R E P U B L I C OF B U L G A R I A
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FINAL REPORT

from

Investigation of railway accident – fire in locomotive № 91520044063-3, serviced passenger train № 80132 in Yambol station on 20.07.2023

2023

OBJECTIVE OF INVESTIGATION AND EXTENT OF RESPONSIBILITY

The National Air, Maritime and Railway Transport Accidents Investigation Board (NAMRTAIB), which is an independent body performs the investigation of significant accidents, accidents and incidents. The National Board is within the Council of Ministers (CM) of the Republic of Bulgaria, and aims to find the circumstances and causes that led to the accidents and incidents occurrence in order to improve the railway transport safety, and to avoid such, giving priority to the prevention of significant accidents.

The investigation, which the NAMRTAIB performed is independent from any judicial investigation, and does not include the determination of fault or responsibility.

The investigation is performed in accordance with the requirements of DIRECTIVE (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway transport safety, the Railway Transport Act (RTA), Ordinance No59 dated 5.12.2006 on the rail transport safety management, as well as per Agreement dated 11.04.2023 on the interaction during investigation of accidents and incidents in the air, maritime and railway transport between the Prosecutor's Office of the Republic of Bulgaria, Ministry of Interior, and the National Air, Maritime and Railway Transport Accidents Investigation Board.

The Investigation reports follow the requirements of REGULATION (EU) 2020/572 of the Commission dated 24 April 2020 on the reporting structure for railway accident and incident investigation reports.

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ABBREVIATIONS, USED IN THE REPORT

FT – Fast train
BDZ PS EOOD –„BDZ-Passenger Services“ EOOD – state carrier for passenger services
TDRD – Train dispatching radio connection
HST – Higher school of transport „Todor Kableshkov“ – Sofia
MAS – Main air switch
MPO – Major periodical overhaul
DMT – Diesel motor train
SE NRIC – State enterprise „National railway Infrastructure Company “(railway infrastructure manager)
EMT – Electrical motor train
EPV – Electrical pneumatic valve
RS – Railway section
RTA – Railway Transport Act
TOU- Traffic organization unit
km – track kilometre
OCL – Overhead contact line (catenary)
SPR – Small planned repair
Ordinance № 59 – Ordinance on the rail transport safety management
NAMRTAIB – National Air, Maritime, and Railway Transport Accidents Investigation Board (Independent Specialized National Investigation Body)
RAEA/NSA – Railway Administration Executive Agency, National Safety Authority
TF – Task Force
SE – Signalling equipment
SABS – Semi-Automatic Block System
PT – Passenger train
FEI – Fire-extinguishing installation
RRS – Rail Rolling Stock
FAS – Fire Alarm System
LR – Lift repair
TOMR – Train operation management and reporting
RD FSaCP – Regional Division Fire Safety and Civil Protection
RD MoI – Regional Division Ministry of Interior
EIM – Entity in charge of maintenance
SMS – Safety Management System
TI – Technical inspection
TOSAMD – Train operation and station activity management Division
DCCM – Device for communications, connections and messages
PTQC- Professional training requalification centre for the personnel at SE NRIC
PTC – Professional training centre at BDZ

1. Summary

1.1. *Brief Description of the Event.*

On 20.07.2023 at 13:30 p.m. FT No. 80132, consisting of 2 coaches, 8 axles, 94 tons, operated by electric locomotive No. 91520044063-3, with a locomotive driver and an assistant locomotive driver, train manager and conductor, departed from Burgas station. The staff serving the train, the locomotive and the coaches belong to the railway undertaking for passenger transport "BDZ-Passenger Services" EOOD.

During the movement of train No. 80132 in the Zavoy - Yambol interstation, the train manager, who was traveling in the first compartment of the first coach, smelled smoke and notified the locomotive driver by mobile phone. The locomotive driver disconnected the locomotive from the MAS and removed the pantograph, he continued the movement of the train by inertia to Yambol station. The train manager promptly gave a fire signal to the single emergency call number 112. At 15:45 p.m., with 9 minutes of delay, train No. 80132 settled on the third acceptance-departure track at Yambol station. The switchman on duty at Post No. 2 noticed that thick black smoke was coming out of the locomotive to the left in the direction of movement and notified the traffic manager on-duty. Before settling on the third track, the assistant locomotive driver informed the traffic manager on-duty that the locomotive could not continue the movement. The traffic manager on duty notified the train dispatcher at TOU Plovdiv and requested the disconnection of the voltage in the catenary at Yambol station.

At 16:00 p.m., the voltage in the catenary in Yambol station was switched off.

At the place of the accident at around 16:05 p.m., arrived two fire fighting vehicles from the Yambol RD FSaCP. They used one fire extinguisher and water to control the fire in the locomotive. At 16:20 p.m., the fire was extinguished and the team manager from RD FSaCP wrote in the dispatcher's order log that the locomotive was secured, but could not be supplied with voltage from the OCL. At 16:21 p.m., the voltage was applied to the catenary at Yambol station and the train operation was restored.

The composition of PT № 80132 remained on the third acceptance-departure track in Yambol

Fig. 1.1. Locomotive № 91520044063-3 of PT № 80132 in Yambol station.

station (fig. 1.1).

The locomotive crew, serviced locomotive № 91520044063-3, the transport crew and the passengers in the train were not injured.

There were no material damages to the railway infrastructure.

Damages were caused to the fired locomotive № 91520044063-3, which serviced PT № 80132 (fig. 1.2 and 1.3).

Fig. 1.2.

Fig. 1.3.

The movement between the stations Bezmer – Yambol – Zavoy was not interrupted.

The passengers were transhipped by bus to the final for the train destination station Stara Zagora.

1.2. Location and time of the event occurrence.

During movement at around 15:39 p.m. between the stations Zavoy and Yambol in locomotive №91520044063-3, serviced PT № 80132, was felt fumigation (smoke) in the engine compartment. At 15:44 p.m. the train entered in Yambol station on third acceptance-departure track and stopped at 15:45 p.m. (fig. 1.4).

Fig. 1.4. Scheme of the settlement place of FT № 80132 in Yambol station.

1.3. ***Factors determining and contributing the event.***

1.3.1. The causal (determining) factor was failure in the valves of the second air compressor, which led to an increase in the voltage, and continuing work of the compressor's engine, and an increase to inadmissible values of the temperature of the power supply unit and cables, accompanied by loose cable connections;

1.3.2. Contributing factor was a contaminated environment in the engine compartment from oiling the air duct for cooling the auxiliary machines in the engine compartment of the locomotive;

1.3.3. System factor was poor-quality performance of inspections and repairs, extension of the intervals between repairs of the locomotives of these series, regulated by internal departmental regulations and instructions, which led to deterioration of the technical condition of the locomotives, given the mileage accumulated over the years and unperformed overhauls.

1.4. Direct causes and consequences of the event.

The accident occurred as a result of damages occurring in the compressor and an increase in temperature during operation in the area of the power unit of the compressor.

The consequences of the event are:

- The locomotive is partially fired;
- As a result of the fire, the locomotive is out of service and is due to undergo a major periodical overhaul (MPO) at the Plovdiv Locomotive Depot;
- The locomotive will be out of service until the completion of the repair.

1.4. ***Safety recommendations and addressees to which they are addressed.***

In order to prevent other similar accidents, the Investigation Commission proposes to the National Safety Authority RAEA safety recommendations related to the SE NRIC and "BDZ Passenger Services" EOOD.

- Recommendation 1, proposes that SE NRIC and "BDZ-Passenger Services" EOOD shall inform the interested personnel on the contents of this report;
- Recommendation 2 proposes that BDZ PS EOOD to carry out an analysis of the damage that occurred, which led to accidents and the subsequent repairs as necessary;
- Recommendation 3, proposes BDZ PS EOOD to carry out a comprehensive change of the regulations for the repair and maintenance of the electric locomotives series 43, 44 and 45, which have not been overhauled (PDR-LS 0103/1978 and PZR - PLS 127/2005);
- Recommendation 4, proposes BDZ PS EOOD to conduct periodic trainings to increase the professional qualification of the engineering and technical personnel involved in the repair and maintenance of the locomotives;
- Recommendation 5, proposes that BDZ PS EOOD assigns to the locomotive depots every locomotive entered for TI, that the engine compartment is regularly cleaned with a vacuum cleaner, and that the large aggregates are dismantled and thoroughly cleaned at each IPR;
- Recommendation 6, proposes BDZ PS EOOD to equip the locomotive depots with infrared cameras to detect the places with increased temperature after prolonged operation of the locomotive

2. Investigation

2.1. *Decision for starting the investigation.*

Decision to initiate a safety investigation was made on 24.07.2023 by the member of Management Board of the NAMRTAIB in the Republic of Bulgaria, leading the investigation of railway accidents and incidents in accordance with the requirements of art. 22, paragraph 1 and paragraph 3 of Directive (EU) 2016/798 of the EPC. Given the severity of the accident and its impact on safety in rail transport, the investigation is mainly focused on analysing and establishing the causes aimed at preventing other accidents of a similar nature.

2.2. *Motives for the decision to initiate the investigation.*

The member of the Management Board of the NAMRTAIB, leading the railway investigation section, took the decision to initiate the investigation based on art. 20, paragraph 2 (a) of Directive (EU) 2016/798, art. 115к, paragraph 1, item 2 of RTA, and art. 76, par. 1, item 2 of Ordinance No 59 dated 5.12.2006.

The investigation was undertaken taking into account the circumstances that led to the fire in locomotive No. 91520044063-3, which served train No. 80132 during its stay at Yambol station.

2.3. *Scope and restrictions of the investigation.*

In the scope of the investigation, the organizational and human factors, the Safety Management System related to the repair and maintenance of the locomotive were analysed. The risk assessment with registered hazards for traction rolling stock, which is owned by the railway company "BDZ-Passenger Services" EOOD.

2.4. *Competences of the persons, involved in the investigation.*

In accordance with the requirements of art. 22, paragraph 1 of Directive 2016/798, the Investigation Commission is headed by the member of the Management Board of the NAMRTAIB, head of the railway transport department. The members of the commission are independent external experts - qualified persons from higher transport educational institutions, scientific circles, experts in the field of human and organizational factors with qualifications in railway infrastructure, rolling stock and operation and management of railway transport.

2.5. *Communication and consultations with the persons and entities, involved in the event.*

The Commission determined the parameters of the investigation and coordinated its actions with the Task Force, which included managers, experts and safety authorities of the two entities (BDZ PS EOOD and SE NRIC). The Task force collected all documents and samples, written statements of the personnel of the entities related to the accident, the records from the recording device of the locomotive No. 91520044063-3, hauling PT No. 80132 on 20.07.2023. The materials and documents were provided to the head of the safety investigation in NAMRTAIB. The Investigation Commission conducted an interview with the train staff (locomotive driver, assistant locomotive driver and train manager) and got acquainted with the statements of the persons related to the accident. BDZ PS EOOD additionally requested and provided information on the repair and maintenance of the locomotive. Interviews were conducted with the safety authorities of the two entities, with the management of the railway undertaking BDZ PS EOOD and the SE NRIC. A printout of the actual movement of train No. 80132 from Burgas station to Yambol station on 20.07.2023 was requested and provided by SE NRIC.

2.6. *Degree of cooperation from the participating entities.*

During the investigation carried out by the Commission in the NAMRTAIB, the managers of the railway undertaking BDZ PS EOOD and of the SE NRIC provided full assistance and a full set of all requested necessary materials and documents. Full access to the burned locomotive No. 91520044063-3 at the Plovdiv Locomotive Depot was provided for inspections and measurements of units and machines.

2.7. *Methods and techniques of investigation and analysis.*

On 20/07/2023 at 15:58 p.m., the deputy chairperson of the Management Board of NAMRTAIB with competence to investigate railway accidents received a notification on the mobile phone from the dispatcher on duty of BDZ PS EOOD. At 16:00 p.m., an SMS notification was sent to the mobile phone

from the central dispatching office of the train traffic to the manager of the railway infrastructure (SE NRIC) about an accident that had occurred - the ignition of locomotive No. 91520044063-3, serving train No. 80132 at Yambol station.

After analysing the information, the deputy chairperson of the Management Board of NAMRTAIB ordered the management of BDZ PS EOOD to move locomotive No. 91520044063-3 to Locomotive Depot Plovdiv (main locomotive depot) and to restrict the access to it due to the initiation of an investigation on safety by the Commission at the NAMRTAIB.

In the period 25.07.÷28.07.2023, the Investigation Commission in the NAMRTAIB went to the Locomotive Depot Plovdiv, where, together with the managers of BDZ PS EOOD for the operation and maintenance of railway transport and for safety, a safety investigation was started to establish the circumstances and reasons, caused the fire in the locomotive. The commission carried out comprehensive inspections outside and in the engine compartment of locomotive No. 91520044063-3. The burned machines and aggregates were dismantled from the engine compartment.

● Inspections and measurements of the II rectifier cabinet No. 022 were carried out and it was established:

- Burnt insulation board of II rectifier No. 022;
- Burnt power cables of II rectifier No 022 for II engine compressor No 235;
- Loose connection from power fuse P7 to II engine compressor No 235.

● Inspections and measurements of II engine compressor No. 235 were performed and it was found:

- Low flow rate of the II engine compressor No 235;
- 3 broken valves - 1 exhaust and 2 intake;
- Due to the failure, the compressor was constantly running and that had led to the burning of the power supply cables from the II rectifier No. 022.

● Inspections and measurements were made of the disconnected body shell and bogies of the locomotive and it was established:

- Dismantled III-rd traction engine - working cables, terminal board, strong casing;
- There is no presence and traces, and it appears that the ignition started under the locomotive body shell in the area of the terminal board of the III traction engine.

● Inspections and measurements of the locomotive's fire alarm system were carried out and it was found:

- Serviceable auxiliary relay № 528;
- Signal lamps No. 530 and No. 531 on the locomotive control panel working;
- Due to a disconnected connector of the II rectifier No. 022 for thermal fuse No. 527.4 in the intermediate terminal board of the III-rd traction motor and burnt operational cables of the thermal fuse No. 525.5 it was not possible to perform functional tests.

In the period 02.08.÷04.08.2023, the Investigation Commission at the NAMRTAIB went again to Locomotive Depot Plovdiv, where new inspections and measurements of machines and aggregates were carried out, additional documentation was requested for the types of repairs carried out over time.

● Inspections and measurements of the II engine pump No. 239 were carried out and it was found:

- Traces of smoking on the casing of both capacitors;
- The capacities of the two capacitors were measured and the reported values were 82.2 mF - in norms. They were not damaged as a result of the damage that occurred - they were serviceable

● Inspections and measurements were made of thermal fuse No. 525.5 located in the intermediate terminal board of the III traction engine and it was found:

- The thermal fuse was burnt with slight damage, but standing;
- The bimetallic plate – working, the glass rod and the membrane – working;
- Thermal fuse No. 527.4 triggered the locomotive's fire alarm system. Because of that the warning lamp on the control panel was probably giving a signal.

In the above-mentioned period at the Plovdiv Locomotive Depot, the Investigation Commission of the NAMRTAIB conducted an interview with the locomotive crew that operated locomotive No91520044063-3 and the train manager who served train No. 80132. It got acquainted with their written statements given on the day of the accident and with the testimony of the other employees connected with the accident.

The Chairperson of the Commission demanded and received:

- the speedometer tape for the movement of locomotive No. 91520044063-3, which served train No. 80132 on 20.07.2023 in the Burgas - Yambol section;
- financial report on the damage caused as a result of the fire in the locomotive from the railway company owner BDZ PS EOOD;
- extract from the logbook for the Operational inspections of the locomotive carried out before the accident;
- extract from the passport of the locomotive for the types of repairs carried out in the time before the accident;
- extract from the protocol on the status of the PIS and PGI from 14.07.2023 during the IPR of the locomotive;
- extract from the train movement logs of the traffic manager on duty at Yambol station with adjacent stations and the train dispatcher;
- extract/printout from the TWOU system for the actual movement of train No. 80132 in the section from Burgas station to Yambol station;
- the testimony of the employees involved in the accident of the two entities.

On 02.08.2023, the head of the safety investigation at the NAMRTAIB received from the head of the Task Force at the TOSAD - Plovdiv the collected materials and documents in connection with the fire in locomotive No. 91520044063-3, which served PT No. 80132 on 20.07.2023.

In the period 23.08.÷25.08.2023 at the Plovdiv Locomotive Depot, the Investigation Commission at the NAMRTAIB continued with the inspections, and after dismantling the remaining units from the machine compartment, an additional inspection was made and it was established that in the tub under the traction smoothing reactor, as well as in the cooling air channel of the reactor and the rectifier unit, a considerable amount of oil had collected, which had leaked from the air compressor and, together with the accumulated dust and other impurities, had greatly contaminated the channel and thus contributed to the creation of a fire hazard environment in that area.

2.8. ***Difficulties faced during the investigation***.

During the investigation, the NAMRTAIB Commission did not encounter any difficulties. The Task force officers and the safety authorities of the railway infrastructure manager and the railway undertaking/carrier provided full assistance to the safety investigation commission.

2.9. ***Interaction with the judicial authorities.***

At the place of the accident, joint inspections by representatives of the pre-trial proceedings were organized and conducted by the Yambol RD Ministry of Interior and the railway undertaking BDZ PS EOOD. A protocol has been drawn up for the inspections carried out.

At 16:20 p.m., after the completion of the procedural and investigative actions, written permission was given by the authorities of the RD Ministry of Interior, Yambol, to carry out emergency recovery activities, released the burnt locomotive from supervision and restored the train traffic.

In accordance with the Agreement (effective from 11.04.2023) on interaction between the pre-trial proceedings and the NAMRATIB, the investigation authorities from the RD of the Ministry of Interior of Yambol, RD Yambol and the head of the safety investigation at NAMRATIB, information was exchanged regarding the fire in the locomotive serving FT No. 80132 on 20.07.2023.

2.10. ***Other important information for the investigation context.***

In connection with the provisions of the Agreement on interaction between the bodies of pre-trial proceedings and the NAMRATIB effective from 11.04.2023, in accordance with the requirement of the Agreement, the Yambol District Prosecutor's Office did not initiate pre-trial proceedings in connection

with the burning locomotive at the Yambol station, due to technical issues that arose, causes that led to the fire, without personal and external intervention.

3. Description of the event

3.1.Information on the event and the context.

3.1.1.Description of the event type.

On 20.07.2023 at 13:30 p.m., passenger train No. 80132 departed from Burgas station consisting of 2 wagons, 8 axles, 94 tons, served by electric locomotive No. 91520044063-3 with a locomotive driver and an assistant locomotive driver, train manager and conductor. The rolling stock of the train and the service personnel were part of the railway undertaking "BDZ-Passenger Services" EOOD.

During the movement of train No. 80132 at the Zavoy-Yambol interstation, the train manager smelled smoke and notified the locomotive driver by mobile phone.

The locomotive driver disconnected the locomotive from the main air switch (MAS), removed the pantograph and moved the train on inertia to Yambol station. The train manager sent a fire signal to the single emergency telephone number 112 about the fire that occurred in the locomotive.

PT No. 80132 entered in Yambol station on the third acceptance-departure track at 15:45 p.m., with 9 minutes delay. The post switchman on duty of Post No. 2 noticed that smoke was coming from the locomotive and informed the traffic manager on duty. To the left in the direction of movement, thick black smoke was coming out of the draft gear of the locomotive. Before settling on the track, the assistant locomotive driver informed the traffic manager on duty that the locomotive could not continue the movement. The traffic manager on duty informed the train dispatcher at the Plovdiv Railway Station about the situation that has arisen, and requested the disconnection of the voltage in the catenary at Yambol station. At 16:00 p.m., the voltage in the catenary in Yambol station was switched off.

The train manager and the conductor took timely measures to evacuate the passengers from the train to a safe distance.

At the place of the accident at around 16:05 p.m., two firefighting vehicles from the Yambol Fire Rescue Service arrived. They used a portable fire extinguisher and water to control the fire inside the locomotive. At 16:20 p.m., the team leader from RD FSaCP wrote in the dispatcher's order log at Yambol station that the locomotive was secured, but could not be supplied with voltage from the OCL.

At 16:21 p.m., the voltage was applied to the catenary at Yambol station.

The composition of PT No. 80132 with the burnt locomotive remained on the third acceptance-departure track at the Yambol station.

The passengers from the train were transhipped by buses to the train's final destination station, Stara Zagora.

On 21.07.2023, the coaches of train No. 80132 with locomotive No. 91520044063-3 in non-working condition were included in train No. 80230 from Yambol to Stara Zagora. At the Stara Zagora station, the coaches of train No. 80132 with locomotive No. 91520044063-3 in non-working condition were included in train No. 80112 to Plovdiv station. Locomotive No. 91520044063-3 was moved to the Plovdiv Locomotive Depot at 10:10 a.m. on 21.07.2023.

The locomotive crew that served locomotive No. 91520044063-3, the transport crew of PT No. 80132, as well as the passengers on the train, were not injured.

There was no material damage to the railway infrastructure.

Material damages were caused to the burnt locomotive No. 91520044063-3, serving PT No. 80132.

During the time of the accident, the movement of trains between Bezmer - Yambol - Zavoy stations was not interrupted.

3.1.2.Date, punctual time and place of the event.

On 20.07.2023 at 15:45 p.m. PT № 80132 arrived in Yambol station and stopped on the third acceptance-departure track. The third acceptance-departure track in Yambol station on the trains' direction is a main track and continuation of current track № 2 to Bezmer station. The track is in a straight line with profile 0,27 ‰ – descending. (fig. 1.2).

Fig. 3.1. Route of PT № 80132 and the place of the accident.

- Origin station of PT № 80132;
- Major stations along the train alignment;
- Final destination station of PT № 80132;
- Place of the accident – Yambol station;
- Track, which PT № 80132 has passed;
- Track, which PT № 80132 was about to pass;

PT № 80132 has been moving along the main line № 8 in direction Burgas – Karnobat – Zimnitsa – Stara Zagora (fig. 3.2).

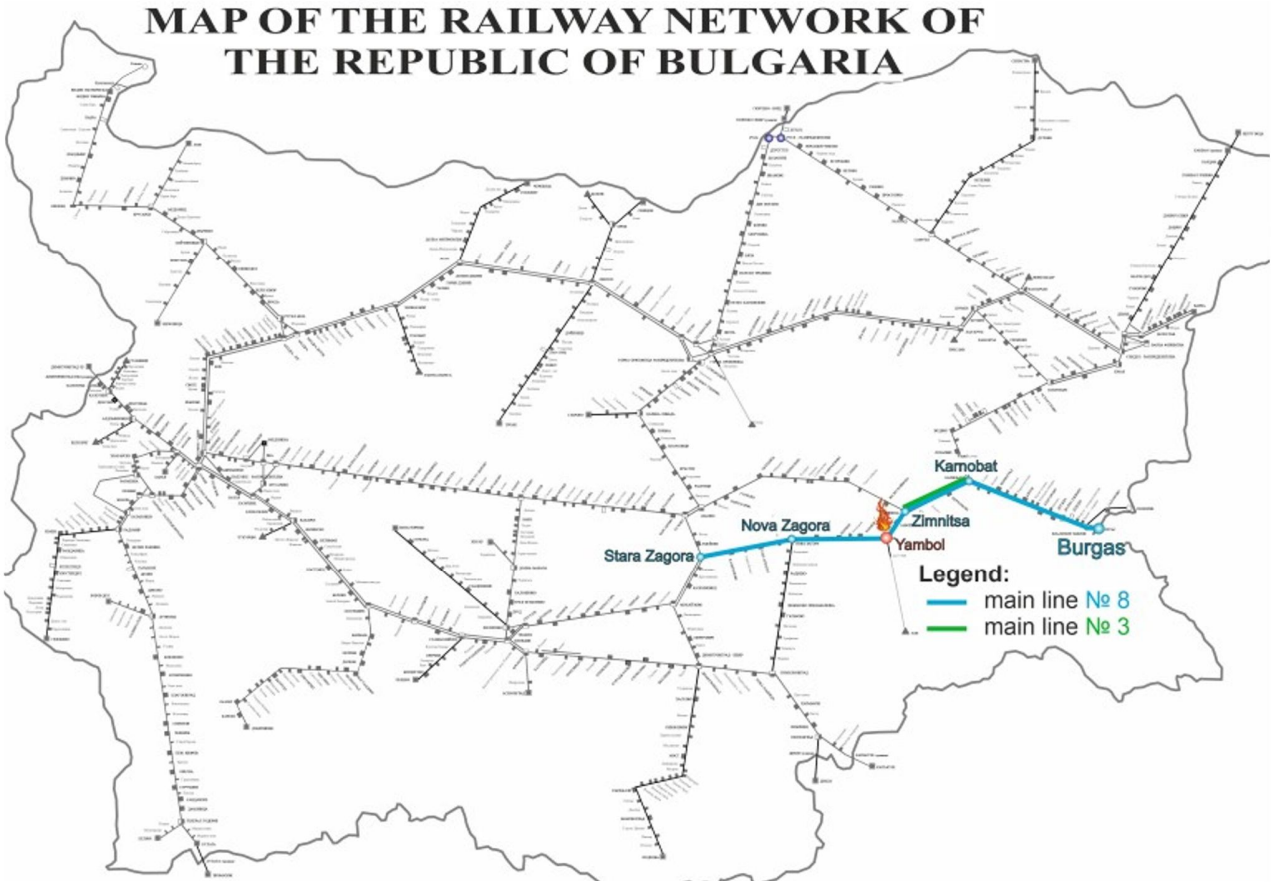


Fig. 3.2. Map of the route of movement of PT № 80132.

3.1.3. Description of the place of event:

3.1.3.1. Location of the accident place (fig. 3.3).

Geographic width: 43° 7'31.93"N

Geographic length: 23°42'9.07"E

Fig. 3.3. GPS location and place of PT № 80132 with locomotive №91520044063-3 in Yambol station at km 183+509.

3.1.3.2. Meteorological and geographical condition at the time of the event.

- In the light part of the day – 15:45 p.m. (as per the data of the locomotive recording device);
- Air temperature: +38ºC;
- Wind speed and direction approximately 2 m/s, Southwest;
- Weather – clear, hot with clear visibility of the signals;
- Average relative air humidity 21 %;

3.1.3.3. Performance of construction activities on the site or in vicinity.

Along the Zavoy - Yambol interstation and in the area of the Yambol station, at the time of the accident, no construction works on the railway infrastructure (railway and facilities, catenary and signalling equipment) were carried out by the manager of the railway infrastructure.

3.1.4. Fatalities, injuries and material damages:

3.1.4.1. Employees of the railway infrastructure manager or railway undertaking.

None.

3.1.4.2. Other persons officially connected with the location of the event.

None.

3.1.4.3. Passengers.

None

3.1.4.4. External persons.

None

3.1.4.5. Cargo, luggage or other property.
None.

3.1.4.6. Rolling stock, infrastructure and environment.
Railway undertaking:

- Material damages caused to locomotive № 91520044063-3 amounting to 1 013,40 BGN.;
- Material damages to passenger coaches – none;

Railway infrastructure

- Damages caused to the rail track – none;
- Damages caused to the catenary – none;
- Damages caused to the signalling equipment – none;
- Damages caused to the environment – none;

Total costs of the damages: 1 013,40 BGN

3.1.5. Description of other consequences, including the event impact on the usual activity of the participants.

In the period 15:50÷16:30 p.m. on 20.07.2023 the railway infrastructure manager and the railway undertakings generated additional costs under the train movement and capacity schedule modification along the section.

- Deviated trains of railway undertakings – None;
- Cancelled trains of railway undertakings – 283,00 BGN;
- Assigned trains of railway undertakings – None;
- Delayed trains of BDZ PS EOOD – 20,00 BGN;
- Delayed trains of railway undertakings – 46,00 BGN;
- Costs for rehabilitation means – None;
- Costs for BDZ PS EOOD for passenger transport of PT 80132 by bus – 1 023,00 BGN

Total other costs: 1 372,00 BGN

3.1.6. Identity of the participants and their functions.
Railway infrastructure:

- SE "National Railway Infrastructure Company" has a Safety Authorization, which guarantees that the manager of the railway infrastructure has built a Safety Management System for the operation and maintenance of the railway infrastructure. Ensures equal and non-discriminatory access to all licensed and certified railway enterprises for the transport of passengers and goods to the railway infrastructure of the Republic of Bulgaria.

Personnel of SE NRIC involved in the accident:

- Train dispatcher in TOU Plovdiv;
- Traffic manager on-duty in Yambol station;
- Post switchman in Yambol station.

Railway undertaking:

- BDZ PS EOOD owns a License and a Single safety certificate, which guarantees that the railway undertaking has constructed a Safety management system for performance of railway services for transport of passengers along the railway network in the Republic of Bulgaria. BDZ PS EOOD is a national carrier under a contract with the State for performance of passenger transport services.

Personnel of BDZ PS EOOD involved in the accident:

- Locomotive driver of locomotive № 91520044063-3;
- Assistant locomotive driver of locomotive № 91520044063-3;
- Head of train of PT № 80132.

3.1.7. Description of the respective parts of the railway infrastructure and signalling system:

3.1.7.1. Type of the track, railway switch, rail crossing etc.

Yambol station has six acceptance-departure tracks. From the Zavoy station to the east, the line is a single-track electrified line. From Bezmer station to the west, the line is a double-track and electrified. Second and third are main tracks, continuation of current track No. 1 and No. 2 in the direction of Bezmer station. The remaining four tracks are acceptance -departure. The tracks at the station are straight. In the direction of Bezmer station, the tracks have a slope of 0.27 ‰. Yambol station is a junction station of the railway network in the direction of the main railway line No. 8 with a deviation from the main railway line (Fig. 1.2).

The third track at the Yambol station in the direction of the movement of train No. 80132 is a main track, a continuation of the current track No. 2 to the Bezmer station. The third track is 750 m useful length in a straight line with a profile of 0.27 ‰ in descent.

3.1.7.2. Interstation block system, station installation, type of signalling and messages.

Interstation block system

The interstation Zavoy – Yambol – Bezmer are equipped with ABS without transition signals with axle counters – functioning;

Interlocking:

Yambol station is equipped with RRI type WSSB GS-2 with shunting without routes with shunting boards – functioning;

Type of signalling:

In Yambol station – entrance and exit semaphores are under the speed signalling – functioning;

3.1.7.3. Train protection systems.

Yambol station does not have a train protection system. Yambol station and the interstation are equipped with TDRC, with the help of which radio communication is carried out between the locomotive driver of the train with the traffic managers on duty, the train dispatcher, with the trains of the respective railway section - operational.

Locomotive No. 91520044063-3 is equipped with an active type vigilance device and a "Hasler RT9" type recorder - working

3.1.8. Other information referring the event.

3.1.8.1. Train documents of PT № 80132 at „BDZ-Passenger services“ EOOD.

The train documents „Waybill“, „Nature sheet“, „Accompanying sheet“ and „Brake mass certificate“ (fig. 3.5 ÷ 3.11) are in accordance with the hours of the actual train movement as per the data presented by the TWOM and the decoding of the locomotive recording device.

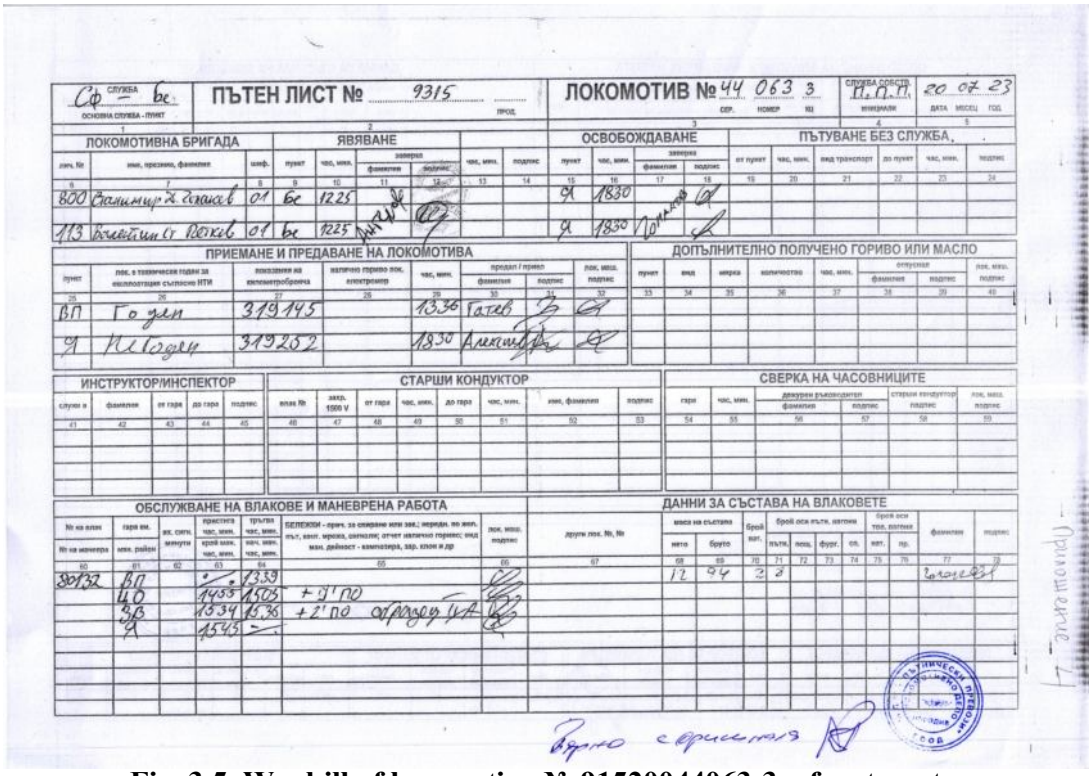


Fig. 3.5. Waybill of locomotive № 91520044063-3 – front part.

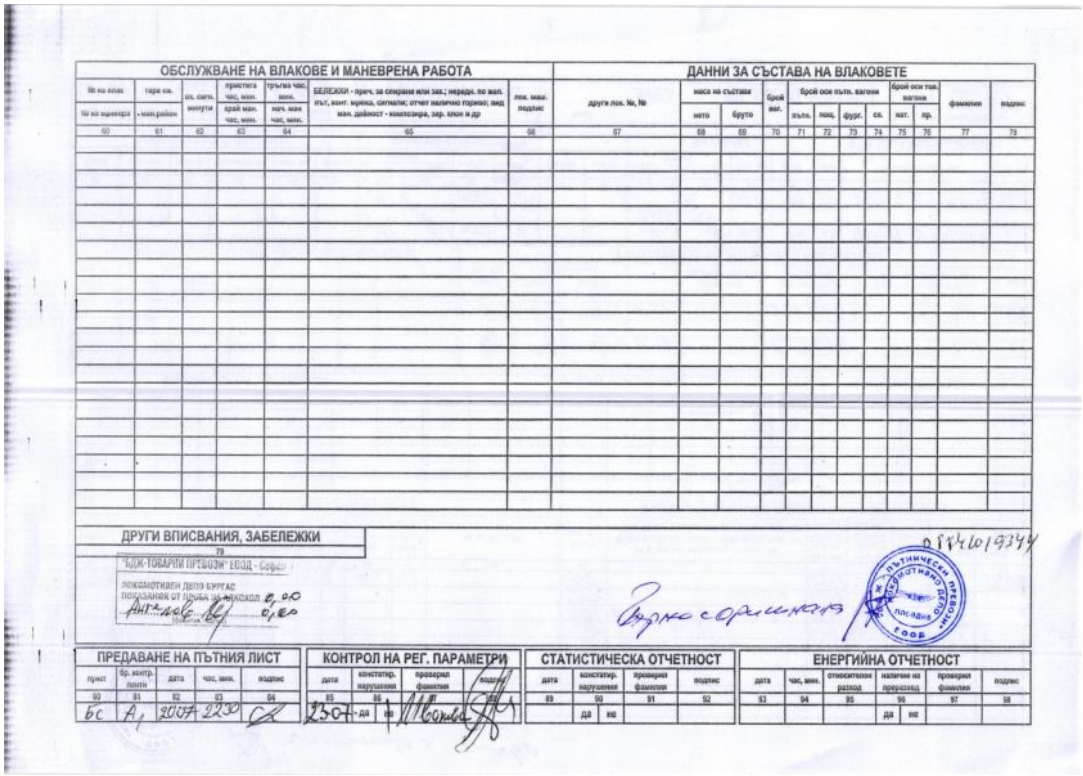


Fig. 3.6. Waybill of locomotive № 91520044063-3 – rear part.

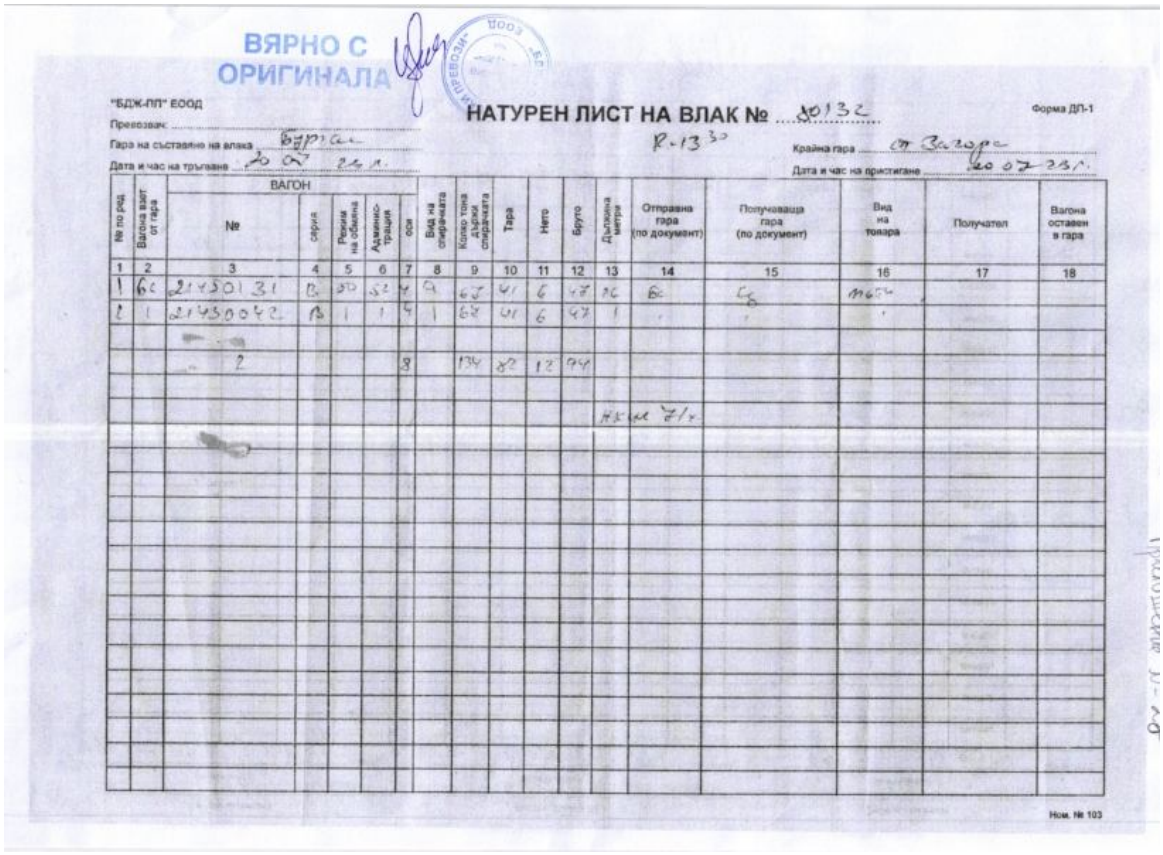


Fig. 3.7. Nature sheet of PT № 80132 – front part.

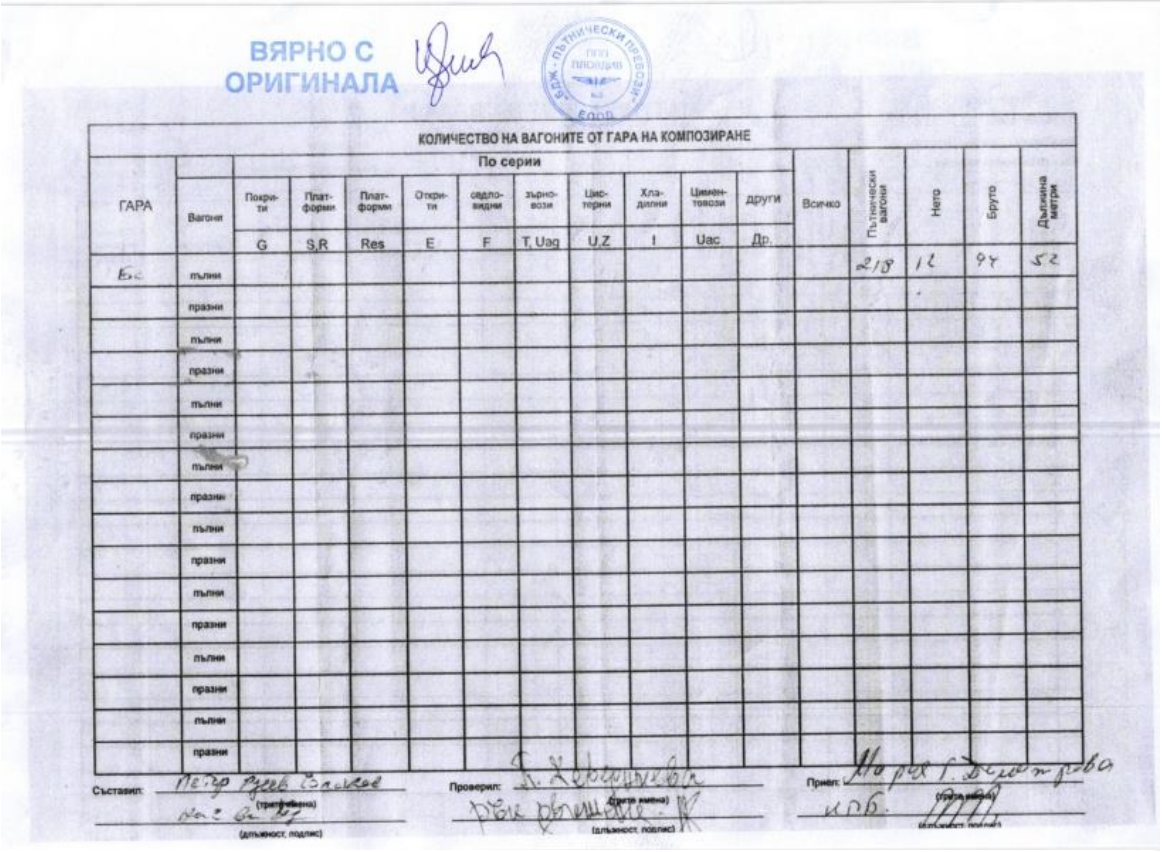


Fig. 3.8. Nature sheet of PT № 80132 – rear part.

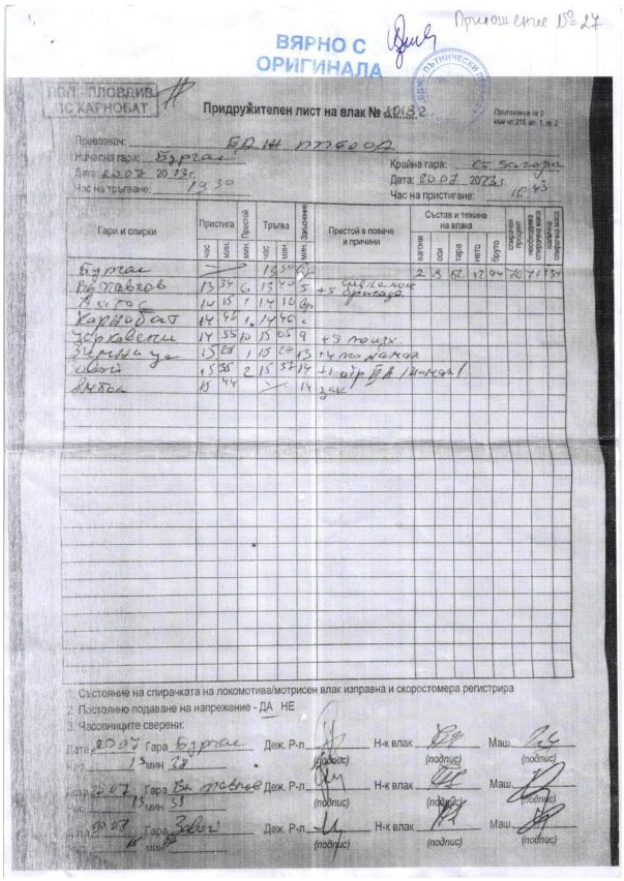


Fig. 3.9. Accompanying sheet of PT №80132 – front part.

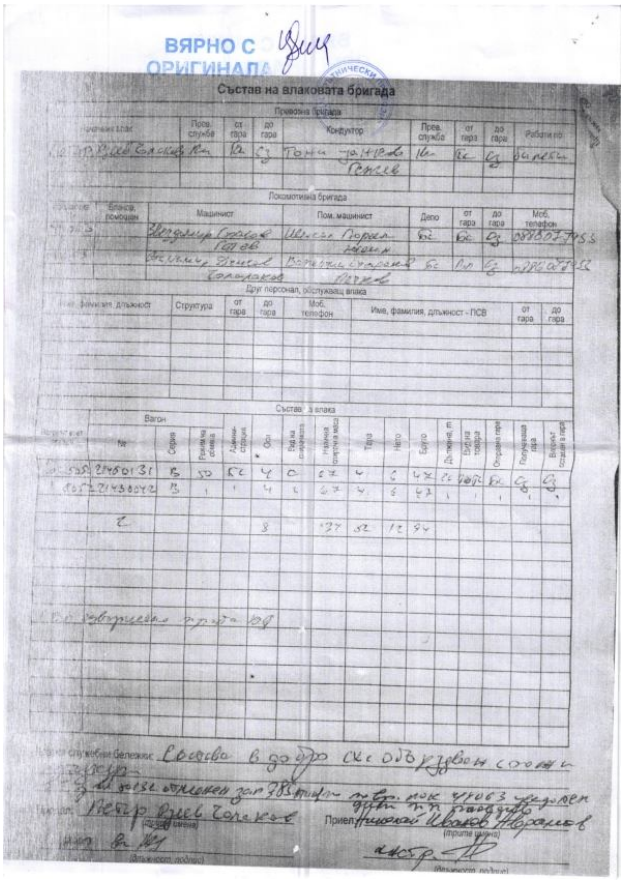
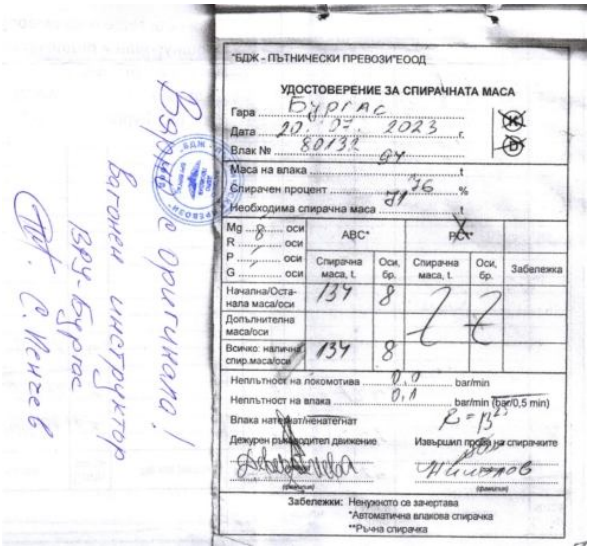


Fig. 3.10. Accompanying sheet of PT №80132 – rear part.



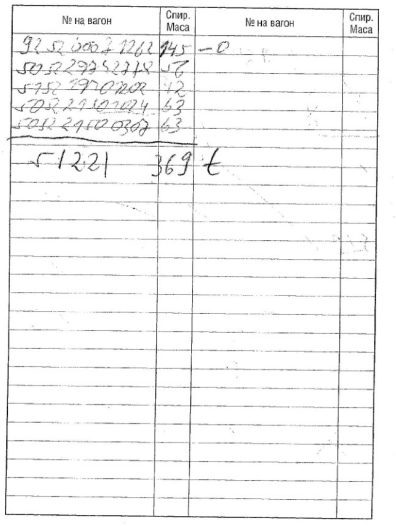


Fig. 3.11. Brake mass certificate of PT № 80132, issued in Burgas station– front and rear part.

3.2. Factual description of the occurred.

3.2.1. Immediate sequence of events that led to the accident, including:

3.2.1.1. Actions that the involved in the event persons undertook.

At 15:39 p.m. during the movement of train No. 80132 in the Zavoy - Yambol interstation, the train manager, traveling in the first compartment of the first coach next to the locomotive, smelled smoke. Through the window of the coach, he saw black smoke coming out of the locomotive, he notified the locomotive driver on his mobile phone. The locomotive driver disconnected the locomotive from the MAS, removed the pantograph and continued the movement of the train by inertia to the Yambol station. The train manager promptly gave a fire signal to the single emergency call number 112. At 15:45 p.m., train No. 80132 arrived on the third acceptance-departure track at Yambol station. The switchman on duty at Post No. 2 also noticed that thick black smoke was coming out of the locomotive and notified the traffic manager on duty. The traffic manager on duty notified the train dispatcher at the Plovdiv railway station and requested the disconnection of the voltage in the catenary at the Yambol station.

At 16:00 p.m., the voltage in the catenary in Yambol station was switched off.

Around 16:05 p.m., two fire vehicles from the Yambol Fire Emergency Service arrived at Yambol station. They used a portable fire extinguisher and water to control the fire in the engine compartment of the locomotive.

At 16:20 p.m. the fire was extinguished.

At 16:21 p.m., the voltage was applied to the catenary at Yambol station and the train operation was restored.

The composition of PT No. 80132 remained on the third acceptance-departure track at Yambol station.

The transport crew: train manager and conductor, promptly organized the removal of all passengers from the coaches with their luggage to a safe distance.

The railway undertaking "BDZ-Passenger Services" EOOD created an organization for taking passengers by bus along the direction of the train to the Stara Zagora final destination station.

On July 21, 2023, at 10:10 a.m., the burned locomotive No. 91520044063-3 was moved from Yambol station to the Plovdiv locomotive depot (main locomotive depot).

3.2.1.2. Rolling stock and technical facilities functioning.

● Until the time of the accident, the rolling stock of PT No. 80132 (the locomotive and two coaches) were technically sound.

Locomotive № 91520044063-3 is owned by BDZ PS EOOD, manufactured in 1975, factory №6443 in ŠKODA Plzeň factory Czechoslovakia, with regular registration in the European vehicles register (EVR), (fig. 3.12).

Fig. 3.12. Plate of the manufactory plant.

During the service of PT No. 80132 from Burgas station to Yambol station, the locomotive crew of locomotive No. 91520044063-3 did not find failures, damages and conditions for a fire in the locomotive.

Coaches with No. 50522145013-1, 51522135004-2 series Bm, from the composition of PT No. 80132 are serviceable, with regular registration in the European Register of Vehicles (ERV).

The rolling stock of BDZ PS EOOD (locomotives and coaches) was insured with civil liability insurance.

● The traffic manager on duty at the Yambol station has ordered a route with the station interlocking RRI type WSSB GS-2 to receive train No. 80132 on the third main track with the train stopping at the station according to the schedule.

3.2.1.3. Operational system functioning.

The operational system for managing the train traffic on the main railway line No. 8 and between Zavoy - Yambol - Bezmer stations before the accident was functional and functioning normally. The train traffic along the section Zimnitsa - Zavoy - Yambol is carried out on a single electrified railway line.

During the time of the accident, the train traffic control at Yambol station did not function due to a power outage in the catenary from 15:50 p.m. to 16:21 p.m. on 20/07/2023.

3.2.2. Sequence of the events from the beginning of the occurrence until the end of the rescue services actions:

3.2.2.1. Undertaken measures for protecting and guarding the event location.

At 15:50 p.m., the authorities of the RD, Ministry of Interior, Yambol arrived at the Yambol station, after clarifying the situation, the area was restricted to outsiders. The authorities of RD FSaCP and the interested officials of the entities were admitted to the site. The media access was restricted.

3.2.2.2. Actions of the emergency rescue services.

At 15:50 p.m., the voltage in the catenary at Yambol station was turned off.

At 15:55 p.m., two specialized vehicles of RD FSaCP Yambol arrived at the Yambol station and started extinguishing the locomotive. The fire in the locomotive was extinguished at 16:20 p.m.

At 15:21 p.m., after the permission of the authorities from RD FSaCP Yambol, the voltage was applied to the catenary of Yambol station.

3.2.2.3. Actions of the emergency rehabilitation services.

Not applicable.

3.2.2.4. Actions, which SE NRIC and "BDZ-Passenger Services" EOOD for restoring the schedule and capacity of the railway line

On 20.07.2023 at 16:20 p.m., after the completion of the procedural and investigative actions, written permission was given by the RU of the Ministry of Interior of Yambol to carry out emergency restoration activities.

At 16:21 p.m., the movement of trains through Yambol station was restored.

On 21.07.2023, the coaches of train No. 80132 with locomotive No. 91520044063-3 in non-working condition were included in train No. 80230 from Yambol to Stara Zagora.

At the Stara Zagora station, the coaches of train No. 80132 with locomotive No. 91520044063-3 in non-working condition were included in the train No. 80112 to Plovdiv station.

Locomotive No. 91520044063-3 was moved to the Plovdiv Locomotive Depot at 10:10 a.m. on 21.07.2023.

4. Analysis of the event

4.1.Participation and responsibilities of the entities, involved in the event

4.1.1. Railway undertaking.

Analysis of the movement of PT № 80132.

The analysis of the movement of the train was made for the section in which it was served by the latest locomotive crew, paying attention to the movement in the last interstation Zavoy - Yambol.

The decoding was made on the basis of the data recorded on the speedometer tape of locomotive No. 91520044063-3, at the head of PT No. 80132 on 20.07.2023.

The registration of the main and most important parameters of the movement of the locomotive, respectively of the train, in speedometer installations "Hasler" system was done by recording on the speedometer control tape:

- Track speed (V-S);
- Astronomical time by graphing and printing on the tape, as well as travel and staying time (T chart);
- Distance travelled for individual track sections (through perforations on the tape – 2.5 mm = 0.5 km)

The following additional parameters can also be registered on the speedometer tape of RT9 type devices (such as those on locomotive no. 91520044063-3):

- Pressure in the main air duct;
- Travelling direction;
- Switching on the rheostat brake;
- Activation of the automatic brake (pneumatic registration);

The speedometer tape is checked to determine:

- Has the prescribed maximum speed of the train been observed?
- Is the speed limited to the prescribed speed when crossing a section that must be crossed with a speed limit
- Is the duration of reduced speed movement respected, i.e. to travel a distance equal to the length of the reduction plus the length of the entire train;
- Are there any unplanned stops on the interstation;
- Are there any noted slippages of the locomotive;
- Is there a pressure drop in the main air duct of the air brake when performing the various tests;
- How the automatic train air brake was used and how the rheostat brake was used;
- Availability of additional registrations in accordance with those provided for each series of TPRRS (traction power rail rolling stock);
- Availability of all records for the relevant TPRRS.

The speedometer control tapes can also be used for other clarifications in the movement of trains, namely:

- Delays in departure and arrival;
- Stopping before closed signals in the stations;
- Within calculation of the energy cost etc.

The speedometer control tapes are considered a valuable objective document in the investigation of transport safety accidents and railway accidents.

Any falsification of the speedometer tape, intentional destruction or deliberate impact of the clock or recording mechanism is considered a transportation safety violation.

Fig. 4.1. Tape tachograph

Fig. 4.2. Tachometer

Locomotive No. 91520044063-3 is fitted with a "Hasler" type speedometer installation, which consists of a three-phase alternating current collector converter (geber) driven by one of the locomotive's wheelset. The resulting three-phase voltage with a variable frequency depending on the speed of movement drives the mechanical speedometer synchronous electric motors mounted on it. One speed measuring device is installed in the locomotive cabins: the recording device (tape tachograph) RT9 in cabin No. 1 (fig. 4.1) and the non-recording device (tachometer) A16 in cabin No. 2 (fig. 4.2). The two speedometers have a range of 0÷150 km/h.

The tape tachograph measures and displays on an overview dial the following data when the locomotive is moving:

- Track speed in km/h;
- The time in hours and minutes;
- The total passed section in km (kilometre counter);

The tachometer measures and displays on a clear dial the same data that the tape tachograph displays, without the distance travelled and without recording the information. It is electrically connected to the tachograph, and if the power cable is interrupted, the two devices stop recording the speed of movement.

The recording equipment of the RT9 tachograph records the following basic parameters:

- The track speed in km/h;
- Astronomical time, and the travelling and staying time;
- The travelled track for separate track sections;
- Other parameters for the locomotive movement.

The recording (speedometer) tape is made of waxed paper. It has linear fields for recording the information transmitted by the tape tachograph (Fig. 4.3). The speedometer tape is a valuable objective data source for accurately determining the beginning, course and end of movement-related processes.
On the speedometer tape are registered:

- The track speed in km/h;
- Astronomical time;
- Travelling time;

- Staying time;
- Travelled track for separate track sections;
- The air pressure in the main air duct (MAD);
  Other data (optional).

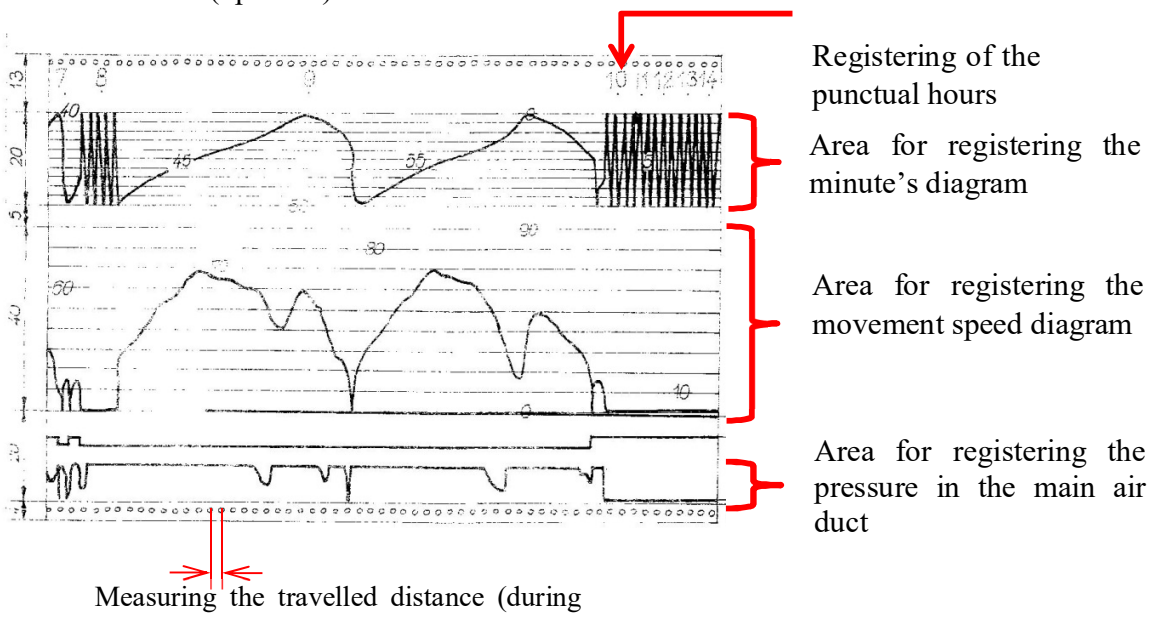


Fig. 4.3.

The new locomotive crew received locomotive No. 91520044063-3 from the Vladimir Pavlov station during its stay at the station from 13:38 p.m. to 13:40 p.m. (Fig. 4.4). It departed from Vladimir Pavlov station at 13:40 p.m. (Fig. 4.4, item 1), increased the running speed to 30 km/h, then stopped gradually with the automatic train brake to perform a test hold (effective brake test) (fig. 4.4, pos. 2). The speed decreased to 8 km/h, after which it gradually started to increase until reaching a value of 80 km/h (Fig. 4.4, item 3). Further, during its movement, the train observed the section speeds and the reductions along the rail track to Zavoy station.

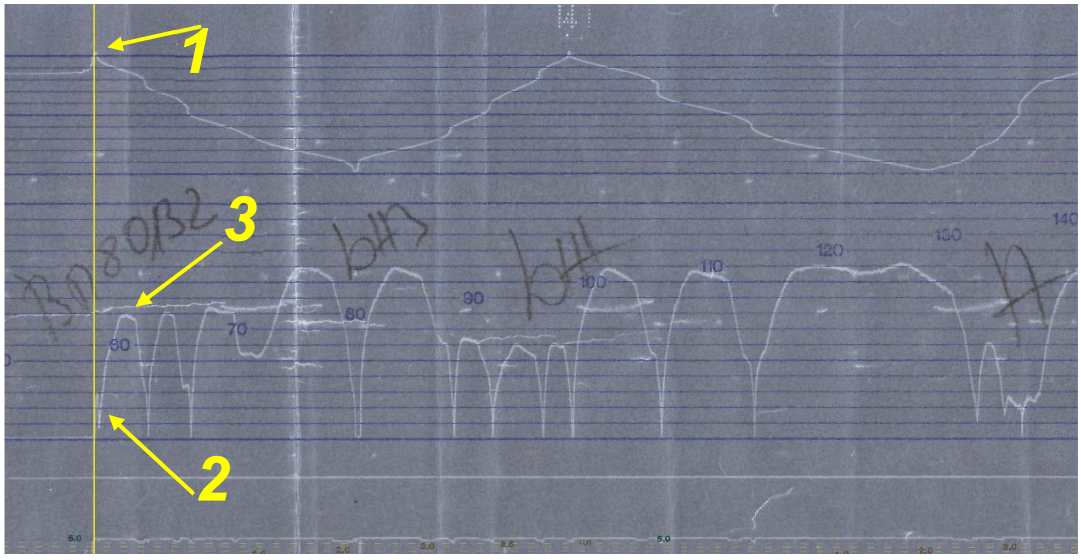


Fig. 4.4.

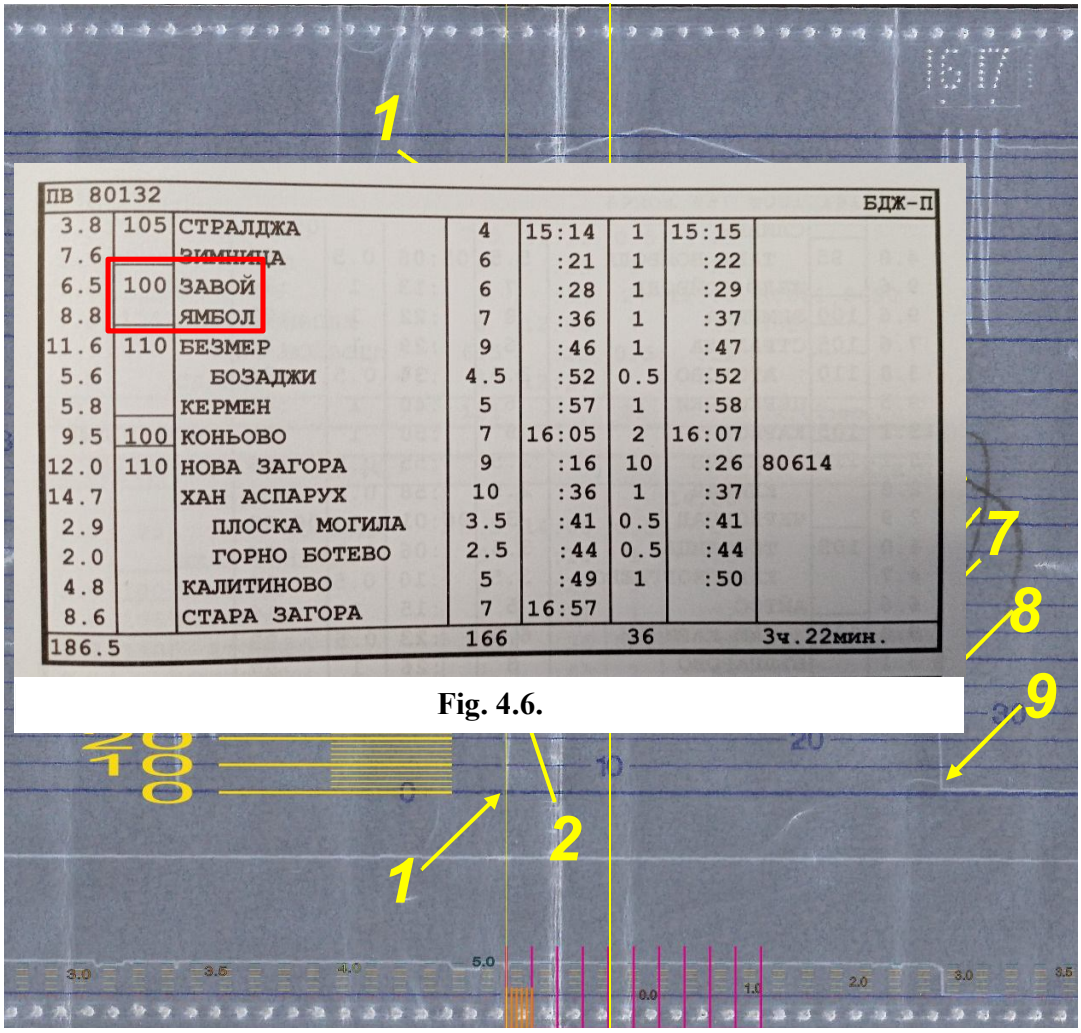


Fig. 4.6.

Fig.4.5.

At the station Zavoy PT No. 80132 arrived at 15:35 p.m. (fig. 4.5, pos. 1). It stayed for about 2 minutes and left at 15:37 p.m. It accelerated to 40 km/h for 100 meters for 20 seconds (Fig. 4.5, item 2). The speed was held at that value for 400 meters, then in the next 350 meters it increased to 59 km/h for 40 seconds (Fig. 4.5, item 3). At that speed, the train moved for 400 meters, then for 800 meters it increased again to 98 km/h (Fig. 4.5, item 4). The maximum permissible speed in the Zavoy - Yambol interstation was 100 km/h (Fig. 4.6). Thus, the train reached its maximum speed after it has traveled 2,000 meters from its departure from Zavoy station. That happened at 15:39 p.m., i.e. after a time travel of 2 minutes. From that point on, the travel speed started to decrease smoothly without using the automatic train brake, i.e. the train moved by inertia and the speed decreased from the natural resistance to the movement of the train (Fig. 4.5, pos. 5). Apparently, that was when the engine driver shut down the engine after the train manager notified him of the smoke in the engine. In that mode of movement, PT No. 80132 travelled 5,200 meters, at the end of which the speed decreased to 64 km/h (fig. 4.5, item 6). At that point, the locomotive driver activated the automatic train brake, releasing 0.5 bar from the main air duct, releasing it after 100 meters and restoring the operating pressure to 5 bar. The speed decreased to 56 km/h, and at that speed the train moved for 300 meters in 30 seconds (Fig. 4.5, item 7). Another arrest with the automatic train brake followed, again the pressure in the main air duct was reduced by 0.5 bar, as a result of which the speed decreased to 40 km/h (Fig. 4.5, item 8). Apparently, that was the time when the train had to pass through the entrance switches of Yambol station, as it was accepted into a diversion track. At a speed of 40 km/h, the train travelled 700 meters in 50 seconds. Another service hold followed with the automatic train brake, reducing the speed to 0 km/h and at 15:45 p.m. the train stopped (fig. 4.5, pos. 1)

Analysis of the causes for the accident

The Commission established and analysed the following:

1. The burned supply bus bars connecting the rectifier to the traction motor through the terminal board of the 3rd traction motor (Fig. 4.7);

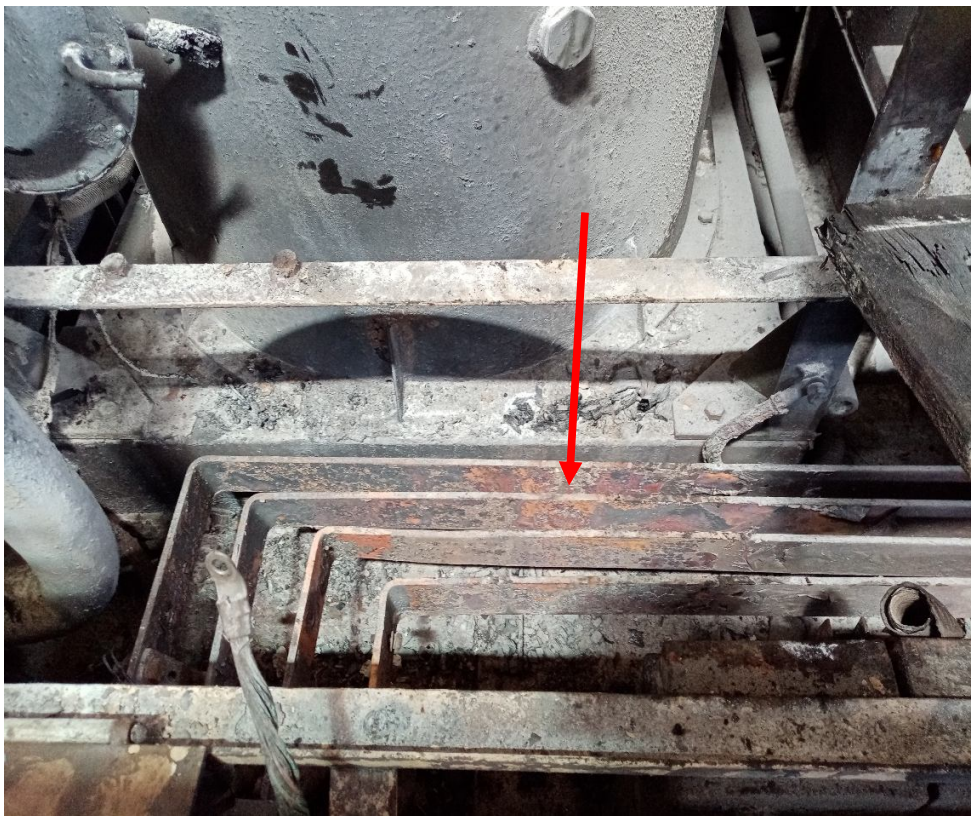


Fig. 4.7. Burnt bus bars of the terminal board of the 3- rd traction engine.

2. The burned traction rectifier 022 (fig. 4.8) in the area of the auxiliary rectifier 221 of engine compressor 235;

Fig. 4.8. The burned traction rectifier 022.

3. The burned insulation of power cables of second engine compressor 235 (fig. 4.9, pos. 1);

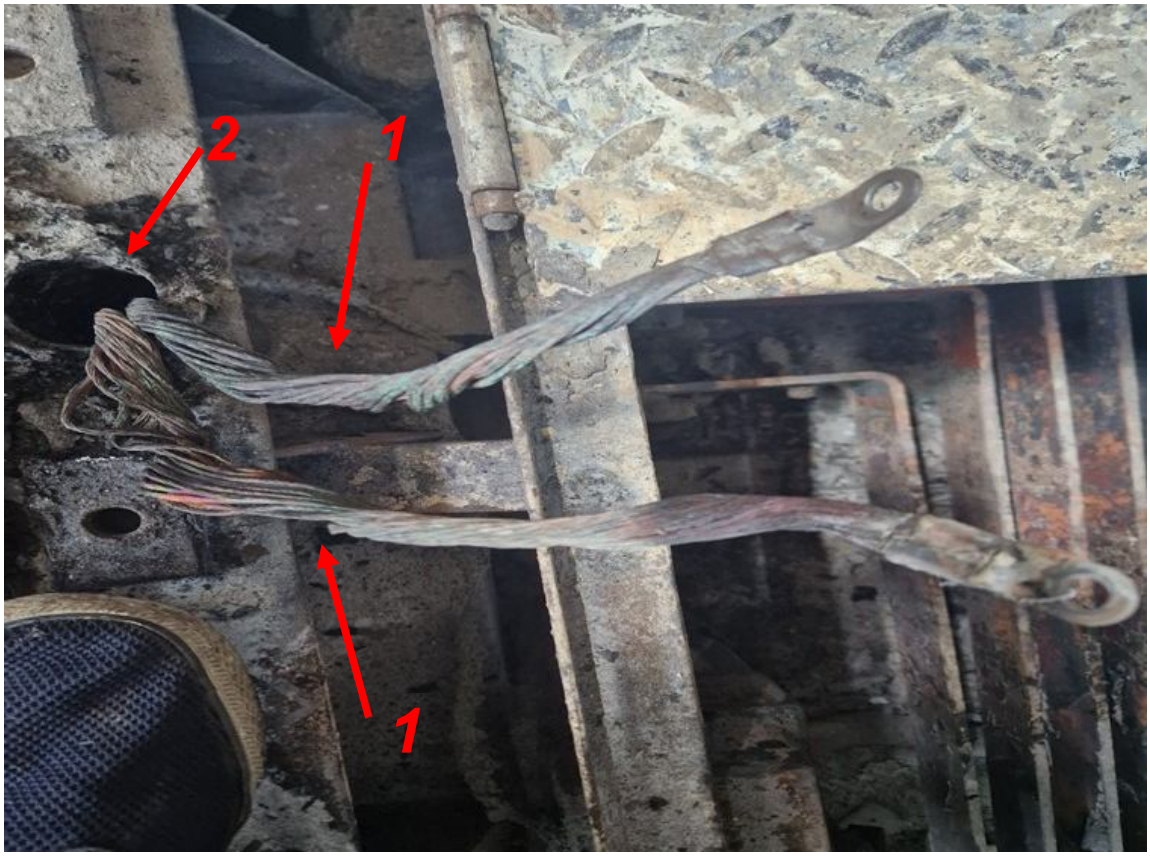


Fig. 4.9. Power cables of second engine compressor 235.

4. After dismantling of repair group 022 - a violation of the insulating pads of the bus bars of the second engine compressor was found. Mainly the power cable of the compressor engine and its protective fuse P7 were burnt (fig. 4.9, item 2).

5. A second terminal board on a second traction engine was checked. It was established that there was no presence of dust and oil after the lifting repair of the locomotive. The bus bars were positioned apart from each other with insulating sleeves (Fig. 4.10).

Fig. 4.10. Power cables on second traction engine terminal board with insulating sleeves

6. With protocol 17, it was confirmed that the thermal fuse 527.4 was triggered by the fire alarm and the fire lamp 531 on the locomotive control panel was lit. According to the testimony of the drivers, fire lamp 531 did not activate.
7. With protocol 16, it was established that the capacity of the starting capacitor of the second engine pump 239 was within the norms and could not be the cause of ignition of the locomotive.
8. With protocol 12, an inspection and measurement of rectifier cabinet 022 was carried out. It was found: the insulation board (fig. 4.11) of the second rectifier cabinet 022 was burnt, the power

Fig. 4.11. Burnt insulation board.

cables of the second compressor engine 235 were burnt and the presence of a loose connection from power fuse P7 to engine compressor 235 (fig. 4.12).

Fig. 4.12. Protector P7 of the engine compressor.

9. By Protocol 13 was checked compressor 235 and a low debit was found, broken valves, which led to continuous work of the engine compressor 235 and to burning of the power cables.
10. By Protocol 14 was established that the integrity of the power cables of third traction engine was not interrupted (fig. 4.13 and 4.14).

Fig. 4.13.

Fig. 4.14.

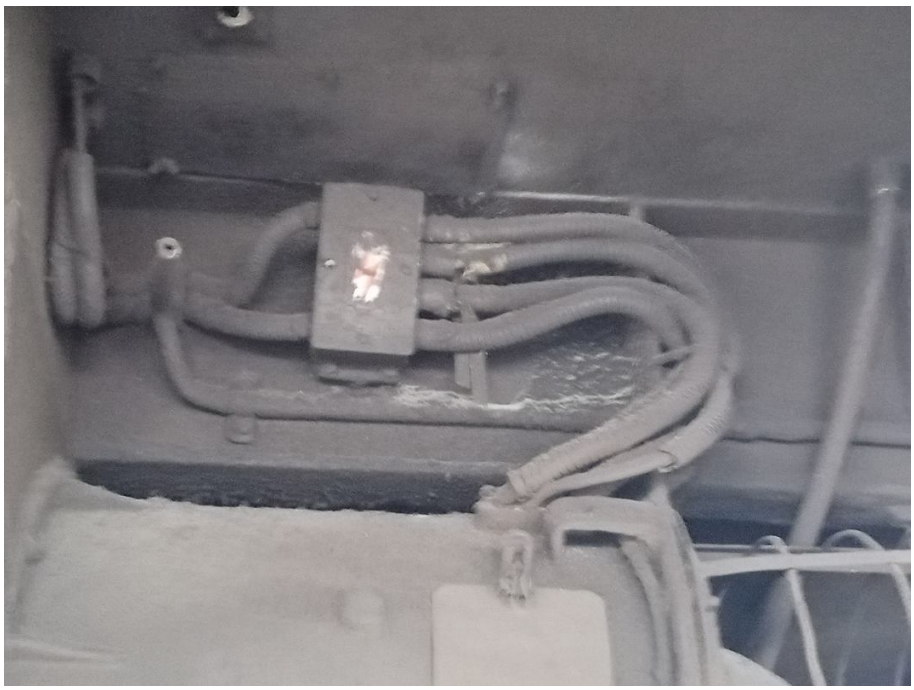


Fig. 4.15.

Fig. 4.16.

During the inspections of the burnt locomotive № 91520044063-3 in Plovdiv locomotive depot it was established that the locomotive could be recovered. The main aggregates of the locomotive have not been damaged, the control cabins, the under body shell equipment (horizontal fan) and the draft gear (bogies) have not been damaged by the fire (fig. 4.15, 4.16). Nevertheless the damages in the machinery compartment were evident. The firefighting installation of the locomotive has not been activated, and traces of fire extinguishing powder was found in the area of second rectifying block/unit (fig. 4.17), which was a result from the actions of the employees of FSaCP within the fire extinguishing.

Fig. 4.17.

After the big aggregates were dismantled in the area of ignition (the rectifying block, smoothing reactor, compressor, radiator for cooling the transformer/s oil) there were ensured access to the places for which was supposed that possibly could be considered as a source of ignition.

There was established a modification in the colour of the current leading bus bars to the interim terminal board of third traction engine, which could be one of the causes for the ignition (Fig. 4.18).

Fig. 4.18.

Fig. 4.19.

There were also found peeling paint on the air duct under the rectifier unit as well as burnt wires on the connection leading to the compressor (Fig. 4.19).

Within the inspection of the taken down aggregates was established that within a change in the

Fig. 4.20.

Fig. 4.21.

colour of the lower part of the metal body of the rectifying block, as well as burnt and charred elements

in the same area (Fig. 4.20). The power supply unit of the compressor is located there, as well as its fuse (Fig. 4.21).

Upon inspection and disassembly of the compressor, it was found that there were two broken valves, which resulted in a reduction in the flow rate when the compressor was running, which in turn forced the compressor itself to run longer to obtain the necessary compressed air, resulting in an increase its operating temperature, as well as the current with which its electric motor is supplied. That caused the temperature of the power unit to rise to unacceptable values, which eventually led to the melting of the insulation and the ignition of the cables and other elements located in the area (Fig. 4.22)

Additional inspection was performed, and it was established that in the bath under the traction

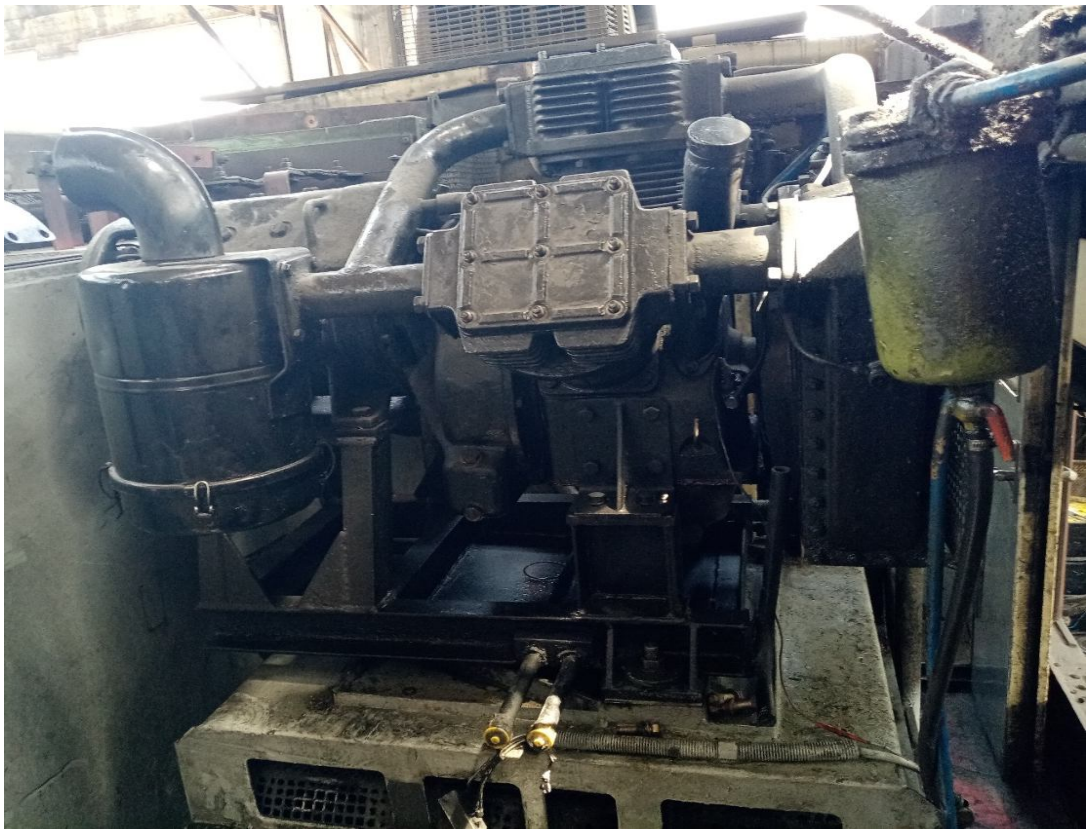


Fig. 4.22.

smoothing reactor as well as in the air channel for cooling a considerable amount of oil was collected, which leaked from the air compressor, and together with the accumulated dust and other impurities, heavily polluted the channel and thus contributed to the creation of a fire-hazardous environment in this area (Figs. 4.23 and 4.24).

The available amount of oil has collected from gaps in the air compressor seals or from leaking after filling with oil. During the movement of the locomotive, the leaking oil flows onto the smoothing reactor 080.

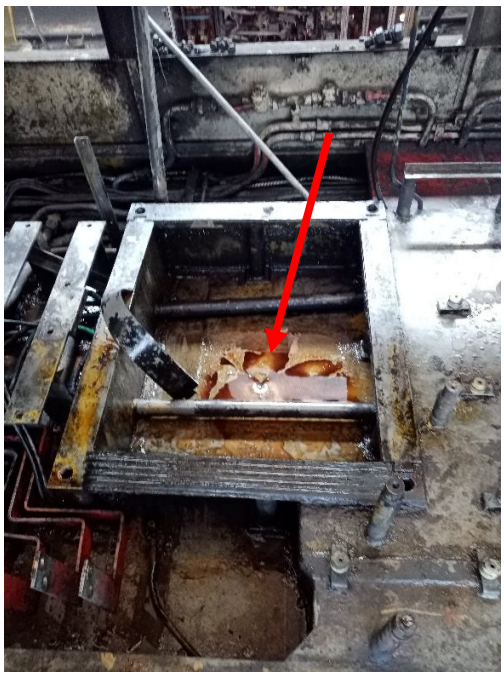


Fig. 4.23.

Fig. 4.24.

Possible causes for occurrence of the fire in locomotive № 91520044063-3

From the inspections and findings, the most likely cause of the fire in locomotive No. 91520044063-3 was established:

Valves on second engine compressor 235 were broken, causing the engine to run at near idle (Protocol 13). As a result, the starting mode deteriorated and a continuous high electric current flowed in the compressor engine. Subsequently, that also led to overheating of the power cables of the engine compressor. The motor is DC with series excitation. As is known, no-load operation is equivalent to short-circuit current. If the valves are broken due to mechanical failure, the motor remains running in current overload mode. The protection did not trip because the current was equal to the starting current. That caused the engine power cables to heat up. The presence of improperly pressed terminal shoes (fig. 4.9) on the power cables of the compressor further worsened their operation. Heating the cable in the cable lug led to an increase in temperature and melting of its insulation. The loose connection of the P7 fuse (which was found during the inspections) caused a spark to occur and ignite the insulation of the power cables of compressor engine 235. From the inspections of the terminal board of the third traction engine, it was seen that the power cable of compressor 235 passed the terminal board of a third traction motor and that caused the collected dust and oil to ignite.

It was not necessary to activate the fire extinguishing installation by the locomotive crew of locomotive No. 91520044063-3 and the fire was extinguished with a manual powder fire extinguisher from the fire service.

The railway undertaking BDZ PS EOOD implemented the schedule for passenger traffic with locomotives owned by the enterprise. The locomotives involved in the train schedule are on a faceless ride throughout the railway network. On the locomotives of series 43, 44, 45, repairs and technical inspections are carried out as necessary in the locomotive depots of the enterprise, and the results found and repairs carried out in some of the depots are not reflected in their technical passports. Often, the locomotive crews do not reflect in the on-board logs for each locomotive the malfunctions found during the shift. In this regard, there is a lack of traceability of the quality of the performed activities. At the same time, there is a lack of sufficiently repaired turning units and aggregates in the locomotive depots to be promptly installed in place of the defective ones in the locomotives.

During the investigation, it was established that over the years, changes were made in the inter-repair cycles in the departmental regulations of BDZ PS EOOD, which led to the deterioration of the technical condition of the locomotives of series 43, 44, 45 in the fleet.

In the period 2012 - 2023, with the aim of improving the technical and fire-fighting conditions, internal orders and rules introduced changes in the operations performed at MPR3 and GPR, the planned revision operations at TP, MPR and PR and other measures related to one-time inspections of individual nodes and aggregates.

In practice, after the amendments and additions to the regulations for the repair of the electric locomotives of the specified series, the condition of the fleet has not improved and their reliability in operation was unsatisfactory with prerequisites for the realization of accidents.

A complete change in the concept of carrying out the planned inspections and repairs of the 43, 44 and 45 series electric locomotives, which have not been overhauled, is required. In order to ensure the safety of the staff and passengers during the operation of the specified series of locomotives, the same should undergo a capital overhaul.

When the "Skoda" electric locomotives were put into operation in the 1970s in the Republic of Bulgaria, the periodicity of planned inspections and repairs in the locomotive depots from 1979 were scheduled in the following order:

- 10,000 km technical inspection TP;
- 50,000 km small periodical repair of MPR;
- 150,000 km of major periodical repair of GPR;
- 300,000 km of lifting PR;

Cyclicality was changed, and the interval between repairs was increased, but without improving the technical security of the locomotive depots, both with the provision of spare parts and with the implementation of new modern methods of diagnosis and control of individual units, aggregates and mechanisms. It is necessary to carry out an analysis of the damage that occurred and subsequent repairs as necessary, which led to accidents. On the basis of the conducted analysis and the results obtained from it, to adjust the intervals between repairs in accordance with the technical condition of the locomotives and the available repair base of the railway undertaking.

With a reduced inter-repair mileage of the locomotives for planned inspections and repairs, the number of necessary repairs will also be reduced, the negative effect on the turnover of the locomotives, as well as the formal performance of operational inspections.

During the investigation, the Commission established that in 2023 the railway company "BDZ-Passenger Services" EOOD amended the inter-departmental regulation PLS 100/23 (Regulations for inter-repair runs and the periodicity of planned inspections and repairs of electric locomotives and electric motor trains of BDZ PS EOOD,) in which the inter-repair mileages of the locomotives were significantly increased compared to those stipulated in LS 0108/1979. To date, the locomotives are highly depreciated as a result of accumulated significant mileage and deteriorated technical condition, which is why such an increase in the intervals between repairs cited in PLS 100/23 of Appendix No. 3 is not justified. The maximum extension between overhaul runs should be limited to the 10% suggested by the manufacturer for Class 43, 44 and 45 locomotives that have not been overhauled.

Training of the repair personnel

In recent years, the fleet of BDZ PS EOOD has been renewed with the delivery of new series of locomotives, significantly different from the old ones, as well as those that have undergone overhauls in various plants outside the country. At the same time, the composition of the repair personnel in the locomotive depots, which lacks the necessary qualifications, was significantly changed and reduced. In this regard, it is necessary to conduct periodic trainings to increase the professional qualification of the engineering and technical personnel involved in the repair and maintenance of the locomotives.

4.1.2. Infrastructure manager.

Analysis of the railway infrastructure condition.

Non-applicable.

4.1.3. Entities in charge of the technical maintenance.

Railway undertaking:

"BDZ-Passenger Services" EOOD owns the Certificate of a structure responsible for maintenance No. BG /31/0021/ 0001, valid from 19.04.2021 to 18.04.2026 with scope of activity passenger coaches, diesel and electric locomotives, DMUs and EMUs for gauge 1435 mm, diesel locomotives and passenger coaches for gauge 760 mm;

Railway infrastructure:

SE NRIC holds a certificate of Structure responsible for maintenance with UIN BG /31/0023/0001, valid from 22.03.2023 to 21.03.2028, with scope of activities of ECM freight wagons, passenger coaches and SPM.

4.1.4. Manufacturers or providers of rolling stock and railway products.

Non applicable.

4.1.5. National Safety Authority.

Railway Administration Executive Agency is the National Safety Authority for railway transport in the Republic of Bulgaria.

4.1.6. Notified bodies or Risk assessment bodies.

Non applicable.

4.1.7. Certifying bodies of the entities in charge of maintenance.

The Railway Administration Executive Agency as the National Safety Authority for railway transport performs certification of the entities in charge of the vehicles maintenance (ECM) in accordance with Directive 2004/49/EC and Regulation (EU) 445/2011, as per Ordinance No 59 on the railway transport safety management and on the maintenance functions in accordance with Directive 2004/49/EC and Regulation (EU) 445/2011.

From June 16, 2020 the RAEA performs certification of the ECM as per the Commission Implementing Regulation (EU) 2019/779 of 16 May 2019 laying down detailed provisions on a system of certification of entities in charge of maintenance of vehicles pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 445/2011.

4.1.8. Persons or entities involved in the event, documented or not in the respective safety management systems or indicated in register.

- SE NRIC implements Safety Procedure SP 2.09 "Methodology for determining, assessing and managing of the risk" version 06 effective from 01.09.2021, part of the SMS.
- BDZ PS EOOD implements Quality Procedure PK-2-15 "Safety Management of Passenger Transportation. Monitoring and information" from 13.12.2018 and Methodology for assessing the safety risk in BDZ PS EOOD from 23.02.2012.

4.2. Rolling stock and technical facilities.

4.2.1. Factors, deriving from the design of the rolling stock, railway infrastructure or technical facilities.

Non applicable.

4.2.2. Factors deriving from the installation and placing into service of the rolling stock, railway infrastructure and technical facilities.

Non applicable.

4.2.3. Factors deriving from manufacturers or another provider of railway products.

Non applicable.

4.2.4. Factors, deriving from the technical maintenance and/or modification of the rolling stock or the technical structures.

Non applicable.

4.2.5. Factors due to the entity in charge of the technical maintenance, workshops for technical maintenance and other technical maintenance service providers.

Non applicable.

4.2.6. Other factors or consequences considered as involved within the investigation objectives.

Non applicable.

4.3. Human factor:

4.3.1. Individual human characteristics:

4.3.1.1. Training and development, including skills and experience.

Railway undertaking:

• Locomotive driver of locomotive № 91520044063-3:

Qualification certificate № 12154 acquired qualification for „Locomotive driver for electrical locomotives", training performed in the period 08.02.÷31.04.2010, training institution PTC at BDZ, issued by RAEA;

Locomotive driving license BG 71 2018 0325, issued by RAEA;

Certificate № III-1090 for position, Locomotive driver" at BDZ PS EOOD dated 17.06.2022;

Additional certificate № 000006069897 from BDZ PS EOOD for rolling stock for which it is permitted the engine driver to drive – series 43, 44, 45, 61, 46200, EMU 32, 52, 55 and 80 dated 03.06.2019 along the national railway infrastructure of the Republic of Bulgaria until 03.06.2022.

• Assistant locomotive driver of locomotive № 91520044063-3:

Qualification certificate № 9966 acquired qualification for „Engine driver", training performed in the period 24.10.1988÷23.04.1989, training institution PQC Plovdiv at SO BDZ;

Professional training certificate № 1343-218/01.04.2013 qualification course for, Locomotive driver of diesel locomotives series 55.000", training performed in the period 14.01.÷24.03.2013, training institution PTQC at BDZ PS EOOD.

Locomotive driving license BG 71 2017 1207, issued by RAEA;

Certificate № III-1157 for position, Locomotive driver" at BDZ PS EOOD dated 15.06.2022;

Additional certificate № 000006523200 by BDZ PS EOOD for rolling stock, for which is permitted the engine driver to drive – series 52, 55 and 43, 44 and 45 dated 02.03.2022 along the national railway infrastructure of the Republic of Bulgaria until 01.03.2025.

• Train manager, passenger traffic of PT № 80132:

Qualification certificate № 8548 acquired qualification for „Train manager", training performed in the period 12.11.2007 ÷ 18.01.2008, training institution PTQC at BDZ, issued by RAEA;

Certificate № IV-48 for position, Instructor TS, train manager", passenger traffic at BDZ PT EOOD dated 18.05.2023.

Railway infrastructure:

● Train dispatcher at TOU Plovdiv:

Qualification certificate № 11338 acquired qualification for „Traffic manager and trade operation", training performed in the period 21.08.1989 ÷ 20.06.1990, and training institution and issued by F BDZ;

Certificate № 4023 for position, Train dispatcher" at TOSAM – Plovdiv dated 01.01.2015.

• Traffic manager at Yambol station:

Qualification certificate № 18186 acquired qualification for „Traffic manager", training performed in the period 01.10.2015 ÷ 15.03.2016, training institution PQTC at SE NRIC, issued by RAEA;

Certificate № 2333 for position Traffic manager at TOSAM – Sofia dated 24.01.2022.

• Post switchman in Yambol station:

Qualification certificate № 8702 qualification acquired for „Post switchman“, training performed in the period 10.03.÷17.05.2008, training institution at PQTC at BDZ;

Certificate № 2000 for the position Switchman/level-crossing guard at TOSAM – Plovdiv dated 24.01.2022.

4.3.1.2. Medical and personal circumstances, which influence the event, including the presence of physical and psychological stress.

Railway undertaking:

• Locomotive driver of locomotive № 91520044063-3:

Medical card № 1747 dated 04.05.2022, issued by Multi-profile transport hospital Plovdiv.

Conclusion: suitable for locomotive driver

Psychological certificate № 760/01.07.2019, issued by Multi-profile transport hospital Plovdiv for locomotive driver.

Conclusion: allowed for a period of 5 years.

• Assistant locomotive driver of locomotive № 91520044063-3:

Medical exam card № 1703 dated 10.04.2023, issued by Multi-profile transport hospital Plovdiv.

Conclusion: suitable for Assistant locomotive driver.

Psychological certificate № 44/14.01.2022, issued by Psychological laboratory National multi-profile transport hospital Plovdiv for locomotive driver.

Conclusion: allowed for a period of 3 years.

• Train manager, passenger traffic of FT № 80132:

Card for periodic medical exam № 7650 from 17.10.2022,, issued by Multi-profile transport hospital Plovdiv.

Conclusion: suitable for train manager, passenger traffic.

Psychological certificate № 862/07.07.2023 issued by Psychological laboratory at Multi-profile transport hospital Plovdiv for train manager.

Conclusion: allowed for a period of 3 years.

Railway infrastructure:

● Train dispatcher at TOU Plovdiv:

Single health dossier dated 14.07.2022., issued by Labour medicine service at SE NRIC;

Conclusion: suitable for train dispatcher.

Psychological certificate № 1021/30.08.2022, issued by Psychological laboratory at Multi-profile transport hospital Plovdiv for train dispatcher.

Conclusion: allowed for a period of 3 years.

• Traffic manager in Yambol station:

Single health dossier dated 05.06.2023, issued by Labour medicine service at SE NRIC;

Conclusion – suitable for traffic manager.

Psychological certificate № 770/01.09.2020, issued by Psychological laboratory at Multi-profile transport hospital Plovdiv for traffic manager.

Conclusion: allowed for a period of 5 years.

• Post switchman in Yambol station:

Single health dossier dated 25.05.2023, issued by Labour medicine service at SE NRIC.

Conclusion: suitable for post switchman.

Psychological certificate № 365/08.03.2023, issued by Psychological laboratory at Multi-profile transport hospital Plovdiv for post switchman.

Conclusion: allowed for a period of 5 years.

4.3.1.3. Fatigue

Railway undertaking:

• Locomotive driver of locomotive № 91520044063-3:
Rest from 12.07.2023 hour and 18 minutes 50 until 20.07.2023 hour 12 minutes 25
Started work: 20.07.2023 hour 12 minutes 25 – (185 hours and 35 min.)

• Assistant – locomotive driver of locomotive № 91520044063-3:
Rest: from 19.07.2023 hour 16 minutes 20 until 20.07.2023 hour 12 minutes 25
Started work: 20.07.2023 hour 12 minutes 25 – (20 hours and 05 min.)

• Train manager, passenger traffic of PT № 80132:
Rest: from 18.07.2023 hour 11 minutes 00 until 19.07.2023 hour 18 min 00 (31 hours and 00 min)
Started work: on 19.07.2023 from hour 18 min 00 – hour 22 min 42 (6 hours and 42 min)
Rest: from 19.07.2023 hour 22 min 42 until 20.07.2023 hour 05 min 35 (06 hours and 53 min)
Started work: on 20.07.2023 from hour 05 min 35 – hour 08 min 00 (2 hours and 25 min)
Rest: from 20.07.2023 hour and 08 min 00 until 20.07.2023 hour 13 min 00 (05 hours and 00 min)
Started work: on 20.07.2023 from hour 13 min 00 for PT № 80132

Railway infrastructure:

● Train dispatcher TOU Plovdiv:
Rest: from 18.07.2023 hour 07 minutes 00 until 20.07.2023 hour 07 minutes 00
Started work: 07.06.2023 hour 07 minutes 00 – (48 hours 00 min.)

• Traffic manager in Yambol station:
Rest: from 18.07.2023 hour 07 minutes 00 until 20.07.2023 hour 07 minutes 00
Started work: 20.07.2023 hour 07 minutes 00 – (48 hours 00 min.)

• Post switchman in Yambol station:
Rest: from 18.07.2023 hour 07 minutes 00 until 20.07.2023 hour 07 minutes 00
Started work: 20.07.2023 hour 07 minutes 00 (48 hours and 00 min.)

4.3.1.1.Motivation and attitudes
Non-applicable

4.3.2. Work related factors:
4.3.2.1.Tasks planning.

Railway infrastructure:

• SE NRIC – railway infrastructure manager carries out maintenance, repair and operation of the railway infrastructure. Prepares a year-round schedule for the movement of all categories of trains on the main and secondary railway lines. Prepares timetables and schedules on requests submitted by railway undertakings/carriers for movement of trains and vehicles on all railway lines.

Railway undertaking:

• "BDZ-Passenger Services" EOOD - a national railway undertaking/carrier that transports passengers according to an approved Train Movement Schedule and Plan for composing the trains, according to the passenger transportation contract with the state.

4.3.2.2.Constructive particularities of the facilities that influence the connection human-machine.
Non-applicable.

4.3.2.3.Communication means in both entities.

Communication connections at Yambol station and at the interstation Zavoy - Yambol - Bezmer are carried out with DCCM - 8, as well as with the switch posts in the station.

In the locomotives of BDZ PS EOOD, TDRD is installed for the implementation of radio communication between the locomotive driver and the traffic manager on duty at the respective station

and with the train dispatcher. The personnel working on a shift basis at SE NRIC and BDZ PS EOOD are provided with official mobile phones for quick communication.

4.3.2.4.Practices and processes.

Non-applicable.

4.3.2.5.Operation rules, local instructions, staff requirements, prescriptions for technical maintenance and applicable standards.

• BDZ PS EOOD and SE NRIC apply national and departmental normative acts, instructions and rules part of the SMS, related to the personnel and the activities of the enterprises.

4.3.2.6.Working time of the involved personnel.

• The personnel involved in the accident of the two entities BDZ PS EOOD and SE NRIC work in shifts, for which the cumulative working time with a 12-hour work shift is applied. In accordance with the requirements for the working hours of the management and executive staff, who are engaged in ensuring the transport of passengers and freight in railway transport, the activity is carried out in accordance with the provisions of the Labour Code and Regulation No. 50 of 28.12.2001.

4.3.2.7.Risk treatment practices.

• SE NRIC applies safety procedure SP 2.09 „Methods of evaluation, assessment and management of the risk „version 05 effective from 01.03.2019, which is part of the SMS.

• „BDZ-Passenger Services" EOOD implements the following procedures:

- Safety risk assessment methodology in BDZ PS EOOD;
- Quality procedure QP-2-15 "Management of the safety of passenger transport. Monitoring and exchange of information";
- Register of hazards in the operation, repair and maintenance of road transport in BDZ PS EOOD

4.3.2.8.Context, machinery, equipment and indications for shaping the working practices

Non-applicable.

4.3.3. Organizational factors and tasks:

4.3.3.1.Planning of the working force and the working load.

BDZ PS EOOD and SE NRIC in accordance with the requirements of the national regulations and related working conditions, have developed methodologies, as well as shared good European practices. The work is planned and related in accordance with the SMS to the personnel in the railway undertakings directly responsible for the operation of railway transport.

4.3.3.2.Communications, information and teamwork.

Non-applicable.

4.3.3.3.Recruitment, staffing requirements, resources.

• BDZ PS EOOD implements a "Human Resources Management System", which includes:

- Rules for personnel recruitment and selection;
- Rules for appointment and changes in labour relations;
- Staff training and development rules;
- Rules for ensuring the SHWCA, Environment, and organization of the activity of STM.

The personnel is selected and appointed with the relevant legal capacity, professional qualification and skills to work in the management and executive staff.

• SE NRIC has an approved "Strategy for Human Resources Management 2021÷2025".

In the SE NRIC, the selection of personnel is carried out according to the established "Rules for recruitment, selection and appointment of personnel in the central administration of the SE NRIC" in force from 01.12.2020.

- Recruitment;
- Maintaining a database of the personnel;

- Creation of a system of selection techniques for recruitment;
- Carrying out the selection together with the head of the unit;
- Documenting the process and communicating with staff;
- Appointment.

4.3.3.4.Implementation management and supervision
Non-applicable

4.3.3.5.Compensation (remuneration).

• BDZ PS EOOD has approved "Internal rules for wages" effective from 01.07.2013, which regulate the general conditions for the organization of wages:

- Formation and allocation of funds for wages in the company;
- Determination and amendment of the basic salaries by position;
- Determination of the types and amounts of additional and other remunerations;
- The order and method of paying staff wages is regulated.

• SE NRIC implements "Internal rules for wages" in force from 01.09.2014, which regulate issues related to the wages of the company's personnel:

- General provisions for the organization of wages in the entity;
- Determination and allocation of salary funds;
- Sources, order and method of formation of remunerations;
- Determination and amendment of wages and additional remuneration;
- Regulation, order and manner of payment of wages.

4.3.3.6.Leadership, powers related issues.
Non-applicable.

4.3.3.7.Organizational culture.
Non-applicable.

4.3.3.8.Legal issues (including the respective European and national rules and provisions).
Non-applicable.

4.3.3.9.Regulatory framework conditions and safety management system application.
Railway undertaking.

- Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety;
- Commission Delegated Regulation (EU) 2018/762 of 8 March 2018 establishing common safety methods on safety management system requirements pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulations (EU) No 1158/2010 and (EU) No 1169/2010;
- COMMISSION IMPLEMENTING REGULATION (EU) 2019/779 of 16 May 2019 laying down detailed provisions on a system of certification of entities in charge of maintenance of vehicles pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 445/2011;
- COMMISSION IMPLEMENTING REGULATION (EU) No 402/2013 of 30 April 2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009;
- Railway Transport Act;
- ORDINANCE No 59 dated 5.12.2006 on the railway transport safety management.

Railway infrastructure.

- Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety;

- Commission Delegated Regulation (EU) 2018/762 of 8 March 2018 establishing common safety methods on safety management system requirements pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulations (EU) No 1158/2010 and (EU) No 1169/2010;
- COMMISSION IMPLEMENTING REGULATION (EU) 2019/779 of 16 May 2019 laying down detailed provisions on a system of certification of entities in charge of maintenance of vehicles pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 445/2011;
- COMMISSION IMPLEMENTING REGULATION (EU) No 402/2013 of 30 April 2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009;
- Railway Transport Act;
- ORDINANCE No 59 dated 5.12.2006 on the railway transport safety management.

4.3.4. Environmental factors:

4.3.4.1.Labour conditions (noise, illumination, vibrations).
Non-applicable.

4.3.4.2.Meteorological and geographic conditions.
Yambol station is located in the southeaster part of the railway network of the Republic of Bulgaria. The city of Yambol is located on both banks of the Tundzha River. According to its climatic factors, the region belongs to the Transitional-continental climatic sub-region of the European-continental climatic region. The geographic latitude and altitude at which the city is located determine the small difference in temperature between the main seasons - with mild winters and hot summers.

4.3.4.3.Construction works, performed on the spot or in very proximity.
Described in item 3.1.3.3.

4.3.5. Any other significant factor for the investigation objectives.
Non-applicable.

4.4. Feedback and control mechanisms, including risk and safety management, as well as monitoring processes:
4.4.1. Regulatory framework conditions.
Commission Delegated Regulation (EU) 2018/761 of 16 February 2018 establishing common safety methods for supervision by national safety authorities after the issue of a single safety certificate or a safety authorisation pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 1077/2012

Commission Delegated Regulation (EU) 2018/762 of 8 March 2018 establishing common safety methods on safety management system requirements pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulations (EU) No 1158/2010 and (EU) No 1169/2010

ORDINANCE No 59 dated 5.12.2006 on the railway transport safety management.

4.4.2. Processes, methods and results from the activities on the risk assessment and monitoring that the involved entities performed:
Railway undertaking.

- "BDZ-Passenger Services" EOOD implements the Quality Management System QP 2-15 "Safety Management of Passenger Transportation. Monitoring and exchange of information". In section 6.7. "SMS implementation control, item 6.7.2 "Periodic control of the implementation of the SMS is carried out through internal audits: monthly and complex. Complex audits are conducted once a year on all safety-related structures."
- In accordance with the requirements of the "Methodology for analysis and assessment of safety risk in force from 23.02.2012", the railway company BDZ PS EOOD prepares and presents monthly

reports for the current year, as well as a complex (annual) audit report for the previous year regarding risk monitoring.

Railway Infrastructure:

- SE NRIC applies Safety Procedure SP 2.09 "Methodology for identification, assessment and risk management" version 05 in force from 01.03.2019, which is part of the SMS.

4.4.2.1.Entities in charge of the technical maintenance.

Railway undertaking:

• BDZ-Passenger Services" EOOD has a certificate of the Structure responsible for maintenance No. BG /31/0021/ 0001, valid from 19.04.2021 to 18.04.2026 with the scope of ECM activities - passenger coaches, diesel and electric locomotives, DMU and EMU, diesel locomotives and passenger coaches for gauge 760 mm;

Railway infrastructure:

• SE NRIC has a Certificate of ECM No. BG/31/0023/0001 valid from 22/03/2023 to 21/03/2028 with the scope of activities of ECM – freight wagons, passenger coaches and RSPM;

4.4.2.2.Producers and all other participants.

Non-applicable

4.4.2.3.Reports for independent risk assessment.

No assessment has been made by an Independent Assessor (AsBo) of any changes in operating conditions or factors relevant to the occurred accident.

4.4.3. Safety management system of the involved:

Railway undertaking:

"BDZ-Passenger Services" EOOD implements the "Safety Risk Analysis and Assessment Methodology" which ensures continuous improvement of the safety management system, including prioritizing the prevention of serious accidents, which is part of the SMS.

Railway infrastructure:

SE NRIC implements a safety procedure SP 2.09 "Methodology for determining, assessing and managing the risk" version 05 effective from 01.03.2019, which is part of the SMS, which ensures the continuous improvement of the safety management system, including prioritizing the prevention of significant accidents, which is part of the SMS.

4.4.4. Safety Management System of the entities in charge of the technical maintenance.

Railway undertaking:

"BDZ-Passenger Services" EOOD implements the Vehicle Maintenance System with the following functions:

- for maintenance development, which is responsible for the management of maintenance documentation, including configuration management based on design and operational data, as well as quality and lessons learned;

- for vehicle maintenance management, which is responsible for the termination of the operation of a vehicle for the purpose of maintenance and its re-commissioning after the maintenance;

- for carrying out the maintenance, which is responsible for carrying out the necessary technical maintenance of the vehicle or its parts, including the documentation related to the technical maintenance, which is part of the SMS in force from 30.07.2017, which regulates and includes the technical maintenance of traction and non-traction rolling stock.

Railway infrastructure:

SE NRIC implements Safety Procedure WP 7.01 "Regulations for maintaining the signalling system (Signalling equipment)", which is part of the SMS;

SE NRIC implements approved "Rules for current maintenance of a rail track" in force from 2021.

4.4.5. Results from the supervision, performed by the National Safety Authority.

The results of the performed audits and inspections regarding the functioning of the Safety Management System of SE NRIC and "BDZ-Passenger Services" EOOD is in accordance with the requirements of Regulation (EU) 2018/761, Regulation (EU) No. 1169/2010, Ordinance No. 56 and Ordinance No. 59 to satisfy the specific requirements of European legislation and national rules for the design, maintenance and operation of the managed railway infrastructure, show that the entities maintain an SMS and can fulfil the requirements provided for in the relevant legal acts.

In the period from 19.10.2020 to 30.10.2020, the National Safety Authority (RAEA) carried out an annual planned supervision of the SMS of SE NRIC.

In the period from 21.11.2020 to 25.11.2022, the National Safety Authority (RAEA) carried out a supervisory inspection of the ECM part of the SMS of SE NRIC.

In the period from 08.02.2021 to 19.02.2021, the National Safety Authority (RAEA) carried out an annual scheduled audit of the SMS of "BDZ-Passenger Services" EOOD.

In the period from 22.11.2022 to 09.12.2022, the National Safety Authority (RAEA) carried out an audit under the SMS, in connection with the issuance of a single safety certificate to "BDZ-Passenger Services" EOOD.

4.4.6. Permits, certificates and assessment reports, provided by the National Safety Authority or other Conformity Assessment Bodies:

4.4.6.1. Safety Authorization of the involved infrastructure manager.

SE NRIC has a renewed Safety Authorization No. BG 21/2023/0001, valid from 01/07/2023 to 30/06/2028, size of the railway enterprise - Large enterprise.

4.4.6.2.Safety certificates of the involved railway undertakings.

"BDZ-Passenger Services" EOOD holds a Single Safety Certificate with EU ID number BG 10 2022 0298, valid from 31.12.2022 to 30.12.2027 size of the railway enterprise - Large enterprise for railway transport services of passengers;

4.4.6.3. Authorizations for placing in service of permanently fixed equipment and permits for placing on the market of vehicles.

Non-applicable.

4.4.7.Other system factors.

Non-applicable.

4.5. Previous similar cases.

NAMRATIB has investigated previous cases of a similar nature - fires that occurred in locomotives, I offer some of them:

1. On 30.11.2009 at 17:50 p.m., a fire broke out in locomotive No. 91520045167-4, serving fast train No. 3601 at the Stamboliyski - Todor Kableshkov interstation. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

2. On 13.10.2015 at 11:40 a.m., a fire broke out in locomotive No. 91520044169-8, serving fast train No. 1621 at the Elin Pelin - Vakarel interstation. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

3. On 12.10.2017 at 16:50 p.m., a fire broke out in locomotive No. 91520044134-2, serving fast train No. 8693 at Dimitrovgrad station. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Committee at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

4. On 04.05.2018 at 21:35 p.m., a fire broke out in locomotive No. 91520044121-2 serving fast train No. 8613 at Dolno Ezerovo station. At the time of the investigation, the locomotive was owned by

"BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

5. On 09.04.2019 at 19:05 p.m., a fire broke out in locomotive No. 91520046221-8, serving fast train No. 8602 between Chirpan and Svoboda stations. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

6. On 28.09.2020 at 19:05 p.m., a fire broke out in locomotive No. 91520044094-8, serving fast train No. 3621 between Chernograd and Aytos stations. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report;

7. On 06.01.2023 at 17:50 p.m., a fire broke out in locomotive No. 91520044169-8 serving fast train No. 2610 at Mezdra South station. At the time of the investigation, the locomotive was owned by "BDZ Passenger Services" EOOD. The Safety Investigation Commission at the NAMRATIB established the cause of the fire and made safety recommendations to the railway undertaking in the final report.

5. Conclusions

5.1. Summary of the analysis for the event causes.

From the inspections and measurements of the individual machines and units of the locomotive at the Plovdiv Locomotive Depot, the following conclusions can be drawn about its technical condition and the causes of the fire:

The fire in locomotive No. 91520044063-3, serving PT No. 80132, occurred due to failure (broken valves) of the second air compressor 235, which led to continuous operation of its electric motor with high current and increased temperature of the power unit.

For the fire occurrence contributed also the loose connection of fuse P7 for powering the compressor, which ignited the insulation of the power cables of the engine-compressor 235. That also ignited the dust and oil collected in the ventilation canal.

On the locomotives of series 43, 44, 45, repairs were carried out as necessary and technical inspections were carried out in the locomotive depots of the railway undertaking/carrier, and the results found and repairs carried out were not always entered in their technical passports. There is a lack of traceability of the quality of the performed activities. There is a lack of sufficiently repaired turning units and aggregates to be promptly installed in place of the defective ones in the locomotives.

Over the years, changes have been periodically made to the regulations for the inter-repair cycles, which have led to a deterioration in the technical condition of the locomotives of series 43, 44, 45 in the fleet of BDZ PS EOOD. After the amendments and additions to the regulations for the repair of electric locomotives, their condition has not improved, their reliability in operation was unsatisfactory and is a prerequisite for the realization of accidents.

The periodicity of locomotive inspections and repairs has been changed without improving the technical provision of locomotive depots with spare parts.

All the above-mentioned rule changes, untimely repairs of the locomotives are related to the constant shortage of serviceable locomotives, with which the railway undertaking shall provide the passenger train schedule on a daily basis.

The composition of the repair personnel in the locomotive depots does not have the necessary qualifications to carry out quality inspections and repairs of the locomotives. At the same time, it has been substantially changed and reduced.

5.2. Undertaken measures after the event occurrence.

The railway infrastructure manager undertakes timely organization and actions to restore the traffic and the capacity of the railway infrastructure, through inspections of the catenary and the railway track.

At 16:21 p.m., the voltage in the catenary at the station was turned on, and the movement of trains through Yambol station was restored according to the schedule.

The composition of PT No. 80132 remained at Yambol station and was subsequently taken to the train's final destination station, Stara Zagora.

An organization was created and the passengers from PT 80132 from Yambol station were taken by buses along the direction of the train to Stara Zagora station.

The burnt locomotive No. 91520044063-3, serving PT No. 80132, was moved with another locomotive to the Plovdiv Locomotive Depot (the place of residence) for the initiation of a safety investigation by the NAMRATIB.

5.3. Additional findings.

Non-established.

6. Safety recommendations

In order to improve the safety in the rail transport, the Investigation Commission at NAMRATIB proposes to the National Safety Authority (RAEA) the following safety recommendations adapted to SE NRIC and “BDZ-Passenger Services” EOOD.

- Recommendation 1, proposes that SE NRIC and "BDZ-Passenger Services" EOOD shall inform the interested personnel on the contents of this report;
- Recommendation 2 proposes that BDZ PS EOOD to carry out an analysis of the damage that occurred, which led to accidents and the subsequent repairs as necessary;
- Recommendation 3, proposes BDZ PS EOOD to carry out a comprehensive change of the regulations for the repair and maintenance of the electric locomotives series 43, 44 and 45 that have not been overhauled (PDR-LS 0103/1978 and PZR - PLS 127/2005);
- Recommendation 4, proposes BDZ PS EOOD to conduct periodic trainings to increase the professional qualification of the engineering and technical personnel involved in the repair and maintenance of the locomotives;
- Recommendation 5, proposes that BDZ PS EOOD assigns to the locomotive depots every locomotive entered for TI, that the engine compartment is regularly cleaned with a vacuum cleaner, and that the large aggregates are dismantled and thoroughly cleaned at each IPR;
- Recommendation 6, proposes BDZ PS EOOD to equip the locomotive depots with infrared cameras to detect the places with increased temperature after prolonged operation of the locomotive

With reference to the requirements of art. 24, paragraph 2 of Directive (EU) 2016/798, and art. 91, paragraph 3 of Ordinance No 59 dated 5.12.2006, the member of the Management Board of NAMRATIB on 15.09.2023 provides a final report that contains information on the investigation of the accident with formulated and agreed safety recommendations in order to improve safety in railway transport.

In accordance with Art. 26, paragraph 3 of Directive (EU) 798/2016, that the National Safety Authority (RAEA) and other bodies or structures to which the safety recommendations are addressed, to report regularly to the member of the management board of the NAMRATIB on the measures taken or planned as a result (sequence) from the recommendations.

Chairperson:

Dr. Eng. Boycho Skrobanski

Deputy President of the NAMRTAIB AB

Members:
1. .....(s)..... **(External expert)**
2. .....(s)..... **(External expert)**