomotive driver during the stopover performed an inspection to the draft gear of the locomotive, but they did not find anything. The train departed from Mihaylovo station, after passing through the exit switches, the locomotive driver increased the speed from 40 km/h to 60 km/h (evident from the explanation). During the train running in the interstation, and after passing Samouilovo halt in Svoboda station direction, the assistant locomotive driver looked through the window in order to inspect the train condition, and he noticed smoke to emit from the third wheelset of the locomotive about which he informed the locomotive driver. He looked through the window from his side and he also saw smoke to emit between the bogies of the locomotive due to which he undertook speed reduction, and a selection of suitable location for the train stopping.

The train-master also felt smoke smell, looked through the coach window, and saw smoke to go out from the locomotive. The train stopped at 12:10 p.m. on km 76⁺⁵⁵⁰ in the interstation, where the locomotive driver got off to inspect the locomotive, but in the meantime the train-master already got off and informed him that fire was going out from the fans under the body-shell.

The locomotive driver requested the assistant locomotive driver to pass him one fire extinguisher, and to switch off the fuse of the rechargeable (storage) battery.

Approaching the fire location, from his right side the locomotive driver saw that there were burning the cables of the fans under the body-shell, and started to extinguish them by the fire extinguisher he was carrying with him. After using the first fire extinguisher the fire ignited again, and the assistant locomotive driver brought second fire extinguisher, and the traffic crew brought the fire extinguishers from the coaches. Due to the expansion of the ignition and the fire passing also from the locomotive left side, the locomotive driver passed to the left started to extinguish there, and the train-master remained to extinguish from the right side in the movement direction. The train-master after using all the available fire extinguishers from the coaches, and the fire was not extinguished ordered to the conductor, and the trainee train-master to evacuate the all the passengers in the hind-coach, and to protect the coaches against self-propelling, and submitted the information on the occurred fire to the emergency phone number 112.

At that moment, the locomotive driver saw that the transformer oil started to leak from the locomotive, and ordered to the assistant locomotive driver to uncouple the locomotive from the coaches, and he from his side activated the fire-extinguishing installation and again made an unsuccessful attempt to separate the locomotive from the coaches. Then followed attempts for separation of the locomotive through pushing by the train personnel, however due to the presence of slight inclination in the uphill they did not succeed. The train-master organized the evacuation of the passengers from the coaches and together with the conductor, and the trainee train-master performed manual shunting, using the track inclination and with risk separated the coaches from the burning locomotive.

Due to the fast expansion of the fire and the presence of dense and stifling smoke the locomotive crew did not succeed to take off the speedometer tape and the on-board logbook of the locomotive, but only the personal baggage. Subsequently from the expanded fire were burned the contact wire and the main cable of the catenary.

The first firefighting vehicle arrived at the accident site approximately 60 minutes after the fire occurrence and undertook the locomotive extinguishing, however the water in its tank was consumed without the fire localization. The firefighting vehicle withdrew to the near channel in order to charge water, and after that returned and continued the extinguishing, but without any evident result. The fire continued to expand until the arrival of the second firefighting vehicle by which assistance was overcome and completely suppressed at 17:00 p.m. (evident from the written explanations of the locomotive crew).

In order to service the passengers who travelled by Fast train No 4681 to their final destination BDZ -Passenger Services provided a bus from Samouilovo halt.

At 14:05 p.m. from Mihaylovo station was sent diesel locomotive No 06111 for transporting back from the interstation, the coaches of fast train No 4681 at 14:35 p.m.

After freeing the interstation at 17:20 p.m. from Svoboda station was sent DM No 1658 to repair the catenary, and from Mihaylovo station at 17:36 p.m. was sent AGMU-E-6. After completing the work on the catenary the AGMU-E-6 returned back at 19:10 p.m. in Mihaylovo station. At

19:21 p.m. from Mihaylovo station was sent diesel locomotive No 06111 in order to transport back from the interstation the burned locomotive No 44-141.0 at 19:55 p.m.

As a result from the occurred fire the train movement in Mihaylovo-Svoboda interstation was closed from 12:10 p.m. till 23:50 p.m.

2. Officials, involved in the case.

2.1 Locomotive crew:

2.1.1. „Locomotive driver” of electrical locomotive No 44141.0 of Gorna Oryahovitsa locomotive depot at BDZ -Passenger Services Ltd. –8 years of working experience;

2.1.2. „Assistant locomotive driver” of electrical locomotive No 44141.0 of Gorna Oryahovitsa locomotive depot at BDZ –Passenger Services Ltd. – 1 year and 4 months of working experience.

2.2. Traffic crew:

2.2.1. “Train-master” of Gorna Oryahovitsa territorial centre passenger services, at BDZ-Passenger Services Ltd. – 12 years and 7 months of working experience;

2.2.2. “Conductor” of Gorna Oryahovitsa territorial centre passenger services, at BDZ-Passenger Services Ltd. – 32 years and 7 months of working experience.

2.2.3. Trainee with position “Train-master” of Gorna Oryahovitsa territorial centre passenger services, at BDZ-Passenger Services Ltd.

2.3. Station employees:

2.3.1. „Traffic managers” – Mihaylovo station – employee at Train operation and station activity management division – branch Plovdiv (TOSAM-Plovdiv), National railway infrastructure company (NRIC) – 26 years of working experience;

2.3.2. „Switchman level-crossing guard” – Mihaylovo station – employee at TOSAM – Plovdiv, NRIC – 37 years of working experience;

2.3.3. „Traffic manager” – Svoboda station – employee at TOSAM – Plovdiv, NRIC – 22 years of working experience.

3. Physical condition of the officials, involved in the accident.

To the officials, involved in the accident was ensured the necessary duration of rest before starting work as required by the Labour Code and Ordinance No 50 dated 28.12.2001 on the Working time of the management and executive personnel, involved in the provision of passenger and freight rail transport.

To the officials, involved in the accident was performed a pre-travel (pre-shift) instruction and they were declared to be alerted, rested and that did not drink any alcohol and other drugs.

The officials, involved in the accident possessed valid certificates of psychological examination.

4. Documents, certifying work qualification and exercise of work position.

The officials from SE NRIC involved in the accident possess the necessary qualification and documents for their working position.

The locomotive personnel of BDZ - Passenger services Ltd operated electrical locomotive No 44141.0 possess the necessary qualification documents and qualification for driving the respective locomotive series

5. Activities of the officials before and during the accident.

The SE NRIC officials, acted immediately prior and during the accident in accordance with the established regulations and internal rules, which regulate the rail transport safety.

The BDZ - Passenger services Ltd. officials, acted immediately prior and during the accident in accordance with the established regulations and internal rules, which regulate the rail transport safety.

6. Circumstances, preceding the accident in terms of track, signalling equipment, catenary, rolling stock etc.

6.1. Meteorological weather data, which had impact on the visibility of the signals:

- in the daylight hours;

- air temperature: 26 ÷ 27 °C;

- without wind;
- clear weather without clouds;

6.2. Track:

- regular with no reference to the occurred railway accident;

6.3. Station and interstation signalling equipment before the accident:

- the interstation is equipped with Automatic block system with axle counters, regular does not refer the occurred accident.
- the two neighbouring stations are equipped with Route-relay interlocking (RRI) regular does not refer the occurred accident.

6.4. Catenary:

- regular with no reference to the occurred railway accident.

6.5. Train composition station:

- Varna.

6.6. Communication technique and telecommunications interfaces:

- technically regular.

6.7. Profile, geometry, and track layout:

- the train stopped in Mihaylovo-Svoboda interstation at km 76⁺⁵⁵⁰ in left curve, in movement direction with descent inclination 2 ‰.

6.8. Rail rolling stock:

The electrical locomotive No 44141.0, serviced by FT No 4681 was with reduced power (insulated 3rd traction engine), however with regular draft gear, brake system, light and sound signalling means as per the technical standards and requirements, which is evident from the records of the respective logbooks, copies of which were presented in the report of the Task force. Coaches: 3, 2 of which second class – B₄ and 1 first class – A₄ technically regular.

Total number of the train axles – 12.

7. Fulfilment of the working procedures and technologies within the system of the SE NRIC before and during the accident.

The working procedures and technologies before and during the accident at the Train Operation and Station Activity Management Division – Plovdiv, part of the SE NRIC structure, were complied. It was evidenced by the report of the Task Force and its annexes, additionally requested materials and conducted interrogations with the persons, involved in the accident by the investigation Commission.

8. Fulfilment of the procedures and technologies for rolling stock service within the railway undertaking system before and during the accident.

The railway undertaking BDZ Passenger Services Ltd. possesses Safety certificate Part A with No BG1120130003 and Part B with No BG1220130003 valid until 30.12.2017.

The fast train No 4681 was ensured with the necessary brake mass, and equipped with the necessary train documents. The locomotive and traffic crews were equipped with business mobile phones.

The electrical locomotive No 44141.0 was manufactured in 1980 and assigned to the Gorna Oryahovitsa Locomotive Depot's fleet in 1981.

The balance value of locomotive No 44141.0 at 30.06.2016 was 434 647,29 BGN.

In the table below are shown the runs of the electrical locomotive from the recent planned repairs:

TYPE OF REPAIR	DATE OF REPAIR	RUN FROM REPAIR
Capital repair (CR)	30.11.2005	1 882 375 km.
Mid-term repair (MTR)	-	-
Raising repair (RR)	23.05.2014	392 055 km.
Major periodic repair (MPR)	20.06.2016	9271 km.

Light periodic repair (LPR)	-	-
Technical inspection (TI)	-	-
Operation inspection (OI)	07.07.2016	-

Within the performed check of the technical documentation was found that from the date of the Capital repair on 30.11.2015 up to the date of the accident occurrence all the inspections and repairs were in accordance with PP_PLS 100/11 and “Instruction for inter repair runs and cyclic recurrence of the planed inspections and repairs to electrical locomotives and Electrical multiple units (EMU)” of BDZ -Passenger services Ltd. as per the approved inter-repair cycle.

Within the performed check of the “Technical passport of locomotive No 44141.0” (LS 005-1) and „Logbook for necessary repairs of traction rolling stock (Form. LP - 9) there were not found and registered any breaches of the effective “Rules for factory and depot repair, and maintenance of electrical locomotives”, as well as of the procedures in the repair activity that are related to the fire occurrence.

9. Railway infrastructure and rolling stock status before, during, and after the accident.

9.1. Status before the accident.

It was found that the railway infrastructure before, during, and after the accident was technically regular.

9.1.1. Permanent way and structures:

Before the accident the permanent way (track) and its adjacent structures were technically regular – do not refer.

9.1.2. Signalling:

The interstation was equipped with automatic block system (ABS) with axle counters– regular does not refer.

9.1.3. Catenary – regular does not refer.

9.1.4. Rolling stock

- Before the accident electrical locomotive No 44141.0 serviced fast train No 4681 was with reduced power (insulated 3rd traction engine) and not found other irregularities.

- Before the accident the coaches in the composition of train No 4681 were technically regular and do not refer to the occurred accident.

9.2. Status after the accident.

9.2.1. Fatalities – there were no any;

9.2.2. Seriously injured – there were no any;

9.2.3. Failures and damages caused to the locomotive:

Electrical locomotive No 44141.0 is property of Gorna Oryahovitsa locomotive depot at BDZ Passenger Services Ltd. During the performance of the inspection to the locomotive by the Investigation Commission at MTITC was found that the same was completely burned.

9.2.4. Failures and damages caused to the coaches:

To the coaches from the composition of train No 4681 as result from the occurred accident were not caused any failures and damages.

9.2.5. Failures and damages caused to the railway infrastructure:

9.2.5.1. Permanent way and structures:

- rails type S-49 – 2450 kg.;
- sleepers ST-6 for rails type S-49 – 4 pcs. ;
- spikes for sleepers ST-6 for rails type S-49 – 20 pcs.;
- edge rubber pad for sleepers ST-6 for rails type S-49 – 22 pcs.;

The costs for the track rehabilitation amount to 1972,81 BGN., without VAT.

9.2.5.1. Catenary:

- contact wire RI 100 – 3 kg.;
- main cable 70 mm² – 3 kg.;
- wedge terminal – 7 pcs.;
- terminal A – 8 pcs.;
- connecting terminal for CW – 2 pcs.;
- stringed terminal – 20 pcs.;
- copper wire f4 – 3,5 kg.

The costs for rehabilitation of catenary amount to 4 268,22 BGN with VAT.

9.2.5.3. Other caused failures and damages:

- The costs for passengers transshipment by train No 4681 amount to 2966,16 BGN with VAT.
- The costs for working extra hours by the traffic crews as a result from the ignition of locomotive No 44141.0 by No 4681 on 08.07.2016 amount to 449,19 BGN with VAT.

9.2.6. Traffic interruption:

As a result from the occurred railway accident with locomotive No 44141.0, which serviced FT No 4681 the train movement was closed in Mihaylovo – Svoboda interstation from 12:36 p.m. to 23:50 p.m. on 08.07.2016.

9.2.6.1. Caused train delay:

Deviated trains:

- train No 8602 of BDZ PS Ltd. Mihaylovo – Dimitrovgrad – Plovdiv;
- train No 8612 of BDZ PS Ltd. Mihaylovo – Dimitrovgrad – Plovdiv;
- train No 8601 of BDZ PS Ltd. Plovdiv – Dimitrovgrad – Mihaylovo;
- train No 8613 of BDZ PS Ltd. Plovdiv – Dimitrovgrad – Mihaylovo;
- train No 80571 of Bulmarket Rail Cargo Ltd. Belosem – Philipovo – Karlovo – Stara Zagora;
- train No 8641 of BDZ PS Ltd. Plovdiv – Dimitrovgrad – Mihaylovo;
- train No 8632 of BDZ PS Ltd. Mihaylovo – Dimitrovgrad – Plovdiv;

Cancelled trains:

- train No 4681 of BDZ PS Ltd. Mihaylovo – Plovdiv section;
- train No 4680 of BDZ PS Ltd. Plovdiv – Mihaylovo section;
- train No 80101 of BDZ PS Ltd. Chirpan – Zimnitsa section;
- train No 80102 of BDZ PS Ltd. Stara Zagora – Plovdiv section;
- train No 80115 of BDZ PS Ltd. Tchirpan – Stara Zagora section;
- train No 80114 of BDZ PS Ltd. Stara Zagora – Tchirpan section;
- train No 80104 of BDZ PS Ltd. Stara Zagora – Plovdiv section;
- train No 80103 of BDZ PS Ltd. Tchirpan – Yambol section;
- train No 80601 of BDZ Cargo Ltd. Belosem – Stara Zagora section;
- train No 80604 of BDZ Cargo in Stara Zagora – Plovdiv marshalling yard section;
- train No 80603 of BDZ Cargo in Plovdiv marshalling yard – Stara Zagora section;

Assigned trains:

- train No 80191 of BDZ PS Ltd. with route Stara Zagora – Zimnitsa;
- train No 80192 of BDZ PS Ltd. with route Tchirpan – Plovdiv;
- train No № 80193 of BDZ PS Ltd. with route Stara Zagora – Yambol;
- train No 80194 of BDZ PS Ltd. with route Tchirpan – Plovdiv;
- train No 80996 of BDZ Cargo Ltd. with route Belosem – Plovdiv;
- train No 80308 of BDZ PS Ltd. with route Yambol – Stara Zagora
- train No 80907 of BDZ PS Ltd. with route Plovdiv – Mihaylovo;
- train No 80307 of BDZ PS Ltd. with route Tchirpan – Plovdiv;
- train No 40990 SE NRIC with route Dimitrovgrad – Mihaylovo.

9.2.6.2. Costs for modifying the Train operation schedule – there were no any.

9.3. Rehabilitation vehicles movement.

9.3.1. Rehabilitation train – there was no any;

9.3.2. Other rehabilitation vehicles – there were no any.

10. Causes for the occurred accident.

Cause for the accident – fire occurrence in electrical locomotive No 44-141.0 during movement is, **rupture of the shell of the autotransformer switch (ATS) due to occurrence of or voltaic arc between the fixed contacts and the rollers of the switch on grades**, due to broken chart of the apparatus switch – displayed on (fig. 1).

The voltaic arc caused the ignition of the oil, located in the internal part of the switch which from its side led to the ignition of the other elements and aggregates in the machinery compartment of the locomotive.

11. Analysis of the causes, which led to the railway accident.

The Commission for investigation of the accident at MTITC performed several detailed and long inspections to the burned locomotive in Plovdiv locomotive depot, and in Gorna Oryahovitsa locomotive depot. It became aware of the factual circumstances and the submitted materials and documents from the Task Force and the additionally required in the course of the investigation. Interrogated the train crew (locomotive and traffic) for their activity.

During the inspection, the Commission found that almost all the aggregates and nodes, located in the machinery compartment of the locomotive were burned and disabled to be rehabilitated.

Upon the investigation, the Commission together with other called experts reviewed and discussed several possible causes for the fire ignition. Analysing the circumstances for the accident occurrence reduced the possible working hypothesis to three with different grade of probability.

First hypothesis, the ignition was caused by sparks obtained during the train stopping, due to the friction between the brake blocks and the wheels of the locomotive. The probability the ignition to appear due to that cause is *pretty insignificant*. It is true that the draft gear of the locomotives is rather dirty as the dirt is caused by dust, accumulated during movement of the locomotive, adherent to oiled elements of the underframe aggregates and the bogies of the locomotive. In the practice there have been observed many cases of similar ignitions of rail rolling stock (RRS), caused during the stopping process, when because of the friction between the brake blocks and wheels appear sparks, which could be a cause for ignition of accumulated dirt. It must be noticed that during the stopping process of train composition are used the brake systems of the coaches and only in exceptional cases this is performed by using also the locomotive brake system. In our case the locomotive brake was used, but for a short time, which could not cause sparks and temperature increase, leading to ignition. Even if there is a spark, which to ignite the accumulated on the frames of the bogie and the frame of the locomotives layers of dust and oils, it would ignite (possibly) the cables of the horizontal fan under the body-shell, but the flames could not transfer to the machinery compartment (fig. 1), (which was found from the Commission) moreover that during the usage of the fire-extinguishers the fire was not overcome and ignited immediately after the fire-extinguisher



Fig. 1

was directed in another direction (from the locomotive driver explanations), consequently the **occurred outbreak of fire was not under the frame of the locomotive.**

Second hypothesis, the ignition occurred from some of the rectifying units from both traction groups. In principle these aggregates are with low level of fire hazard and are not frequently met reason for the locomotive ignition; however the practice is aware of similar cases. The Commission considers the probability the rectifying units to be a cause for the ignition in the case as insignificant mainly because of the fact that the two cabinets, which service the two separate traction groups were burned to equal extent (fig. 2). That may happen or in case that the fire started from the both groups in parallel, which is practically impossible, either that they are not source of the ignition. As an additional argument may be indicated the fact that during ignition of the rectifying cabinets from the horizontal fans under the body-shell comes fire – occurrence that during and before the fire have not been noticed. All these evidences display that the **rectifying cabinets are not source of the locomotive ignition**.



Fig. 2

Third hypothesis, which the Commission considers as the *most probable*, the ignition of the locomotive was caused from ignition of the oil in the autotransformer switch (ATS) as a result from destruction of its shell. Arguments for the statement, gives the progress of the case just before and during the ignition itself. During the train entrance in Mihaylovo station the locomotive driver heard strike from the inside of the locomotive (as per his explanations), which (at his discretion) came from the draft gear. That made the two locomotive drivers to perform a brief inspection of the draft gear of the locomotive during the short stopover in Mihaylovo station, however they did not find anything irregular, due to which continued their movement under the schedule. When the locomotive driver was asked the question whether during hearing the strike he felt the typical inclination ahead of the locomotive in case of failure of the draft gear, he answered in a negative manner. Those circumstances give grounds to be considered that most probably the heard noise (taken as a strike in the draft gear by the locomotive driver) is a result from rupture of the ATS shell, which led to oil leakage in the machinery compartment. The very ignition of the oil was caused by voltaic arc, occurred in the switch due to a broken working chart, which led to the shell destruction (fig. 3). After departure from Mihaylovo station, the train-master felt smell of burnt diesel fuel (naphtha), (evident from his explanation). That was the first sign for the presence of ignition in the locomotive. As the transformer oil is with very similar to the diesel fuel indicators during burning, having in mind the train-master is not a specialist and it is absolutely possible to be wrong. The train passed few kilometres after its departure from Mihaylovo and under the frame of the locomotive started to emit grey-white smoke – a sign that oil was burning. In the case the transformer and the ATS oil. The oil is pretty strong source of heat in case of burning as in the meantime it has possibility to maintain continuous burning due to its significant quantity of viscosity. That was reason the shell of the ATS, which was produced in aluminium to



Fig. 3

As the transformer oil is with very similar to the diesel fuel indicators during burning, having in mind the train-master is not a specialist and it is absolutely possible to be wrong. The train passed few kilometres after its departure from Mihaylovo and under the frame of the locomotive started to emit grey-white smoke – a sign that oil was burning. In the case the transformer and the ATS oil. The oil is pretty strong source of heat in case of burning as in the meantime it has possibility to maintain continuous burning due to its significant quantity of viscosity. That was reason the shell of the ATS, which was produced in aluminium to

melt and its smelt to start gathering on the floor of the machinery compartment. As a result from the high temperature, obtained from the oil burning, were deformed the floor sheet metals of the locomotive, and the melted metal started to flow along the shell of the fans under the body-shell, as it burned the insulation of the feeding cables (fig. 4). The fire expanded under the body-shell of the locomotive and burnt the frame, the floor's sheet metals from their lower side, and shells of the horizontal fans, feeding cables, rechargeable batteries and the traction engines, and frames of the two bogies as well. From the pictures taken by the train crew (conductor – trainee train-master, locomotive driver and assistant locomotive driver) is evident that the fire transferred under the locomotive and there it caused the serious damages on the aggregates under the frame (fig. 5 and 6).

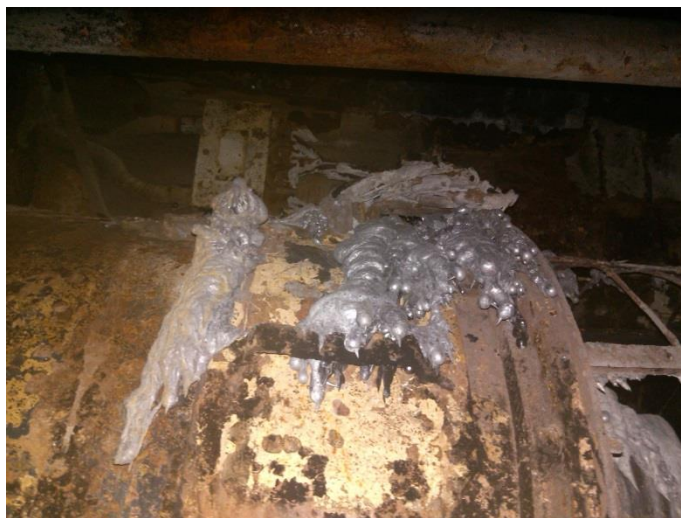


Fig. 4

After the so presented facts and arguments become evident that the **most probable cause for the fire occurrence in the locomotive.**



Fig. 5



Fig. 6

In 2016 has been observed increasing of the number of fires in locomotives series 44 and 45 during the service of trains in movement, which are property of railway undertaking BDZ- Passenger Services Ltd. Most of the electrical locomotives of the above mentioned series are of 35 – 40 years age. In this line, the Commission for investigation required additionally from the Entity, the part of the Safety Management System (SMS), related to the risk assessment of the operational personnel and of the RRS:

- “Methodology of analysis and assessment of the safety risk with the Register of hazards during the operation, repair and maintenance of RRS in BDZ - Passenger Services Ltd.;

- “Methodology of analysis and risk assessment during the maintenance of RRS with the Register of hazards for the maintenance activities in BDZ - Passenger Services Ltd.

Evident from the presented methodologies and prepared to them Registers of assessed hazards as in the operation as well as in the maintenance of RRS, comes clear the non-assessed risk from fire occurrence in traction rolling stock (TRS) during movement. In the part subjective factor –

locomotive driver and assistant locomotive driver during the locomotive operation, are not assessed the hazards with possible consequences from which is evident that the risk for fire occurrence is assessed as for the locomotive crew as well as for the TRS. In most of the cases upon fire occurrence the locomotive crew cannot understand where the fire occurred, which from its side leads to increasing of the risk as for them as well as for the rest of the personnel, passengers and coaches in the train composition. In the Register of hazards is obvious that is assessed only one hazard for ignition of TRS, after performance of a poor quality repair, which leads to failure of the locomotive during movement. In the table of Annex No 2 is evident that there has not been assessed completely the risk for the separate aggregates and apparatuses in the respective maintenance levels, which as a result from the incomplete assessment of the operation, maintenance or repair became cause for the ignition of the electrical locomotives.

12. Recommendations and suggestions for events that prevent against other accidents of similar nature.

In order to improve the safety level and to avoid other accidents of similar character and under art. 94, par. 1 of Ordinance No 59 dated 5.12.2006 on the management of the railway safety of the Minister of Transport, the Railway Administration Executive Agency (RAEA) in its quality of National Safety Authority shall order the implementation and realisation of the given safety recommendations.

1. The railway undertaking BDZ Passenger - Services Ltd. shall perform analysis and assessment of the risk as a result from the more frequent fires occurred in TRS and shall prepare measures for minimizing the risk.

2. The railway undertaking BDZ Passenger - Services Ltd. shall make amendment and integration of the “Methodology for analysis and assessment of the risk for the safety”, which is an integral part of the Safety Management System, where to include and assess the probabilities of possible risk for fire occurrence in TRS during movement.

3. The railway undertaking BDZ Passenger - Services Ltd. shall perform assessment of the risk and hazards related to “subjective factor” (locomotive and traffic crews), as well as in the part “technical factor” related to the maintenance and repair of electrical locomotives.

4. The railway undertaking BDZ Passenger - Services Ltd. shall complete the “Register of hazards for the maintenance activities in Annex No 2”, as to the respective maintenance level shall be assessed the possible risks for fire occurrence in the operation in separate apparatuses and aggregates upon the performed repair in TRS.

5. The railway undertaking BDZ Passenger - Services Ltd. shall provide the locomotive crews with protective masks.

With reference to the requirements of art. 94, par. 4 of Ordinance No 59 dated 5.12.2006 on the management of the railway safety the addressees of the recommendations shall notify in written the Chairman of the Investigation Commission at MTITC on the undertaken actions for the implementation of the given recommendations.

Chairman:

Boycho Skrobanski

State inspector on investigation at MTITC