



REPUBLIC OF BULGARIA
MINISTRY OF TRANSPORT,
INFORMATION TECHNOLOGY AND COMMUNICATIONS

9 Dyakon Ignatiy Str., 1000 Sofia
tel.: (+359 2) 940 9771
fax: (+359 2) 988 5094

mail@mt.government.bg
www.mt.government.bg

AIRCRAFT, MARITIME AND RAILWAY ACCIDENT INVESTIGATION
UNIT DIRECTORATE
(AMRAIUD)

FINAL REPORT

on

Technical investigation of railway accident – an outbreak of fire in electric locomotive No 44117.0, which serviced fast train No 8613 between Kaloyanovets – Stara Zagora stations on 07.08.2014



November 2014

FINAL REPORT

Subject: *Technical investigation on railway accident – an outbreak of fire in electric locomotive No44117.0, which serviced fast train No 8613 between Kaloyanovets – Stara Zagora stations on 07.08.2014*

1. Ascertained facts and circumstances in the course of investigation.

On 07.08.2014 fast train (FT) No 8613 in a composition of 5 coaches, 20 axles, mass of 203 tonnes, with electric locomotive No 44117.0 run from the I-st cabin by a locomotive crew in a composition of driver, locomotive, and assistant driver, locomotive, and a transport crew of a train master and a train conductor was running under the Train traffic timetable (TTT) in Sofia-Burgas direction.

At 18:03 p.m. FT No 8613 passes without stopping Kaloyanovets station at a speed of 120 km/h, as evidenced by the decoding of the speedometer tape of the electric locomotive. During the train movement between Kaloyanovets – Stara Zagora stations after km 102+000, the locomotive crew felt a sharp and specific smell of heated insulation. After checking, they found that the engine compartment was filled with a thick, black, acrid smoke. Immediately after that, at 18:11 the engine driver undertook a fast stopping with the train brake. Even before the final stop of the train, he noticed through the side window of the door of the command cabin fire in the area of the horizontal fans, under the body shell frame of the locomotive. The train passed the entrance semaphore of Stara Zagora station on km 102+630, which was with allowing indication and stopped. The locomotive crew undertook immediate actions for fire extinguishing with fire extinguishers, which resulted in a quickly localisation and extinguishment of the fire in the area of the horizontal fans.

Immediately after that, the locomotive driver undertook actions for extinguishing the fire in the area of the II-nd oil pump of the traction transformer in the engine compartment. During the suppression of the fire, there were also used 5 dry powder extinguishers from the coaches.

At 06:18 p.m., the train master gave signal on emergency phone number 112 and also informed all the interested offices through the business GSM. Together with the train conductor, he assisted in the evacuation of passengers and in the transfer of the fire extinguishers available in the coaches to the locomotive.

After receiving the message on the fire at 06:18 p.m., the Regional Directorate „Fire Safety and Civil Protection”– Stara Zagora (RD FSCP) sent two fire extinguishing trucks to the accident site. They arrived at 06:27 p.m. and found that the fire was suppressed by the locomotive drivers. Nevertheless, the RD FSCP officials required the voltage in the catenary along the two current tracks between Kaloyanovets and Stara Zagora stations to be switched off and ensured duty posts on the site.

The investigating police officer began a pre-trial investigation on the accident site.

Following the direction of the Chairman of the Commission for technical investigation, locomotive No 44117.0 was uncoupled from the train composition and carted away to Stara Zagora locomotive depot by a shunting crew with a diesel locomotive in order the Commission to perform further inspections.

The voltage in the catenary was recovered at 08:43 p.m.

At 09:20 p.m., after coupling of electric locomotive No 45182.3 and performing of test "A" (full test) of the automatic train brake, train No 8613 continued its operation towards Burgas station.

Due to the occurred accident, the train operation along track No 1 and No 2 in the section between the Kaloyanovets and Stara Zagora stations was interrupted from 06:15 p.m. to 09:25 p.m. on 07/08/2014.

2. Officials involved in the case.

2.1 Locomotive crew:

2.1.1. „Engine driver, locomotive” of electric locomotive No 44117.0 at Sofia locomotive depot, „BDZ – Passenger Services” EOOD - 27 years of work experience;

2.1.2. „Assistant engine driver, locomotive” of electric locomotive No 44117.0 at Sofia locomotive depot, „BDZ – Passenger Services” EOOD - 7 months of work experience;

2.2. Transport crew:

2.2.1. „Train master” at Stara Zagora Passenger Centre, „BDZ – Passenger Services” EOOD - 7 years of work experience;

2.2.2. „Train conductor” at Stara Zagora Passenger Centre, „BDZ – Passenger Services” EOOD - 33 years of work experience.

2.3. Station officers:

2.3.1. „Traffic manager” Stara Zagora station – employee at Plovdiv Train operation and station activity management Division (TOSAMD), SE NRIC - 17 years of work experience;

2.3.2. „Traffic manager” Stara Zagora station – employee at Plovdiv TOSAMD, SE NRIC - 23 years of work experience;

2.4. Other officers

2.4.1. „Technician on electrical systems/catenary“, Plovdiv ES, Stara Zagora sub-district - 25 years of work experience;

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

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

To all the officials involved in the accident was provided pre-travel (pre-shift) instruction and they declared that they were alert, rested and that did use alcohol and other drugs.

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

Before starting work, an alcohol test was given to the officials in accordance with the requirements of art. 24 and art. 28 of Ordinance No 54 dated 02.06.2003 on the medical and psychological requirements for operating personnel, which perform railway transport of passengers and freights and the related activities to conduct the pre-travel (pre-shift) medical examinations.

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

All the officials involved in the accident possess the necessary work and professional qualifications for respective work position and certificate for its occupation.

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

Despite the atmosphere of strong separation of black smoke and toxic substances that threatened the human health created as well as the circumstances, which contributed to the expansion of the fire, all the officials were acting in accordance with the regulations and internal rules established and promptly undertook the necessary measures for suppressing the fire with the fire extinguishers available in the locomotive and coaches and notified about the fire in the locomotive on the emergency phone 112.

The locomotive and transport crews informed the respective offices on the fire occurred and on taking the passengers out of the coaches, who then continued on their relation (direction).

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

Meteorological weather data with impact on the visibility of signals:

- air temperature + 27 °C;
- in the daylight hours;
- Good visibility.

Whether the train acceptance at the station plan was respected: irrelevant to the railway accident.

Permanent way: regular and irrelevant to the railway accident.

Status of the station and interstation signalling equipment before the accident: regular and irrelevant to the railway accident.

Catenary: regular and irrelevant to the railway accident.

Train composition station: Sofia

Communication equipment and telecommunication connections: technically regular.

Rolling stock:

The electric locomotive No 44117.0, which serviced FT No 8613 was technically regular, including the moving parts, brake system, sound and lightning signalling means, in accordance with the technical standards and requirements, which is evident from the records of the respective log-books, copies of which were presented in the Task force report.

The electric locomotive was equipped with the following fire protection means:

- Portable fire extinguishers “Yatrus-12” with powder agent – 2, marked with stickers for a technical inspection until the month of 12.2014 – both were used in the fire suppression;
- Portable fire extinguishers “Yatrus -6“ with powder agent – 2 marked with stickers for a technical inspection until the month of 12.2014- they were not used in the fire suppress;
- Stationary powder extinguishing installation – it was not activated following the assessment of the locomotive crew.

The electric locomotive was not equipped with two dioxide (CO₂) fire-extinguishers, as per the requirements of the „Instruction on the rules and requirements for fire safety in the rolling stock in operation, the buildings, areas and sites of „BDZ – Passenger Services“ EOOD and the activities in case of fire“ effective from 01.10.2013.

The electric locomotive was not equipped with two gas protection masks, as per the requirements of art. 427, paragraph 1, p. 7 of Ordinance No 13 dated 30.12.2005 on provision of safe and healthy work conditions in the rail transport.

The coaches (5) were technically regular, in accordance with the technical standards and requirements, which is evident from their usage during the fire suppressing. The coaches were equipped with 1 portable fire extinguisher each, located at the places, indicated in the „Instruction on the rules and requirements for fire safety in the rolling stock in operation, buildings, regions and sites of „BDZ – Passenger Services“ EOOD and the activities in case of fire“, effective from 01.10.2013 and marked with stickers for performed technical inspection.

7. Fulfilment of the working procedures and technologies within the system of the SE National Railway Infrastructure Company before and during the accident.

The working procedures and technologies before and during the accident at the Train Operation and Station Activity Management Division – Plovdiv, part of the SE NRIC structure, were complied with, which is evident from the Task Force report and annexes thereto, additional course materials as well as from the confrontations performed with the persons involved in the accident.

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

The fast train No 8613 was ensured with the necessary brake mass and was equipped with the necessary train documents. The locomotive and transport crews were provided with mobile business phones.

Electric locomotive No 44117.0 was produced in 1979, enrolled in Gorna Oryahovitsa locomotive depot rolling stock (fleet) and put into service on 19.12.1979.

The balance value of the electric locomotive up to 30.06.2014 was 394 087, 82 BGN.

At the time of the accident, the runs of the electric locomotive from the last planned repairs are shown in the following table:

TYPE OF THE REPAIR	DATE OF THE REPAIR INSCRIPTION	RUN OF THE REPAIR
Overhaul repair (OR)	04.03.1991	1 965 940 km.
Overhaul repair (OR)	04.03.2003	1 992 466 km.
Mid repair (MR)	14.12.2012	1 441 316 km.
Small periodical repair 3 (SPR 3)	06.02.2014	1 713 052 km.
Small periodical repair (SPR)	28.05.2014	1 780 049 km.

Technical inspection (TI 2)	05.08.2014	1 816 848 km.
Operational inspection (OI)	07.08.2014	103 km.

Within the review of the technical documentation it was found that in accordance with the PP_PLS 100/11 "Prescription for inter repair runs and cycles of the planned inspections and repairs of electric locomotives and EMU of "BDZ Passenger Services" EOOD, all the inspections and repairs were carried out accordingly to the approved inter repair cycle.

Within the review of the „Technical passport of locomotive No 44117.0” (LS 005-1) and the „Log-book of the repairs in case of necessities to the traction rolling stock” (Form LP - 9), there were not found and registered any infringements of the effective Rules of factory and depot repair and for electric locomotives maintenance as well as of the procedures in the repair activity related to the fire ignition.

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

It was found that the railway infrastructure was regularly functioning before, during and after the accident.

Before the accident, the electric locomotive No 44117.0 and the coaches of FT No 8613 were in good working condition.

In result of the accident occurred there were caused damages to the electric locomotive and the railway infrastructure, which are given in details in p. 10 „Consequences from the accident”.

10. Consequences from the accident.

10.1. Fatalities – none;

10.2. Seriously injured – none.

10.3. Failures and damages to the railway rolling stock:

10.3.1. Electric locomotive:

The electric locomotive No 44117.0 was operated by the „BDZ – Passenger Services” EOOD, Gorna Oryahovitsa locomotive depot. The following findings were ascertained during the inspection of the Technical investigation commission:

- Burnt power supply cables (feeders) of the II-nd horizontal fan 233;
- Burnt power supply cables (feeders) (wire 262 and 263) of the II-nd oil pump 239;
- damaged insulation of the power cables of the III-rd traction engine;
- Burnt cables of the current transformers of the traction transformer;
- Burnt rubber compounds between the traction transformer and the II-nd oil pump;
- The ceramic fuse 248 and the II-nd oil pump were regular;
- No activated protection in cabinet 830.

As per Appendix No 3 to „Rules of depot repair and maintenance of BDZ electric locomotives” series 40 – sign. No LS 0103 a Finding report dated 20.08.2014 on material damages assessment was prepared, which amounted to 1 124 BGN, without V.A.T.

10.3.2. Coaches:

- Coach No 50528433005-3, BDZ PS EOOD property;
- Coach No 50522974116-8, BDZ PS EOOD property;
- Coach No 50522974012-9, BDZ PS EOOD property;
- Coach No 50523143007-2, BDZ PS EOOD property;
- Coach No 50522974146-5, BDZ PS EOOD property.

No damages were caused to the coaches.

10.4. Caused damages and failures to the railway infrastructure:

10.4.1. Permanent way and structures: none.

10.4.1. Signalling and communications, radio connections, power supply: none.

10.4.2. Catenary: none.

10.4.3. Other damages and failures: none.

10.5. Damages and spill of freights, baggage and parcels: none.

10.6. Train circulation interruption:

As a consequence from the fire between Kaloyanovets and Stara Zagora stations the train circulation along the section on track No 1 and track No 2 was interrupted from 18:15 p.m. to 21:25 p.m. on 07.08.2014.

10.7. Caused train delays

10.7.1. Delayed trains:

- **train No 8613 – BDZ PS EOOD – 191 min.;**

- train No 8641 – BDZ PS EOOD – 39 min.;

- train No 8612 – BDZ PS EOOD – 179 min.;

- train No 80109 – BDZ PS EOOD – 121 min.;

- train No 80114 – BDZ PS EOOD – 224 min.;

- train No 30147 – BDZ PS EOOD – 69 min.;

- train No 80106 – BDZ PS EOOD – 206 min.;

- train No 8632 – BDZ PS EOOD – 74 min.

10.7.2. Cancelled trains:

- train No 80611 – from Sz to Kn of BDZ PS EOOD.

10.7.3. Appointed trains:

- train No 30691 from Sz to Kn of BDZ PS EOOD.

10.8. Rehabilitation vehicles circulation.

10.8.1. Rehabilitation train: no any.

10.8.2. Other rehabilitation means: no any.

10.7.5. Caused losses to „BDZ – Passenger services“ EOOD in result of the accident:

10.7.5.1. From returned tickets – 97, 60 BGN., with VAT.

10.7.5.2. For transport crews from Plovdiv, Stara Zagora and Sliven transport offices – 669, 35 BGN with VAT included.

10.7.5.3. Caused damages to Sofia PSD – 978, 12 BGN with VAT included.

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

From the performed, and the provided materials, it was evident that:

- The fire occurred at around 18:00 hours during the movement of the fast train No 8613 between Kaloyanovets and Stara Zagora stations on road No 2;

- The outbreak of the fire was located under and around the II-nd oil pump of the traction transformer.

From the nature of the destructions and traces from the fire action found in the burning zone, in the area of thermal impact and in the area filled with smoke, it was established the place of the fire ignition. Maximum depth of burns and char were observed on the place of the fire ignition due to continuous combustion. There were considerable evidences of strong thermal effects and deformation on the composite materials and structural elements. Depending on their type, the combustible materials in the hearth of the fire were charred, melted, destructed or deformed. After evaluating their condition the temperature reached in certain areas of the fire could be determined. The products formed in the combustion area constituted a multicomponent mixture, which in burning create increased pressure. Under the impact of this pressure, the combustion products were spread out of the burning zone. As a result of the temperature differences in height in this area and in the space at a certain distance beyond, the heated hydrocarbon particles were cooled down and deposited on the vertical and horizontal structures, which formed a coating that coloured surfaces in black and dark brown. This coating remained on the surfaces only in a certain critical temperature, which was in the range 600-630° C. At the places of the burning zone where the temperature was higher, the deferred solid hydrocarbon particles burned out forming white spots and areas and around them where the temperature was lower than 600° C, the surfaces remained black or dark brown.

During the performed initial and additional inspections of the locomotive, the characteristic signs of fire ignition were identified and unilaterally found under and around the II-nd oil pump of the traction transformer. The burning spread from the fire outbreak - the power wires of the engine pump, over the flammable insulations of the electrical wires and other combustible materials in all directions in the form of a sphere, vertically upwards under the convection flows effect, horizontally in all directions under the action of the primary thermal conductivity and radiant heat flux and vertically

downwards under the action of the melting materials. The fast expansion of the fire led to burning of the operating conductors of the current measuring transformers and the electro-pneumatic valve 075₂₁. The spread to the elements of the cooling system, oil radiator, pump and oil lines of the traction transformer and the subsequent melting and burning of the rubber compounds and gaskets caused the leak of its oil. The ignition of the oil, the rubber gaskets and the insulation of the cables in the conditions of a powerful air exchange caused intense temperature increase and smoke emission in the engine compartment. The fire spread as well under the body shell frame of the locomotive through the technological hole (with diameter of 50 mm) where a rubber joint is mounted for outpour of the oil that failed into the tub of the traction transformer, where the fire encompassed the power lines of the II-nd horizontal fan 233 between the terminal box and the engine and power lines from the terminal box (the binoculars) leading to the III-rd traction engine 052.

The electrical short circuits are random events that occur as a result of defects in the insulation of the current-carrying cables and wires. Cables could be damaged by aging, moisture and chemical active substances, excessive mechanical strain or loss of their insulating characteristics. The short circuit occurs under created conditions for electrical contact by a touch of electrical wires with different polarity and voltage applied and when the contact is realized through a very small resistance, which is not eligible for normal operation conditions of the locomotive electric circuits. A specific indication of arisen electric short circuits are the traces of meltdown of the wires from an electric arc whose temperature could reach 1500 ° to 4000 ° C and by which typical frozen drops of "pearls" from the molten metal were formed.

Sized from the locomotive engine compartment power wires of BDTV/DPSL type of the II-nd oil pump of the traction transformer contained a copper four-stings and multicore cable with partly and completely burned insulation and partly melted and charred insulation along its entire length. To its stings at the one of the cable ends were installed copper shoes and three of its cores were welded together by melt from the plastic insulating hoses with a length of 26 cm. The four cores were 50 cm long along the cable length, then only two cores continued with a length of 185 cm to the opposite side, ending with strongly charred remains of insulation and plastic insulated tubing with a length of 15 cm. One of the two cores was entire and continuous, and the second was cut off at a distance of about 50 cm from the cable shoe. At the place of cut traces of melting of the copper core were observed resulting from a high temperature. Along the length of the cores, traces of blue colouring typical for overloading of electrical conductors were found. To the sized cable was carried out an X-ray structural analysis with X-ray apparatus URS 2.0 for determination of the short circuit type. Following the performed X-ray analysis, done in the "Centre for Research and expertise" to the General Directorate "Fire Safety and Civil Protection" in the Ministry of Interior, it was unilaterally found that the short circuit on the seized pieces of wires was "**secondary**", i.e. the same occurred as a result of the fire.

According to the technical documentation of locomotives of 44000 series the fuse protecting the circuit of the engine pump 248 against overloading is for a nominal current of 40 A. During the inspection performed, it was found that the fuse installed had a nominal current of 100 A. The fuse works correctly, if it's nominal current (or current of setting) **I_n** is larger than the maximum load current **I_b**, but smaller than the maximum allowed for the circuit current **I_z**, i.e. 1.45 **I_n**. Given that the engine pump is of 2.2 kW power, it rated current is 10 A. Therefore, the fuse found and included in the circuit was with a ten times larger current for triggering than the nominal current and the fuse could not fulfil its protective function in a long lasting starting process.

According to the technical documentation, the wire feeding the engine pumps is with a section of 4 mm². Such a wire section allows a maximum current of 40 A to pass. In case the maximum current exceeds that value, the insulation of the wire will be violated by overheating. The quality of the insulation, whose main characteristic is the electric resistance is of particular importance for the electrical installations. That referred both to the insulation of the wires and to the one of the consumers connected to them. The insufficient insulation resistance may lead to serious consequences such as:

- Compromising the underlying structural measures against direct and indirect contact;
- Ground/corpus connection with a large volume of current flow, leading to activation of the protection and respectively – to loss of power supply;
- Regardless the action of the protection the large volume currents lead to accelerated aging and damage to certain categories of equipment;

- Wrong triggering of control circuits and sensitive equipment, which may result in severe accidents, loss of power supply, endangering people's lives, fires occurring from local overheating in places of damaged insulation.

For electric motors with light starting conditions (fans, pumps, centrifuges, etc.) the circular magnetic field is achieved when the frequency of rotation is close to the nominal. When starting, the field is elliptical and the moment for triggering the motor is smaller than the one formed in a circular magnetic field. For this reason, for starting the engine a separate starter solenoid and start capacitor are used. In order to provide starting moment $M_{\Pi} = (0,8-1,2) M_{\Pi}$, for a short-term (several ms) the starting current should be up to ten times bigger than the nominal current ($I_{\Pi} = (7-9) I_{\Pi}$). In case of continuous starting process and not functioning starting circuit (interruption of wire 263), the operating current of the engine pump increases many times (almost ten times) and remains at this level during the time the pump is switched on. In this working mode of the pump with increased current in the operating circuit to approximately 100A, the heat emitted by the wire 263, which was with a section of 4 mm², led to melting and breaking of its insulation, and occurrence of electrical contact after touching of the power electric wires 208 and 263, which were with different polarity and voltage applied. Due to the short circuit and the emerging electric arc, the plastic tube, in which the power wires were laid, melted.

On 12.08.2014 in Gorna Oryahovitsa locomotive depot, the Technical investigation commission measured the parameters of the dismantled from the locomotive II-nd horizontal fan 233, II-nd oil pump 239 and cast fuse 248 in order to assess their technical condition and found the following:

II-nd horizontal engine fan 233

- Insulation resistance of the armature winding – 20 MΩ;
- Insulation resistance of the excitation coil – 20 MΩ;
- Functionality of the engine fan under external supplying voltage 220 V – regular.

II-nd oil pump 239

- Insulation resistance of the operating coil – 600 MΩ;
- Insulation resistance of the starting coil – 600 MΩ;
- Measuring the current in the operating coil of the engine pump – 4, 5 A;
- Measuring the current in the starting coil of the engine pump – 9, 5 A;
- Check the functionality of the engine pump under external supplying voltage 220 V – regular.
- Measuring the current in the operating coil of the engine pump in simulative interruption of the starting capacitor – 15 A;
- Measuring the current in the starting coil of the engine pump within simulative interruption of the starting capacitor – 80 A.

Operational starting capacitor 267

- Measuring the capacity of the operational starting capacitor – 90 μF.

Melting blade fuse 248

- Nominal current – 100 A (accordingly to the technical documentation it should be an automatic fast acting fuse with nominal current of 40 A).

In V-th and VI-th delivery of electric locomotives of 44000 and 45000 series the automatic fast-acting fuses 246 and 248 were removed and replaced with melting blade fuses.

The circumstances, which led to the emergence and spread of the fire, were:

- Lack of overloading protection with automatic fast acting fuses;
- Placing the power wires 208, 213, 262 and 263 of the II-nd oil pump in a combustible plastic tube instead of armoured metal tube;
- Presence of large quantity of combustible material in the engine compartment of the electric locomotive - combustible insulations of electric wires and cables, layering of powders, oils, plastics and other;

- Non-equipment of the electric locomotive with gas masks pursuant to art. 427, para. 1 pt. 7 of Ordinance No 13 dated 30.12.2005 to ensure healthy and safe working conditions in the rail transport.

There was a real risk of fire spreading throughout the whole locomotive and the coaches behind it, which was dangerous for the life and health of the passengers and the staff. From the materials and evidences collected from the technical investigation it became clear that the train driver of fast train

No 8613 with a risk for his life (lack of Respiratory protection) managed to locate and liquidate the fire still in its infancy with the fire extinguishers available in the electric locomotive and coaches.

The fire spread was prevented as well due to the incomplete combustion, which evolved slowly within the machinery compartment and timely, adequate and professional actions of the locomotive and transport crews.

12. Cause for the accident.

In result from repeated inspections on the site and in Gorna Oryahovitsa locomotive depot, after studying the data and information from collected protocols on the scheduled repairs performed, technical checks, measurements and other technical documentation on the case, the facts given in the Task Force report, the additional written and oral explanations taken from the locomotive crew involved in the accident, the outcome from the triple fire technical expertise, the opinions of the independent external experts and the performed analysis, the Commission considers that:

The immediate technical cause of the occurred railway accident - fire ignition in electric locomotive No 44117.0, which serviced fast train No 8613 between Kaloyanovets and Stara Zagora stations, is the interruption of wire 263 connecting the starting circuit of II-nd engine pump 239. It resulted in long lasting starting mode and unacceptably large operating current, which led to melting of the wire insulation and its ignition due to improper placed fuse 248 of 100 A (instead of 40A).

The insulation of the cables and wires is subject to aging and deterioration of its mechanical and insulating characteristics as a result of many years of operation, repeated bending, vibration, moisture, loose connections or excessive heat.

13. Recommendations and proposals for activities to prevent other incidents of a similar nature.

In order to prevent the occurrence of similar accidents in the future and with reference to the requirements of art. 94, par. 1 of Ordinance No 59 from 5.12.2006 on the management of railway safety, the Railway Administration Executive Agency shall order "Holding BDZ" EAD to implement the following safety recommendations:

1. To perform replacement of safety fuses 246 and 248 with automatic high-speed fuses with nominal current 40A to all electric locomotives of 44000 and 45000 series in operation;

2. To perform a single check to all electric locomotives in operation for fulfilment of:

2.1. Requirements of art. 371, art. 372, art. 586 and art. 587 of the „Rules on depot repair and maintenance to electric locomotives of BDZ" (Sign. No LS 0103) dated 1979 and art. 461, art. 462, art. 469 and art. 471 of the PLS 127/05 „Regulation on factory repair of electric locomotives of series 44000 and 45000";

2.2. Requirements of art. 728 art. 730, art. 733, art. 735 and art. 743 of the PLS 127/05 „Regulation on factory repair of electric locomotives series 44000 and 45000" in regards to wires 208, 213, 260, 261, 262 and 263;

2.3. Installation of wires 208, 213, 260, 261, 262 and 263 in corrugated metal body;

2.4. The portable fire extinguishers to be unified under type and location schemes for all the series of electric locomotives in operation.

3. Railway Administration EA shall require the implementation of art. 427, para. 1 pt. 7 of Ordinance No 13 from 30.12.2005 on provision of healthy and safe working conditions in the rail transport and to ensure and equip the locomotives operated by the licensed railway undertakings in the country with gas protection masks.

With reference to the requirements of art. 94, par. 3 of Ordinance No 59 dated 5.12.2006 on the management of railway safety the Railway Administration Executive Agency and "Holding BDZ" EAD shall notify in writing the AMRAIU Directorate at MTITC on the implementation of the recommendations given not later than 30.12.2014.

Chairman:

..... (Boycho Skrobanski)

State Inspector at AMRAIUD, at MTITC

Members:

1. (Boyko Stoilov)
Chief Inspector at AMRAIUD, MTITC
2. (Dimitar Iotov)
Inspector at AMRAIUD, MTITC
3. (Ivan Petrov)
Independent external expert RRS
4. (Gheorghi Maloselski)
Independent external expert ST