



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

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FINAL REPORT

from

**Technical investigation of railway accident –
fire occurred during movement of electrical locomotive No 44085.9, which
serviced fast train No 3622 in Sahrane railway station on 16.06.2016**



September 2016

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Objective of the report and extent of responsibility

As per Directive 2004/49/EC of the European Parliament and the Council on safety on the Community's railway, Rail Transport Act (RTA) of 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 them and to avoid such in future, **without searching for personal fault and responsibility.**

The investigation was performed in accordance with art. 115 i, par. 2, of RTA, art. 76 of Ordinance No 59 dated 5.12.2006 and by the force of Order No RD-08-318/23.06.2016 of the Director of AMRAIU Directorate at the Ministry of Transport, Information Technology and Communications (MTITC), a Commission for technical investigation of railway accident was assigned.

The Commission performed several inspections to the burned electrical locomotive, and conducted an interrogation with the persons involved in the accident. In order to achieve fast clarification, and to find the circumstances and causes that led to the accident occurrence, also external experts were included to the Commission of technical investigation. In the course of the investigation were analysed the report, observation protocols and other materials, and documents, submitted by the Task Force, and additionally requested materials.

In the presence of the Commission of Investigation of MTITC were seized evidences from the experts of the Centre for Researches and expertise of the "Chief Directorate Fire Safety and Civil Protection" (CDFSCP) of the Ministry of Interior (MoI) based on which were prepared Complex Fire technical and Electrotechnical expertise. In parallel were discussed, and the Chairman of the Commission accepted the submitted statements of the appointed external experts in performance of their tasks.

1. Established facts and circumstances in the process of investigation.

On 16/06/2016, fast train (FT) No 3622 composed of four carriages (3 second class, and one first class) serviced by electrical locomotive No 44085.9, was moving in Burgas - Karlovo - Sofia direction as per the Train operation schedule (TOS). The train was handled by the II-nd cabin of locomotive No 44085.9 by locomotive crew consisting of an engine driver and an assistant engine driver locomotive, employees of Sofia Locomotive Depot – "BDZ - Passenger services" Ltd. The traffic crew, which served the train consisted of Head of train and conductor –employees of "Territorial Center for Passenger Services- Sofia" at "BDZ - Passenger services" Ltd.

The train departed from Burgas railway station, scheduled at 8:55 a.m., and was moving respecting the traffic speeds and times of arrival and departure from stations in accordance with TOS. During the train movement to Kazanlak railway station there were not found any failures by the locomotive and traffic crews as well as by the traffic managers on duty and switchmen on duty at the stations the train passed through.

Within the stopover at the Kazanlak station, the locomotive crew made an inspection of the engine compartment, draft gear and roof equipment of the locomotive, during which were not found any failures (shown by the explanations given).

The train departed on schedule from Kazanlak station at 12:07 p.m. with regular exit signal and departure order given by the traffic manager on duty. After the train departure, the traffic manager on duty and the duty switchman observed the train movement until it left the station area, but did not notice anything unusual within its movement.

The traffic manager on duty at Dunavtsi station prepared a route for transit pass through the train station and went out to give a signal to the engine driver for its transit. The train passed through the station at a speed of 70 km/h. The traffic manager on duty and the switchman on duty observed the train movement. During its passing they noticed smoke coming out from the draft gear of the locomotive. After the train departure to the interstation, the traffic manager on duty informed the train dispatcher and the traffic manager on duty at the next Sahrane station on the train condition. The train dispatcher ordered to the traffic manager on duty at Sahrane station to stop the train in the station and to inspect the locomotive in order to find out where the smoke was coming from.

During the movement along Dunavtsi – Sahrane interstation while was approaching the level-crossing at km 193⁺³⁸⁴ the engine driver reduced the train speed of to 12 km/h, because the automatic level-crossing signalling (ALCS) of the level-crossing was not activated. After passing the level- crossing, the engine driver accelerated the train speed to 70 km/h, and passed around 1000 meters with that speed, at that moment in the cabin was sensed the smell of smoke. Within the subsequent inspection of the engine compartment of the locomotive, the crew noticed that the compartment was filled with smoke. The engine driver started reducing the speed and after approximately 1400 meters at 12:22 p.m., the train stopped in the interstation. After the train stopping the locomotive crew checked the engine compartment and located the place from where the smoke was coming out, the fans under the body shell (shown by the explanations given). After a minute stay in the interstation, the engine driver, taking into account the unfavourable terrain for train access to the train of firefighting automobiles, and the nearby located entrance signal of Sahrane station, departed again as he speeded up to 50 km/h, and at 12:25 p.m. stopped at station. At the time of movement to the station the engine driver informed the Head of the train for the situation. The train was accepted in Sahrane station on the Second main track. After the train stopping, the locomotive crew took action for uncoupling the locomotive from the coaches and for moving the locomotive to a safe distance. The already uncoupled locomotive was secured against self-propelling and the engine driver activated the fire extinguishing installation of the locomotive, but it did not operate.

Immediately after that, the locomotive crew ousted all available fire extinguishers and started to extinguish the fire. At the same time and after receiving the alert signal by the engine driver the Head of the train informed the emergency phone number 112 about the occurred fire and together with the train conductor brought two fire extinguishers from the coaches to help the fire extinguishing. Nevertheless the use of all the fire extinguishers, the fire continued to rage, which imposed the traffic crew to bring the other two fire extinguishers of the train. Meanwhile, the traffic manager on duty acted to switch off the power supply of the railway station in order to secure the burning locomotive.

At 13:00 p.m. two firefighting automobiles arrived at the accident site, and overtook extinguishing actions. Eventually, the fire was extinguished at about 14:20 p.m.

In order to ensure the movement of FT No 3622 with passengers traveling to the final station, from Kazanlak station was sent locomotive No 44 132 to service the train. After performing shunting with the train composition from the second to the third track in Sahrane station, the train continued its journey in the direction and departed at 15:26 p.m. with a delay of 178 minutes.

The burned locomotive No 44085.9 remained on the second main track in Sahrane station. On 17.06.2016, at 18:26 p.m. the locomotive departed to Plovdiv Locomotive Depot.

As a result from the occurred fire the traffic on the second main track in Sahrane station was suspended from 15:24 p.m. on 16/06/2016 to 18:26 p.m. on 17/06/2016.

2. Officials, involved in the case.

2.1 Locomotive crew:

2.1.1. “Engine driver, locomotive” of electrical locomotive No 44085.9 from BDZ “Passenger Transport” LTD Sofia – with 22 years of working experience;

2.1.2. „ Assistant engine driver, locomotive ” of electrical locomotive No 44085.9 from BDZ “Passenger Transport” LTD Sofia – with 12 years of working experience;

2.2. Traffic crew:

2.2.1. „Head of train” from Sofia territorial centre for passenger transport of “BDZ-Passenger services” Ltd.– with 18 years of work experience;

2.2.2. „Conductor” from Sofia territorial centre for passenger transport of “BDZ-Passenger services” Ltd – with 1 month of work experience.

2.3. Station employees:

2.3.1. „Traffic manager” –Sahrane station – an employee of Train operation and station activity management division – branch Plodiv (TOSAM-Plodiv), State enterprise “National railway infrastructure company” (SE NRIC)– with 28 years of work experience;

2.3.2. „Switchman – level crossing guard” – Sahrane station – an employee of Train operation and station activity management division – branch Plodiv (TOSAM-Plodiv), SE NRIC – with 5 years of work experience;

2.3.3. „Traffic manager” – Dunavtsi station – an employee of Train operation and station activity management division – branch Plodiv (TOSAM-Plodiv), SE NRIC – with 26 years of work experience;

2.3.4. „Switchman on duty” – Dunavtsi station – an employee of Train operation and station activity management division – branch Plodiv (TOSAM-Plodiv), SE NRIC – with 28 years of work experience;

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

To the officials, involved in the accident was ensured the necessary length of rest before starting work as required by the Labour Code and Ordinance No 50 of 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 appointment documents

The officials from “BDZ- Passenger services” Ltd 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: 23 ÷ 29 °C;
- South-west wind, speed 3 m/s;
- clear, sunny weather;

6.2 Track:

- regular with no impact and connection to the occurred railway accident;

6.3. Station and interstation signalling equipment before the accident:

- the station was equipped with Route-relay interlocking (RRI), the interstation - Automatic block system with axle counters (ABS), regular does not refer the occurred accident.

6.4. Catenary:

- regular with no connection to the occurred accident;

6.5. Train composition station: - Burgas;

6.6. Communication technique and telecommunications interfaces: technically regular;

6.7. Profile, geometry and track layout:

- the train stopped in Sahrane station on the Second main track in straight-line section without inclination;

6.8. Rolling stock:

The electrical locomotive No 44085.9, which serviced FT No 3622 was technically regular with regular running gear, brake system, light and sound signals as per the technical standards and requirements, in accordance with the technical standards and requirements, which was evident from the records in the respective log-books, presented in the Task Force report;

Coaches: 4 pcs, 3 from the series B₄ and 1 from the series A₄ – common 16 axles;

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, further refined materials and conducted interrogations with the staff involved in the accident investigation by the Commission.

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

The fast train No 3622 was ensured with the necessary brake mass, and equipped with the necessary train documents. The locomotive and traffic crew were equipped with business mobile phones.

The electrical locomotive No 44085.9 was manufactured in 1976 and assigned to the Locomotive Depot Sofia and was placed into service in 1977.

The balance value of the electrical locomotive on 16/06/2016 was 2 726 130 042 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)	01 June 1998	2 401 303 km
Mid-term repair (MTR)	08 February 2008	1 200 303 km
Raising repair (RR)	12 June 2012	635 406 km
Major periodic repair (MPR)	16 October 2014	259 073 km
Light periodic repair (LPR)	05 April 2016	35 450 km
Technical inspection (TI)	06 June 2016	4 612 km
Operation inspection (OI)	–	–

Within the performed check of the technical documentation was evaluated that from the date of the Capital repair on 01 JUN 1998 up to the date of the accident 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 44085.9” (LS 005-1) and „Diary 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 technologies in the organization and operation that are related to the fire occurred.

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

9.1. Status before the accident.

Railway infrastructure before, during, and after the accident was regular.

9.1.1. Switches

The switches in Sahrane station were regular – don't have relation to the accident.

9.1.2. Signalling

Route relay interlocking (RRI) in Sahrane station – regular.

9.1.3 Catenary – regular;

9.1.4. Rolling stock

Before the accident, electrical locomotive No 44085.9 of fast train No 3622 was technically in order.

Before the accident, the coaches from the composition of train No 3622 were technically in order.

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:

Locomotive No 44085.9 is owned by “BDZ- Passenger services” Ltd., Sofia Depot.

During the inspection performed in Plovdiv Depot by the Commission for investigation, the following irregularities were found:

- Traction rectifiers – completely burned;
- Auxiliary rectifiers – completely burned;
- Extender of traction transformers – completely burned;
- Power cables between the pantograph and traction transformer – completely burned;
- Knife switches for commutating into brake regime – completely burned;
- Dischargers – completely burned;
- Insulators – completely burned;
- Brake controllers – completely burned;
- Contactors and resistances of ATP – completely burned.

9.2.4. Failures and damages caused to the passenger coaches:

- the passenger coaches of train No 3622 after the accident were regular with no damages

9.2.5. Failures and damages, caused to the railway infrastructure:

9.2.5.1. Permanent way and equipment – no;

9.2.5.2. Signalling equipment, radio connections, and power supply: no;

9.2.5.3. Catenary: burning of contact wire

The expenditures of the Territorial branch - „Plovdiv Energy section” of SE NRIC due to the accident occurred amount to 238,49 BGN;

9.2.5.4. Other damages and failures: no;

9.2.6. Interruption of the train circulation:

As a result from the occurred accident the train movement on the 2nd main track in Sahrane station was interrupted from 15:24 p.m. on 16.06.2016 to 18:26 p.m. on 17.06.2016.

9.2.6.1. Caused train delay:

Delayed trains:

- train No 30142, railway undertaking BDZ – PS Ltd. + 5 min.;
- train No 30580, railway undertaking BRC AD + 77 min.;

Cancelled trains:

- train No 30133, railway undertaking BDZ – PS Ltd. – along the section Kazanlak – Zimnitsa;

- train No 30132, railway undertaking BDZ – PS Ltd. – along the section Zimnitsa - Karlovo;

Appointed trains:

- train No 82208, railway undertaking BDZ – PS Ltd.;
- train No 30391, railway undertaking BDZ – PS Ltd.;
- train No 30392, railway undertaking BDZ – PS Ltd.;
- train No 30997, railway undertaking BDZ – PS Ltd.;

- train No 30390, railway undertaking BDZ – PS Ltd.;
- train No 30994, railway undertaking BDZ – PS Ltd.;
- 9.2.6.2. Costs for modifying the Timetable of train operation – there were no any;

9.3. Rehabilitation vehicles circulation.

- 9.3.1. Rehabilitation train – **it was not used**;
- 9.3.2. Other rehabilitation vehicles – **there were not used**;

10. Causes for the accident.

The Investigation Commission considers that the cause for the fire of locomotive No 44-085.9 is the presence of a wooden piece under the bearing grid of the smoothing reactor of the auxiliary machines, which is located on the oil cooling radiator of the traction transformer (Fig. 1 and 2). The grid itself was repeatedly welded on the same place due to a fatigue of the material as a result from the presence of vibrations in the grid during operation. **After the consecutive tear of the welding the same was not restored, and instead of that in the repair point was placed a wooden piece from pine, which served as a support of the grid during operation (Fig. 5).**



Фиг. 1



Фиг. 2

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

The accident investigation Commission got acquainted in details with the condition of the locomotive set on fire, with the circumstances preceding the fire as well as with the actions of the train and traffic crew. During the inspection was found that at the beginning the fire occurred in the middle of the engine compartment, and more precisely in the high-voltage chamber (HVC),



Fig. 3



Fig. 4

then it spread to the roof of the locomotive and burned almost all the equipment mounted on the inner side of the roof, such as cables, insulators, etc., and part of the equipment mounted on the upper side of the roof. The flames affected the underroof equipment, then advanced downwards led by the air-blast caused by the cooling fans and fired a part of the flooring and for this reason occurred a burned spot from the right side of the locomotive body shell in movement direction (Fig. 3 and 4).

That initially directed the Commission to search for the cause either in the locomotive power supply from the main air switch (MAS), or in the components for powering the electrical dynamic brake, which are located next to the smoothing reactor of the auxiliary machines (engines) of first group. However, based on the circumstances, that the locomotive run in traction regime, and did not use the mentioned electrical stop, that version was declined. Searching for the fire outbreak, the Commission directed to the group of oil cooling of the traction transformer, because of the trails left by a high temperature fire. Above that group is located the smoothing reactor for auxiliary machines of the locomotive first traction group. **Namely under the grid of that smoothing reactor was found a completely charred wooden piece, but with its form and dimensions kept, placed as a jamb to support the grid in question (fig. 5).**



Fig. 5



Fig. 6

That circumstance, together with the explanations of the locomotive crew, that during the firing sensed a smell of burning wood, unambiguously confirmed that the primary source of the firing was namely that found wooden piece. The work of the smoothing reactors is accompanied with the emission of significant amount of heat, and their working temperature reaches up to 170°C. For that reason the smoothing reactor of the auxiliary machines is installed on the radiator of the oil cooling heater of the traction transformer, and together with it is cooled by the mounted under the body shell horizontal engine-fan. Over time, the heat was accumulated in the wooden piece (Fig. 2), which led to the specific for the wooden material condition of combustion—*smoulder*, which from its side caused ignition of the wooden piece itself. The emergence of an open fire in the area of the oil radiator to cool the oil in the traction transformer caused the ignition of the oil residues on the radiator itself, the dirt and dust located in the engine compartment, as well as on a later stage, of the insulation of the cables and the rest of the electrical equipment components. Particularly disturbing is the fact, that the fire protection installation of the locomotive did not

operate, nevertheless it was activated by the locomotive crew (Fig. 6 and 7), and that caused further expansion of the fire.

12. Recommendations and suggestions for measures to prevent other accidents of a similar nature.

In order to improve the safety level and prevention of other accidents of a similar nature and in relation to the requirements of art. 94, par. 1 of Ordinance No 59 dated 5.12.2006 on the management of railway safety of the Minister of Transport, the Railway Administration Executive Agency shall order the introduction and implementation of the safety recommendations given.



Fig. 7

1. Immediate check of the fire-extinguishing and fire-alarming installations for their current working order, as well as of the main protections of all the operative locomotives.
2. Strengthening the control over the operating inspections of the locomotives in the main and turnover depots, as well as in the operational service points.
3. Conducting periodic training sessions of locomotive personnel regarding the structure and operation of the fire-fighting installation of locomotives and actions to be undertaken in case of fire.
4. Accomplish modernization of locomotives of 44 and 45 series by means of introducing new fire alarm and fire-extinguishing installations with automatic action and more effective firefighting agent.
5. Remake of the existing fire-fighting installation of the locomotives and adding of extra smoke and flame sensors in danger zones.

With reference to the requirements of art. 94, par. 4, of Ordinance No 59 dated 5.12.2006 on the management of 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 recommendations not later than 31.10.2016.

Chairman:

Boycho Skrobanski

State inspector at AMRAIU Directorate at MTITC