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RAILWAY ACCIDENT INVESTIGATION UNIT
AT THE MINISTRY OF TRANSPORT, INFORMATION TECHNOLOGY AND
COMMUNICATIONS

FINAL REPORT

from

**investigation of railway accident – fire outburst in electric locomotive Nr. 44134.2, having
serviced fast train Nr. 8693 at Dimitrovgrad station on 12.10.2017**



2017

FINAL REPORT

Purpose of the investigation and degree of responsibility

The investigation is carried out in accordance with the requirements of Directive 2004/49/EC of the European Parliament and the European Council on the safety of railway transport in the Community, incorporated in the Railway Transport Act (RTA), Ordinance Nr. 59 dt. 05.12.2006 on safety management in railway transport, and Ordinance Nr. H-32 dt. 19.09.2007 on the concurrence of actions and information exchange upon the investigation of railway accidents and incidents. The investigation of heavy accidents, accidents and incidents, carried out by the Railway Accident Investigation Unit at the Ministry of Transport, Information Technology and Communications (MTITC) is aimed at:

Establishing the circumstances and causes having lead to their realization, in view of improving safety and preventing of heavy accidents, **without searching for anybody's personal guilt or responsibility.**

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1. Summary

On 12.10.2017 from Sofia station at 13:20 h. departed fast train Nr. 8693, composed of electric locomotive Nr. 44134.2 and four passenger wagons. The train travelled in the direction of Sofia – Plovdiv – Dimitrovgrad – Stara Zagora – Burgas.

After the arrival of fast train Nr. 8693 on the Second platform at Dimitrovgrad station at 16:47 h., the locomotive was disconnected from the train's composition for the performance of a maneuver, necessitated by changing the direction of train's trafficking. During the maneuver after 200 m a control lamp "fire of danger" was lit on the control panel of the locomotive, the assisting locomotive driver opened the side window and saw some smoke emitted under the second cart. The locomotive engine driver stopped the locomotive and switched off the accumulator battery pack. The locomotive brigade carried out an examination in the machine room and established emitting of flame around the el. power reading module. They undertook actions to extinguish the fire by means of the available fire extinguishers. The locomotive engine drivers found they could not suppress the fire and activated the fire extinguishing installation, also informing the traffic controller on duty; the latter made a call on phone 112 regarding the fire outburst.

At 17:10 a specialized fire safety automobile arrived at the spot.

At 17:32 the fire outburst in the locomotive was suppressed by the Fire Safety Service by two portable fire extinguishers.

At 17:42 diesel locomotive Nr. 06114 pulled electric locomotive Nr. 44134.2 on a non-electrified platform at the station.

The cause for the fire outburst is the occurrence of an earth circuit, having developed to a short circuit, causing el. discharge on the surface of an insulation element made from textolite, supporting the bus system of the secondary coil of the traction transformer. The earth circuit occurred as a result from ageing of the surface of the textolite supporting insulation elements, contaminated with metal dust, and damping of surfaces as a result from temperature differences. The raised temperature from the arch, having occurred during the short circuits, and the formed copper melt facilitated and created conditions for bursting of fire in the locomotive.

Aiming improvement of safety in the railway transport, four safety recommendations are rendered, all of them addressed to the two companies - BDZ Passenger Transport EOOD and BDZ Freight Transport EOOD.

The first recommendation pertains to strengthening the control over the operational examinations of the locomotives in the major and the running locomotive depots and at the operational stations.

The second recommendations envisages modernization of the locomotives with fire signaling and fire extinguishing installations of a new type, aimed at fast and timely reaction of the locomotive brigades servicing the locomotive.

The third recommendation pertains to improvement of the existing fire extinguishing installation of the locomotives and adding in the hazardous areas of smoke detection sensors, connected with the fire signaling installation for fast reaction of the locomotive brigades.

The fourth recommendation requests elimination of the causes for the occurrence of discharging processes in the textolite insulation plates, supporting the low voltage bus system of the power transformer, in view of their ageing - requested is insulation of the buses in the area of transition through the supporting textolite plates in an appropriate manner.

2. Direct facts and circumstances

2.1. On 12.10.2017 at 05:55 h. from Vidin station departed fast train Nr. 7621, composed of electric locomotive Nr. 44134.2 and 4 passenger wagons, 16 axes of 182 tons

mass weight (as evidenced by the breaking mass weight certificate). The Depot master on duty at EP-Vidin informed with the pre-shift instructions the locomotive brigade that the locomotive had registered an earth circuit of the first traction group. The train's trafficking was normal to Kurilo station. Because of a speed limitation of up to 15 km/h, upon readiness to stop in front of the railway level crossing at Kumaritsa stop between Kurilo and Ilianci stations, equipped with automatic barriers, the locomotive engine driver dropped the train's speed upon readiness to stop, thereafter the driver started accelerating, and upon a speed of 90 km/h an earth circuit of the first traction group occurred. After arriving at Sofia station and pulling of the locomotive at Sofia Locomotive depot, the locomotive brigade informed the Depot master on duty about the occurred earth circuit. The locomotive was examined and tested in the depot by an electrical technician, but no earth circuit was established thereupon.

On 12.10.2017 at 13:20 h. from Sofia station per schedule departed fast train Nr. 8693, composed again of electric locomotive Nr. 44134.2 and 4 passenger wagons, 16 axes and 172 tons mass weight. The train abided to the limitation of 25 km/h at the exit points of the station, thereafter the train started accelerating and reached a speed of 36 km/h, reducing its speed for a while to about 32 km/h. This happened at 13:22 h. For that time the train passed 1000 m, and then the first switch-off of the locomotive due to an earth circuit occurred. The second switch-off happened upon departure from Elin Pelin station at 13:50 h., upon identical conditions (as evidenced by the explanation of the locomotive engine driver). In the section between Septemvri and Plovdiv stations the train travelled with maximum speed of 130 km/h. The locomotive engine driver started more lightly, with small traction power, i.e. with small el. current on the traction engines, and this prevented switch-off of the locomotive. Other switch-offs during trafficking of the train to Plovdiv station were not established. In the section from Sofia to Plovdiv stations the locomotive operated with all traction engines switched on.

Before arriving of the train at Plovdiv station, the locomotive engine driver informed on the official telephone line the Depot master on duty at Plovdiv Locomotive depot about the earth circuit occurrences in the locomotive during trafficking. Upon changing of the locomotive brigades' shifts at Plovdiv station, the information was communicated also to the new locomotive brigade.

Upon taking over of the locomotive at Plovdiv station by the new locomotive brigade and after receiving of information from their colleagues for an earth circuit in the first traction group, the locomotive engine drivers from the new brigade immediately undertook switching off of the second traction engine, for the purpose of precising the engine of the earth circuit. Even upon starting and accelerating of the train at 25 km/h the locomotive was again switched off by an earth circuit. This time the locomotive engine drivers noticed that the switch-off had occurred in the second traction group. Upon the investigation it was proven that the initial indication had also been for an earth circuit in the second traction group, but then the locomotive engine drivers were mistaken and provided incorrect information that the occurrence had happened in the first traction group. The circumstances of this earth circuit were identical with the ones upon departing from Sofia station.

Upon arrival at Parvomai station, because of the continuing indication for an earth circuit in the second traction group, the locomotive engine drivers commenced switching off of the third traction engine, again aimed at precising the place of occurrence of the earth circuit. They made an unsuccessful attempt to switch on the second traction engine. Because of the tries for switching on and off of the traction engines, the train stayed still for 8 minutes. In this situation, from Parvomai station the locomotive started with two operating traction engines – the first and the fourth ones, leading to their greater loading. The train started at 16:29 h. comparatively lightly, due to which no indication for an earth circuit was obtained. From this moment on for 16 minutes the train travelled with a speed between 120 and 130 km/h, passing 28,5 km. The locomotive was loaded between 15th and 25th positions, i.e. the voltage of the operating fourth traction engine from the second group (respectively, the operating first engine from the first group) varied from 400 to 800 V, but the currents were comparatively low because of the high speed. At that moment the speed started lightly to decrease because of the availability of a small climbing inclination ($2 \div 5 \text{ ‰}$) and was kept at 112 km/h for 1 minute;

the train passed about 500 m. This happened at 2,5 km in front of Dimitrovgrad station. The train's speed started dropping, although the road's profile was descending. This provides clear indication that the locomotive travelled not in a traction operational mode, which proves that at that time the overvoltage protection system of the locomotive was activated (which was confirmed by the explanations of the locomotive engine drivers). There followed an additional drop of the speed by activating of the train's break, to abide to the speed limitations upon entering of the train into the station. For the last 2,5 km the train coasted (travelled inertly) for 3 minutes. After activating of the overvoltage protection system the locomotive, the engine drivers considered by judgment that they had had a circuit fire in the traction engine (as evidenced by their explanations, the combination of an earth circuit and activation of the overvoltage protection system is a circuit fire as a must), without having felt the thunder and the hit from the running parts, typical for such an occurrence. After stopping of the train at Dimitrovgrad station at 16:47 h. the indication for an earth circuit was still present, and the primary task of the locomotive engine driver after stopping at the station was to switch off the fourth traction engine, having operated till then, and to switch on the third traction engine. Maneuvering of the locomotive was carried out after stay of the train at the station for 8 minutes, during which one of the locomotive engine drivers performed the switching-off manipulations till switch-off of the fourth traction engine and switch-on of the third traction engine, and the other one disconnected the locomotive from the wagons. At 200 m after departure the speed reached up to 31 km/h, thereafter it started lightly to drop to 25 km/h, and then dropped abruptly to 0 km/h and stopped at 16:57 h. because of the activated fire protection system of the locomotive. The travel lasted for 1,5 minutes, during which the locomotive passed 480 m, thereafter the locomotive engine drivers undertook immediate fulfillment of the procedures on extinguishing of the fire outburst in the locomotive.

2.2. Dimitrovgrad station is a key station located at km 232⁺³⁷⁶ on the First railway line between Yabalkovo and Nova Nadezhda stations and on the Fourth railway line between Dimitrovgrad-North and Haskovo stations. The maximum permissible speed of trafficking on the First railway line is 160 km/h.

2.3. After a notification received from the Senior dispatcher on duty at the Central Dispatcher's Region of the National Railway Infrastructure Company (NRIC), the Head of the Railway Accident Investigation Unit (RAIU) at the Ministry of Transport, Information Technology and Communications (MTITC), in accordance with Art. 68, par. 1, item 2 and par. 2 of Ordinance Nr. 59 classifies the occurrence as a railway accident.

2.4. The investigation of the accident is undertaken on the grounds of Art. 115k, par. 1, item 2 of the Railway Transport Act (RTA), Art. 78, par. 1 and par. 2 of Ordinance Nr. 59 dt. 05.12.2006, on the grounds of which Order Nr. ПД-08-428/20.10.2017 is issued for the appointment of Commission for investigation of the railway accident at the Ministry of Transport, Information Technology and Communications (MTITC). The Investigation Commission includes external experts possessing the relevant professional qualification and specialization.

On 13.10.2017 the Investigation Commission performed surveys of electric locomotive Nr. 44134.2 at Plovdiv Locomotive depot and interviewed the staff members having partaken in the accident, as well as the staff members, indirectly related with the accident.

On 16.10.2017 the Investigation Commission carried out an interview at the MTITC with:

The locomotive brigade from EP-Vidin, having serviced by electric locomotive Nr. 44134.2 fast train Nr. 7621 Vidin – Sofia on 12.10.2017;

The Depot master at Sofia Locomotive depot, which was on duty on 12.10.2017;

The locomotive brigade from Plovdiv Locomotive depot, having serviced by electric locomotive Nr. 44134.2 fast train Nr. 8693 Sofia – Plovdiv on 12.10.2017.

On 25 and 26.10.2017 the Investigation Commission performed surveys of electric locomotive Nr. 44134.2 at Plovdiv Locomotive depot and interviewed:

The Depot master, who was on duty on 12.10.2017 at Plovdiv Locomotive depot;

The locomotive brigade from Plovdiv Locomotive depot, having serviced by electric locomotive Nr. 44134.2 fast train Nr. 8693 Plovdiv – Dimitrovgrad on 12.10.2017.

In the progress of the investigation the Chairman of the Investigation Commission requested by takeover protocol handling over to him of the textolite insulation plates for the elaboration of technical expertise.

Analyzed were the Report, submitted by the Operative Team, and the documents and materials collected to the Report.

The Commission requested additional materials from the parties affected by the accident.

The Commission analyzed the provided technical expertise for the burned textolite plates of electric locomotive Nr. 44134.2, elaborated by the Scientific Research Center at the Technical University-Sofia.

The Chairman of the Investigation Commission accepted the written opinions of the external experts, elaborated in fulfillment of their entrusted tasks on the investigation in progress.

2.5. For the performance of emergency repairing activities, locomotive Nr. 06114 pulled out the fired locomotive Nr. 44134.2, to recover trains' trafficking on schedule.

On 12.10.2017 transport train Nr. 10398 was designated to transport in cold state locomotive Nr. 44134.2 by locomotive Nr. 45197. From Dimitrovgrad station the train departed at 23:38 h. and arrived at Plovdiv station at 01:39 h. on 13.10.2017.

3. General data, established in the process of the investigation

3.1. BDZ Passenger Transport EOOD is a railway carrier, having performed the transportation of fast train Nr. 8693 from Sofia to Dimitrovgrad on 12.10.2017.

3.2. BDZ Passenger Transport EOOD is holder of:

3.2.1. License for passenger railway transport Nr. 21.10.2013/ EU;

3.2.1. The railway carrier BDZ Passenger Transport EOOD is in possession of Safety Certificate, Part A – Nr. BG1120130003 and Part B – Nr. BG1220130003, valid till 30.12.2017.

3.3. Fast train Nr. 8693 is on everyday trafficking schedule per the Trains' Trafficking Schedule on the direction of Sofia – Plovdiv – Stara Zagora – Burgas. Because of the performance of planned repairing works on the railway infrastructure and suspension of the traffic in Plovdiv - Mihaylovo section since 04.09.2017, the route of trains from all categories was changed through Dimitrovgrad – Mihaylovo – Stara Zagora section, continuing on the existing route to Burgas, as exhibited on Figure 2.



Figure 2

3.4. Railway road – reinforced concrete sleepers with elastic fasteners and rails of type 60E1;

3.5. Station and inter-station safety provision equipment:

- Dimitrovgrad station is equipped with Route Computer Centralization System “Elektra-2”, of no relevance to the committed accident;
- the railway section between Yabalkovo and Dimitrovgrad stations is equipped with Automatic Interlock System with axes’ counters – of no relevance to the committed accident;

3.6. Catenary – in proper operational condition;

3.7. Train composition station – Sofia;

3.8. Communication equipment and telecommunication links – in a faultless state;

3.9. Profile, geometry and layout of the railway road in the area of the accident:

- the place of fire outbreak is Dimitrovgrad station, at point Nr. 33 with radius R=300 m, right, of inclination 0 ‰;

3.10. Traction rolling stock:

- Electric locomotive Nr. 44134.2 has serviced fast train Nr. 8693;

- The Locomotive had faultless running parts, breaking systems, light and audio signaling systems, in conformity with the requirements of the technical norms and standards, as evidenced by the records kept in the relevant logbooks, copies of which were submitted with the Report elaborated by the Operative Team.

3.11. Non-traction rolling stock:

- 4 passenger wagons in the composition of the train;

3.12. At the time of realization of the accident no construction works were carried out on the railway infrastructure.

3.13. After performed surveys by the MoI, Dimitrovgrad Regional Department, the locomotive was released in view of its transportation to Plovdiv Locomotive depot.

3.14. Actions were undertaken on freeing of the points’ throttle area and recovery of the trains’ traffic at Dimitrovgrad station. After pulling of electric locomotive Nr. 44134.2 by diesel locomotive Nr. 06114 and enlivening of the catenary at the station, the train’s traffic was recovered at 18:20 h. on the same day.

4. Death cases, injuries and property damages

4.1. Death cases – none;

4.2. Injured persons with traumas – none;

4.3. Property damages:

4.3.1. Damages on electric locomotive Nr. 44134.2;

4.3.1.1. The repair of the fired elements amounts to BGN 5443,11, VAT included;

4.3.2. Damages on the railway line – none;

4.3.3. Damages on the safety provision equipment – none;

4.3.3. Expenditures on changing of the Trains’ Trafficking Schedule:

4.3.3.1. Expenditures generated from delayed trains of BDZ Passenger Transport EOOD – BGN 497,50;

4.3.3.2. Expenditures generated from delayed trains of BDZ Freight Transport EOOD – BGN 117,60;

4.4. Expenditures for recovery equipment – none;

4.5. The total damages and expenditures generated from the accident amount to BGN 6 058,21.

5. External circumstances – climatic and geographic conditions

Meteorological data, affecting visibility:

- in the light hours of the day;

- ambient temperature around +18°;

- weather – clear.

6. Data on staff members, related with the accident, from the railway carrier and the railway infrastructure

6.1 Locomotive brigades having serviced fast train Nr. 8693:

Sofia – Plovdiv:

6.1.1. "Locomotive engine driver" of electric locomotive Nr. 44134.2 – employee at BDZ Passenger Transport EOOD – 20 years, 0 months of service;

6.1.2. "Locomotive engine driver" of electric locomotive Nr. 44134.2 – employee at BDZ Passenger Transport EOOD – 30 years, 0 months of service;

Plovdiv – Dimitrovgrad:

6.1.3. "Locomotive engine driver" of electric locomotive Nr. 44134.2 – employee of BDZ Passenger Transport EOOD – 29 years, 0 months of service;

6.1.4. "Locomotive engine driver" of electric locomotive Nr. 44134.2 – employee of BDZ Passenger Transport EOOD – 11 years, 0 months of service;

6.2. Employees at Dimitrovgrad station:

6.2.1. "Traffic controller", first person at Dimitrovgrad station – employee at "Management of train trafficking and station activities" – Plovdiv, the NRIC – 4 years of service;

6.2.2. "Traffic controller", second person at Dimitrovgrad station – employee at "Management of train trafficking and station activities" – Plovdiv, the NRIC – 30 years of service;

6.3. Professional capability documents and documents for occupying of job position:

6.3.1. The locomotive staff members from BDZ Passenger Transport EOOD, having serviced electric locomotive Nr. 44134.2, are holders of:

- certificate for occupying of the relevant job position;
- professional qualification certificate;
- certificate for capability to drive the relevant series of locomotives;
- certificates for successfully passed examination in accordance with Ordinance Nr. 56

dt. 2003.

6.3.2. The station staff members from the NRIC are holders of:

- certificate for occupying of the relevant job position;
- certificate of professional capability;
- professional qualification document;
- certificates for successfully passed examination in accordance with Ordinance Nr. 56

dt. 2003.

6.4. Duration of rest before the working hours of the staff members related with the accident:

According to the requirements of the Labor Code and Ordinance Nr. 50 dt. 28.12.2001 on the working hours of the managerial and executive staff engaged with the provision of passenger and freight transports in the railway transport, the requested rest hours were ensured to the staff members, related with the accident, before starting work:

Sofia – Plovdiv:

6.4.1. "Locomotive engine driver", first person on electric locomotive Nr. 44134.2, rested from 10.10.2017, 00:30 h., till 12.10.2017, 04:20 h., commenced work on 12.10.2017 at 04:20 h.;

6.4.2. "Locomotive engine driver", second person on electric locomotive Nr. 44134.2, rested from 10.10.2017, 22:05 h., till 12.10.2017, 04:20 h., commenced work on 12.10.2017 at 04:20 h.;

Plovdiv – Dimitrovgrad:

6.4.3. "Locomotive engine driver", first person on electric locomotive Nr. 44134.2, rested from 11.10.2017, 20:00 h., till 12.10.2017, 15:30 h., commenced work on 12.10.2017 at 15:30 h.;

6.4.4. "Locomotive engine driver", second person on electric locomotive Nr. 44134.2, rested from 11.10.2017, 22:15 h., till 12.10.2017, 15:30 h., commenced work on 12.10.2017 at 15:30 h.;

6.4.5. “Traffic controller”, first person at Dimitrovgrad station, rested from 10.10.2017, 06:55 h., till 12.10.2017, 06:44 h., commenced work on 12.10.2017 at 06:45 h.;

6.4.6. “Traffic controller”, second person at Dimitrovgrad station, rested from 10.10.2017, 07:00 h., till 12.10.2017, 06:44 h., commenced work on 12.10.2017 at 07:00 h.

6.5. Pre-shift instructions:

The locomotive brigades, having serviced fast train Nr. 8693, have undergone through pre-shift instructions rendered at Sofia and Plovdiv locomotive depots. They have declared by their personal signatures in the instruction records that they were of fresh standing, well rested and had not used any alcoholic drinks or any other drug substances.

The station staff members at Dimitrovgrad station have undergone through pre-shift instructions. They have declared by their personal signatures in the instruction records that they were of fresh standing, well rested and had not used any alcoholic drinks or any other drug substances.

7. Data from other investigations. Summary of witnessed evidence

No similar investigation of any fire occurrence in the area of the textolite insulation plates of locomotives from series 43, 44 and 45 has been carried out. The Investigation Commission does not dispose of any other witnessed evidence on the investigated accident.

8. Safety management system of the National Railway Infrastructure Company (NRIC) and BDZ Passenger Transport EOOD

8.1. Observance of the procedures from the safety management system of the National Railway Infrastructure Company:

The Investigation Commission got acquainted with the procedures provided by the safety management system of NRIC and established that they had been fulfilled by the staff members of Sub-division “Management of train trafficking and station activities”, Plovdiv, included in the structure of NRIC. This is also evident from the Report of the Operative Team and the additionally requested materials.

8.2. Observance of the procedures from the safety management system of BDZ Passenger Transport EOOD:

The Investigation Commission got acquainted with the procedures provided by the safety management system of BDZ Passenger Transport EOOD.

Upon checking of the technical documentation of locomotive Nr. 44134.2, there were not any established or registered violations of the applicable Rules on plant and depot repair and maintenance of electric locomotives, as well as of the organization and operation technologies.

From the submitted technical documentation of electric locomotive Nr. 44134.2 it is evident that the repair periods were kept in conformity with the normative base. On 10.10.2017 a technical examination (TP-3) was carried out at Plovdiv Locomotive depot. The technical condition of the locomotive was good.

Upon checking of the train’s documents of fast train Nr. 8693 it was established that the requirements of Ordinance Nr. 58 on the elaboration of breaking mass certificate, maintaining of travel sheet, model form JIC-01, and accompanying sheet, model form II-21, were met.

The locomotive brigades of locomotive Nr. 44134.2, having serviced fast train Nr. 8693, were provided with official mobile phones.

9. Rules and norms:

The staff members from NRIC, immediately before and during the accident, have acted in conformity with the established normative regulations and internal rules regulating safety of railway transport.

The locomotive brigades from BDZ Passenger Transport EOOD, having driven electric locomotive Nr. 44134.2 servicing fast train Nr. 8693 on 12.10.2017 from Sofia to Plovdiv and Dimitrovgrad have acted in conformity with the established normative regulations and internal rules regulating safety of transport and the instruction on fire safety, relevant to the locomotive staff members upon fire outburst in locomotives, electric and diesel motor vehicles.

10. Functional status of the rolling stock and technical facilities of the railway infrastructure

10.1. Technical status of locomotive Nr. 44134.2:

- failures caused in consequence of the occurred earth circuit, later developing to a short circuit, in the area of the textolite insulation plates; there was fire outburst from the formed melt on the copper buses;

10.2. Status of wagons – no damages caused;

10.3. Status of the railway line – no damages caused;

10.4. Safety provision equipment – no damages caused;

10.5. Status of catenary – no damages caused;

10.6. Deciphering of the speed of locomotive Nr. 44134.2, executed at Plovdiv Locomotive depot of BDZ Passenger Transport EOOD at Sofia – Plovdiv - Dimitrovgrad section on 12.10.2017:

Fast train Nr. 8693 departed from Sofia station at 13:20 h. At the section between Sofia – Poduyane stations the train travelled with speed of up to 55 km/h. The train stayed at Poduyane station for 1 minute and departed therefrom at 15:26 h. At Iskar station the train stayed for 1 minute and departed at 13:35 h. At the section between Poduyane and Iskar stations the train travelled with the speed of 90 km/h. At the section between Iskar and Elin Pelin stations the train travelled with the speed of 80 km/h. At the section between Elin Pelin and Pobit Kamak stations – with the speed of 120 km/h, and at the section between Pobit Kamak and Vakarel stations – with the speed of 65 km/h. At Ihtiman station the train stayed for 4 minutes, departing at 14:23 h. In the section between Vakarel and Verinsko stations the train travelled with 100 km/h, and Verinsko – Ihtiman – with 110 km/h.

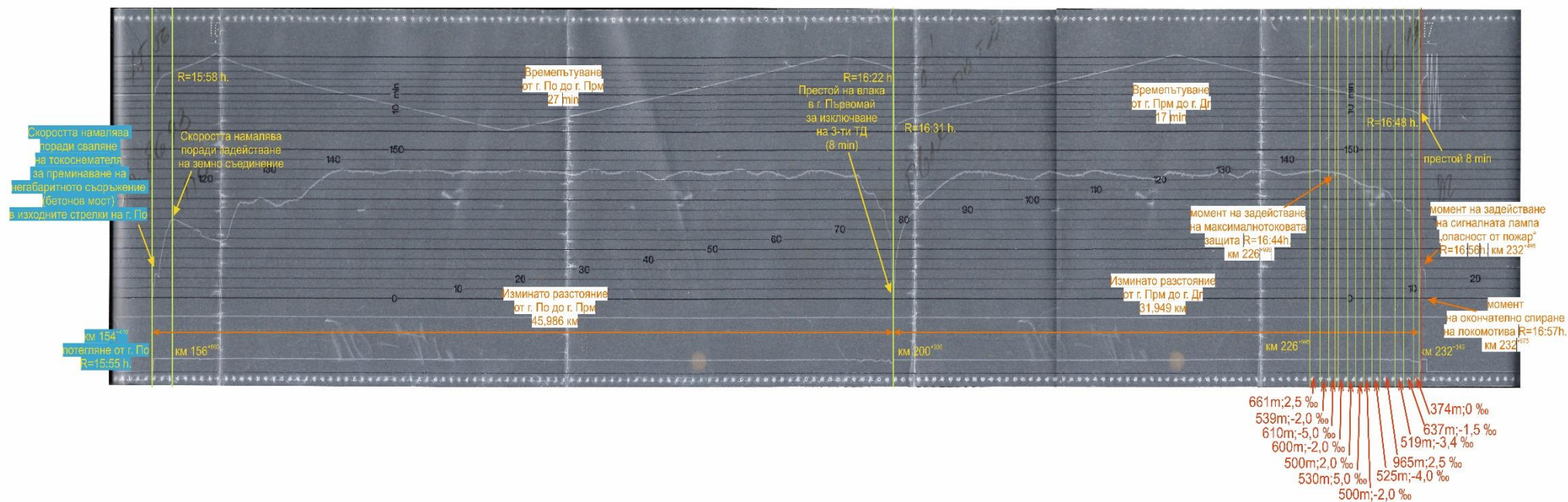


Figure 3

At Kostenets station the train stayed for 1 minute and departed at 14:42 h. At the section between Ihtiman - RP Nemirovo stations the train travelled with the speed of 80 km/h, and at RP Nemirovo – Kostenets intersection – with the speed of 60 km/h. At Belovo station the train stayed for 1 minute and departed at 15:02 h. At Septemvri station the train stayed for 2 minutes and departed at 15:15 h. At Pazardzhik station the train stayed for 2 minutes and departed at 15:25 h. At Stamboliiski station the train stayed for 1 minute and departed at 15:39 h. At Plovdiv station the train arrived at 15:49 h. At the sections between the stations of Septemvri – Pazardzhik – Stamboliiski – Plovdiv the train travelled with maximum speed of 130 km/h. From Plovdiv station the train departed at 15:56 h., passed through Plovdiv-razpredeliteln-East station with the speed of 55 km/h. Up to Krumovo station the train travelled with 100 km/h. At Parvomai station the train stayed for 8 minutes and departed at 16:30 h. At the section between Krumovo & Parvomai stations the train travelled with 130 km/h. At Dimitrovgrad station the train arrived at 16:48 h., stayed for 8 minutes and at 16:56 h. departed isolated locomotive 44134.2, accelerating to 30 km/h, passed about 300 m and at 16:58 h. it stopped travelling.

Upon servicing of the train the speed and traffic limitations were properly kept. There are no registered emergency stops and extreme hold-ups. The speedometer record tape is taken from the locomotive at 17:55 h. at Dimitrovgrad station.

11. Operational system documents – examinations, checks, repairs, maintenance and prophylaxis Документи за експлоатационната система – прегледи, проверки, ремонти, поддържане и профилактика.

For preventing of any consequences from the accident, the trains' traffic at Dimitrovgrad station was suspended from 16:50 h. till 18:20 h. on 12.10.2017. As a result therefrom the following trains were delayed, cancelled, deviated or appointed on the schedule:

11.1. Delayed trains, serviced by BD Passenger Transport EOOD:

- passenger train Nr. 10247, + 69 min. at Dimitrovgrad station;
- passenger train Nr. 10249, + 41 min. at Dimitrovgrad station;
- passenger train Nr. 10146, + 31 min. at Plovdiv station;
- passenger train Nr. 10154, + 58 min. at Septemvri station;

11.2. Delayed trains, serviced by BDZ Freight Transport EOOD:

- freight train Nr. 80603, + 84 min. at Stara Zagora station;

11.3. Cancelled trains – none;

11.4. Deviated trains – none;

11.5. Trains, appointed on the schedule – none.

12. Health and safety of labor

12.1. In connection with the requirements of Art. 13, par. 1 and Art. 14, par. 1 of Ordinance Nr. 50/28.12.2001, no violations of the working hours of the staff members are established.

12.2. In connection with the requirements of Art. 28, par. 1 of Ordinance Nr. 54/02.06.2003, no violations of the pre-shift medical examinations of the staff members are established.

12.3. In connection with the requirements of Art. 20, par. 2 of Ordinance Nr. 54/02.06.2003, the staff members related with the accident are in possession of valid psychological examination certificates.



Figure 4

13. Registered previous accidents of a similar nature

13.1. There are no registered previous accidents of a similar cause for fire outburst in locomotives series 43, 44 and 45.

14. Analysis and conclusions

14.1. Analysis of the rolling stock

The Investigation Commission got acquainted with the circumstances related with the fire outburst, as well as with the actions of the locomotive brigades having serviced locomotive Nr. 44134.2 on 12.10.2017.

14.2. From the performed surveys and the additionally requested materials for electric locomotive Nr. 44134.2, the Technical Investigation Commission drew the following conclusions:

The Investigation Commission carried out detailed surveys of locomotive Nr. 44134.2 at Plovdiv Locomotive depot (Figure 4), getting acquainted with the factual status of the locomotive. The Commission heard by interviewing the locomotive brigades having serviced train Nr. 8693 in the sections between Sofia – Plovdiv and Plovdiv – Dimitrovgrad stations. The investigation studied the positioning of the command units and the indications of the measurement units, left in the locomotive after the accident, which could provide information on the sequence of the consequences having lead to the occurrence of the accident.

The cause for bursting of fire in locomotive Nr. 44134.2 is a short circuit in the el. conductor buses of the second traction group (Figure 5). The short circuit itself has occurred consequentially from the reduced dielectric strength of the supporting textolite plate, caused by the long-lasting operation under heavy conditions, as well as by the additional burdening factors such as moisture, dust, etc.

The reduced dielectric strength of the supporting plate has lead to the initial occurrence of an earth circuit, which in its nature is also a short circuit between the el. conductor bus and the body of the locomotive. This state was almost acceptable, as the protection system was activated upon rather high voltage values – above 800 V (Figure 6). This had enabled the locomotive to travel for a rather long time, because of the comparatively low burdens to which it was subjected.

Upon full power (upon switching on of all 4 traction engines), the el. current is evenly distributed along the power chain, and taking in consideration the small mass of the trains pulled by the locomotive, it becomes clear what is the mechanism of occurrence of the earth circuit and why it has not grown to a more serious accident.



Figure 5



Figure 6

After isolating of one traction engine (before departure from Plovdiv station), and later of a second traction engine (before departure from Parvomai station), as a result from the increased resistance force upon train's movement due to the isolation of the traction engines, the el. current in the el. power chain (upon the same voltages) got increased, which also lead to increasing the load of the insulation textolite plate. Because of its reduced dielectric strength, its material was not able to resist and an outbreak between the two el. conductor buses



Фиг. 7



Фиг. 8

occurred, finally leading to the occurrence of a short circuit. Because of the short circuit occurrence, short circuit el. current passed through the buses, which was of very high values, initially causing very strong heating of the buses and activating of the overvoltage protection system of the locomotive. Because of the high temperature the material of the buses (copper) melted (Figure 7) and formed drops over the cables clad underneath, melted and fired their insulation, which lead to their ignition and bursting of fire in the machine room of the locomotive (Figure 8).

14.2. Analysis of the causes and elaboration of technical expertise

14.3. Causes for the occurrence of the accident

After the performed surveys and the collection of documents on the locomotive, the executed interviews with the locomotive brigades having serviced the locomotive, the elaborated technical expertise and the submitted opinions of the external experts, the Technical Investigation Commission drew the conclusion that the cause having lead to the occurrence of the accident is: an earth circuit, which has grown to a short circuit, with discharge on the surface of an insulation element made from textolite, supporting the bus system of the secondary coil of the traction transformer. The earth circuit occurred as a result from ageing of the surface of the textolite supporting plates, polluted by metal dust and the humidification of their surfaces from temperature differences.

The short circuit developed twice:

16:46 – 16:49 – The duration of the short circuit was about 0,5 minutes;

16:58 – The duration of the short circuit was about 1,5 minutes.

The raised temperature from the generated arch during the short circuits and the formed copper melt from the buses facilitated and created conditions for ignition of cabling insulation and bursting of the fire in the locomotive.

15. Rendered recommendations for preventing of accidents on the same causes

Aiming prevention of other accidents of a similar nature, in connection with the requirements of Art. 94, par. 1 of Ordinance Nr. 59 dt. 05.12.2006 on the management of safety in the railway transport, issued by the Minister of Transport, the “Railway Administration” Executive Agency shall order to BDZ Passenger Transport EOOD and BDZ Freight Transport EOOD implementing the rendered safety recommendations, in view of the operation of electric locomotives series 43, 44 and 45 of similar fire-bursting hazardous areas.

1. Strengthening the control upon the performance of the operational examinations of the locomotives at the major locomotive depots and the operational stations.

2. Modernization of the locomotives, though construction of new fire signaling and fire extinguishing installations in the locomotives, aimed at fast and timely reaction of the locomotive brigade servicing the locomotive.

3. Improvement of the existing fire extinguishing installation of the locomotives and adding in the hazardous areas of smoke and flame detection sensors, connected with the fire signaling installation, for timely reaction of the locomotive brigades.

4. Elimination of the causes for the occurrence of discharge processes in the textolite insulation plates in view of their ageing, supporting the low voltage bus system of the power transformer - requested is appropriate insulation of the buses in the area of transition through the supporting textolite plates.

In connection with the requirements of Art. 94, par. 3 of Ordinance Nr. 59 dt. 05.12.2006 on the management of safety in the railway transport, till 20.02.2018 the "Railway Administration" Executive Agency, BDZ Passenger Transport EOOD and BDZ Freight Transport EOOD shall inform in writing the Chairman of the Investigation Commission at MTITC on the actions undertaken in fulfillment of the rendered safety recommendations.

Sofia
December 20th, 2017

Chairman:

D-r Eng. Boycho Skrobanski

I, the undersigned, Ventseslava Mihailova Mishlyakova certify the truthfulness of the translation made by me from Bulgarian into English of the enclosed document. The translation consists of 16 pages.

Sworn translator:

Ventseslava Mihailova Mishlyakova

