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FINAL REPORT

from
technical investigation of railway accident – derailment of freight train No 50505 during transit passing through Petarch station on 28.08.2016

January 2017

FINAL REPORT
from
Technical investigation or railway accident – derailment of seven loaded wagons from the composition of freight train No 50505 during transit passing through Petarch station on 28.08.2016

Objective of the report and extent of responsibility

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

The investigation was performed in accordance with art. 115 k of RTA, art. 76 of Ordinance No 59 dated 5.12.2006, and by Order No RD-08-425/17.09.2016 of the Ministry of Transport, Information Technology, and Communications was assigned a Commission for investigation of the railway accident.

The Commission for investigation performed several inspections to the accident site, and conducted meetings with the persons directly involved in the accident. In order to achieve the fast clarification and to find the circumstances and causes that led to the accident occurrence, external experts were also involved in the Commission of technical investigation. In the course of the investigation there were analysed the report, observation protocols and documents, submitted by the Task Force, and additionally requested materials as well. The Commission took material evidences, based on which there were prepared technical expertise of the speedometer tapes of the two locomotives, which serviced freight train No 50 505, and a part of the torn traction rod of the third row wagon № 84 52 665 1056-7 of the train. In graphical and tabular format were prepared and presented technical expertise of the speedometer tapes of the two locomotives, as well as an analysis of the regime of the train running by an independent contractor, the company "GNN" Ltd. - Sofia. It was prepared and presented technical expertise of the cut part of the torn traction rod of the third wagon by the Laboratory of Metal knowledge (LIMK) to the "Bulgarian Academy of Sciences" (BAS).

The Chairman of the Investigation Commission accepted the presented technical expertise from the contractors as well as the statements of the appointed external experts in implementation of the tasks that were assigned to them.

1. Established facts and circumstances in the investigation process.

On 28.08.2016 from shunting district Stanyantsi at 12:24 p.m. with 92 min. earlier from the timetable, departed a freight train (FT) No 50505 with direction Stanyantsi – Voluyak – Razmenna – Batanovtsi – Dupnitsa. The train was with 12 loaded wagons (coals), 48 axles, and gross weight 924 tons. To Kalotina station was serviced by a diesel locomotive No 06108.

The train arrived in Kalotina station at 13:08 p.m., its stopping time there was 109 min. due to a change of the locomotive with electrical locomotives No 43551.1 train and No 45166.6 pushing assisting locomotive. The locomotive crews of the two locomotives are employees in Dupnitsa locomotive depot at "BDZ Cargo" Ltd. From Kalotina station after performed shortened test „D" of the automatic train brake, the train departed at 14:57 p.m. with 60 min. Earlier ahead its traffic schedule.

The train arrived in Dragoman station at 15:10 p.m., its stopping time there was 37 min. Due to a meeting with train No 10994 (insulated locomotive No 46221). After performed shortened test „D" the train departed at 15:47 p.m. and passed in transit (without stopping) through the stations, Aldomirovtsi at 15:56 p.m. and Slivnitsa at 16:04 p.m. with 55 min. ahead the schedule.

In Petarch station the traffic manager on duty after he received the departure of freight train No 50505 by the traffic manager on duty in Slivnitsa station at 16:05 p.m., asked approval from the traffic manager on duty in Kostinbrod station for ensuring the train movement. After he received an approval the same prepared the route for the train run on third main track, he opened a permission sign at entrance and exits signals. At 16:08 p.m. the traffic manager on duty went out with the switchman/level-crossing guard at the platform in order to transit the non-stopping train in the station. The train passed at 16:10 p.m. with speed 70 km/h, at a maximum permitted speed for the section 75 km/h (evident from the encoding of the two tapes). Running on the main track, the train passed the station building, passed through switch No 2, and then it was heard a strong crash, cloud of dust appeared and the train stopped. The traffic manager on duty sent the switchman to check on site what happened with the train. After arrival on the site, the switchman saw that part of the train wagons were derailed and informed on that the traffic manager on duty.

It was found that there were derailed seven wagons from fourth to tenth including, and they were to the left and to the right of the track with spilled cargo (coals), and the last two wagons with the pushing locomotive passed the place of derailment and stopped without derailing at km 21^{+185}.

The status and location of the locomotives and wagons from the train composition after the derailment was the following:

The train electric locomotive No 43551.1 and the first three wagons with numbers No84526651341-3, No84526651263-9 and No84526651056-7 did not derail and stopped at km20^{+900} after the train torn/detachment. Traction rod was torn on the third wagon, which was found at km 21^{+190} after the pushing locomotive, retracted by the locomotive driver of locomotive No 45166.6 (evident from his explanations).

The fourth row wagon No 84526651054-2 from the train composition derailed with the two bogies, and laid to the left in movement direction at km 21^{+121}. The two bogies of the wagon remained on the wagon, as from the first one were dropped the two wheelsets, the one just to the bogie, and the other at some meters after the cabinet of the automatic level-crossing device (ALCD).

The fifth wagon No 84526666016-4 derailed and laid to the left at km 21^{+070} with spilled cargo.

The sixth wagon No 84526666116-2 derailed and laid to the right at km 21^{+046} with spilled cargo.

The seventh wagon No 84526651252-2 derailed with the two bogies, the first one to the right, and the second to the left from the ballast prism at km 21^{+068}.

The eight wagon No 84526650024-8 derailed and laid to the left with spilled cargo at km21^{+106}.

The ninth wagon No 84526651291-0 derailed and laid to the left with spilled cargo at km 21^{+085}.

The tenth wagon No 84526650037-0 derailed with the two bogies and remained on the ballast prism at km 21^{+140}.

The last two wagons with No 84526666052-9 and No 84526666101-4 and the pushing assisting locomotive No 45166.6 were on the rails and stopped at km 21^{+185}.

The pushing locomotive No 45166.6 together with the last two wagons of the train composition were dragged back in Petarch station at 18:18 p.m. on third track, and the train electrical locomotive No 43551.1 with the first three wagons were dragged back in Kostinbrod station at 19:24 p.m. After dragging the non-derailed wagons at 20:35 p.m. with Order of the train dispatcher was stopped the traffic of all the trains and vehicles in Kostinbrod-Petarch interstation, except from the rehabilitation vehicles.

From Kostinbrod station at 20:50 p.m. was sent rehabilitation train to the accident site for eliminating/taking the derailed wagons and opening of clearance gauge for traffic on the track and starting of repair-rehabilitation activities on the railway infrastructure.

After performance of renewal of 180 m of destructed rail track, the train traffic in Kostinbrod-Petarch interstation was recovered at 02:45 a.m. on 30.08.2016, as the traffic speed along the derailment site (from km 21^{+000} to km 21^{+300} with front 300 m) was reduced to 25 km/h.

The derailed wagons were lifted and placed on the rails and dragged in Petarch station within the period 17 ÷ 20.09.2016.

As a result from the realized derailment there was no injured railway personnel, however the railway rolling stock, railway infrastructure and transported cargo (coals) suffered material damages in the district of the accident site.

2. Officials, involved in the case.

2.1 Locomotive crew:

2.1.1. „Locomotive driver" of electric locomotive No 43551.1 employee in Dupnitsa locomotive depot, "BDZ Cargo" Ltd. – 18 years and 7 months of working experience;

2.1.2. "Assistant locomotive driver" of electric locomotive No 43551.1 employee in Dupnitsa locomotive depot, "BDZ Cargo" Ltd. – 2 years of working experience;

2.1.3. „Locomotive driver" of electric locomotive No 45166.6 employee in Dupnitsa locomotive depot, "BDZ Cargo" Ltd. – 9 years of working experience;

2.2. Station employees:

2.2.1."Traffic manager" – Petarch station – employee at Train operation and station activity management division – Sofia (TOSAM-Sofia), NRIC–17 years of working experience;

2.2.2."Traffic manager" – Slivnitsa station – employee at TOSAM-Sofia, NRIC–8 years of working experience;

2.2.3. "Switchman/level-crossing guard" – Petarch station – employee at TOSAM-Sofia, NRIC–9 years of working experience;

2.3. Other employees:

2.3.1. „Technician-mechanic, wagon inspector" – Stanyantsi station – employee at Cargo traffic division (CTD) – Sofia, „BDZ Cargo" Ltd. – 10 years and 3 months of working experience;

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

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

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

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

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

The locomotive personnel of BDZ- Cargo Ltd. operated locomotives No 43551.1 and No 45166.6 possess the necessary qualification documents and qualification for driving the respective locomotive series

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

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

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

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

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

- in the daylight hours;

- air temperature: 26 ÷ 27 °C;
- moderate wind in north-east direction with speed of 3 m/s;
- clear weather.

6.2 Track:

- regular under documents.

6.3. Station and interstation signalling equipment before the accident:

- the interstation is equipped with Semi-automatic block system (SABS), regular does not refer the occurred accident.

- Petarch station is equipped with Electrical-mechanic interlocking (EMI), regular and does not refer to the occurred accident.

6.4. Catenary:

- regular with no reference to the occurred railway accident.

6.5. Train composition station:

- Stanyantsi.

6.6. Communication technique and telecommunications interfaces:

- Technically regular.

6.7. Profile, geometry and track layout:

- after switch No 2 in Petarch station Kostinbrod side, the section of the track is in a straight line without inclination before the railway level-crossing, where derailed firs the fourth wagon of the train composition as after it slid the next six wagons.

6.8. Rolling stock:

Electric locomotives No 43551.1 and No 45166.6 that serviced FT No 50505 were with regular draft gears, brake systems, illuminating and sound signals as per the technical norms and requirements as it is evident from the records in the respective log-books, copies of which were presented in the Task Force report.

Wagons: 12 loaded with coals – type $Fals_4$,.

Total number of the axles – 48.

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

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

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

Freight train No 50505 was composed in shunting district Stanyantsi, it was provided with the necessary brake mass and with the necessary train documents. As per the TOS the train departed from the departure station with 92 min. earlier. The train was serviced by the railway undertaking "BDZ Cargo" Ltd. with License No 203/16.10.2013 and with Safety Certificates part „A" BG1120130002 and part „B" BG1220130002.

The locomotive crews, who serviced the train were not provided with business mobile phones.

During an inspection of the technical documentation of locomotives No 43551.1 and No45166.6 were not found and registered any breaches of the effective "Regulation for factory

and depot repair and maintenance of electrical locomotives", as well as the technologies in the organization and operation of work.

From the presented technical documentation for the wagons it was found that the wagons were property of "Bobov Dol Thermal Power Plant" Plc., and middle repair was performed in the following wagon-repair entities, "VRZ – 99" Plc., "Traction" Plc. – Samuil and "RRE Iliyantsi" Ltd.

On the fourth row wagon No 84526651054-2 in the composition, which derailed first was performed a mid-repair in "RRE Iliyantsi" Ltd. on 15.05.2012.

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

9.1. Status before the accident.

9.1.1. Switches – technically regular;
9.1.2. Signalling equipment.
- Electromechanical interlocking (EMI) – technically regular;
9.1.3. Catenary – technically regular;
9.1.4. Rolling stock.

Electrical locomotives No 43551.1 and No 45166.6 were regular and as a result from the occurred accident they did not suffer any damages.

9.2. Status after the accident.

9.2.1. Fatalities – there were no any;
9.2.2. Seriously injured – there were no any;
9.2.3. Failures and damages caused to the locomotives– there were no any;
9.2.4. Failures and damages caused to the wagons:
Wagon No 84526651054-2 derailed (4-th in row of the composition)
- deformed valves – 2 pcs.;
- deformed lever braking system;
- deformed bogie (for scrap);
- torn traction rod;
- torn front beam – 1 pcs.;
- deformed front beam – 1pcs.;

Wagon No 84526666016-4 derailed (5-th in row of the composition);
- deformed bogies (for scrap) – 2 pcs.;
- torn air conduits;
- deformed lever braking system;
- deformed body shell;
- deformed unloading mechanism;
- missing bumpers – 3 pcs.;
- deformed front beam;
- deformed diagonal beam;

Wagon No 84526666116-2 derailed (6-th in row of the composition)
- Undercut and torn front beam;
- deformed body shell
- missing plate 1 pcs.
- torn air conduits;
- deformed diagonal beam (behind the bumper);
- deformed carrier1 pcs. and destructed carrier 1 pcs.;
- deformed first bogie and significantly deformed second bogie (for scrap);
- deformed carrying plate of the towing apparatus;
- torn rods and damaged loading point machine;
- deformed rigid rod;
- deformed shunting steps – 2 pcs.;
- deformed traction hook;

- deformed shaft of unloading mechanism – 4 pcs.;
- deformed valves – 4 pcs.;
- torn ribbing of the body shell;
- torn locking shafts of the valves

Wagon No 84526651252-2 derailed (7-nth in row of the composition)
- damaged bumpers – 4 pcs.;
- torn main air conduit;
- deformed carrier;
- deformed valves together with the rods – 2 pcs.;
- deformed manual unloading mechanism;
- torn shunting steps;
- deformed safety belts – 2 pcs.;
- deformed body shell of the wagon;

Wagon No 84526650024-8 derailed (8-th in row of the composition)
- deformed bogies;
- torn bumpers;
- torn air conduits;
- damaged hand/manual brake
- deformed valves – 2 pcs.;
- torn traction hook;

Wagon No 84526651291-0 derailed (9-nth in row of the composition)
- deformed front beam;
- destructed carrier;
- damaged (punctured) body shell
- damaged bumper – 3 pcs.;
- deformed traction hook;
- deformed valves – 2 pcs.;

Wagon No 84526650037-0 derailed (10-nth in row of the composition)
- deformed valves
- damaged bumper – 3 pcs.;
- deformed transition bridge/gangway and steps;
- deformed hand brake;

The damages of the failure wagons amount to 154 919,95 BGN without VAT.

9.2.5. Failures and damages caused to the railway infrastructure:

9.2.5.1. Permanent way and structures:
- 8 pcs. Railway spans with length 25 m, equipped with sleepers ST4;
- beech normal sleepers – 2 $m^{3;}$

The damages of the railway infrastructure amount to 20 567,55 BGN without VAT.

9.2.5.2. Signalling technique and telecommunications, radio-connections and power supply:
- interrupted track and current circuits (TCC) – 2 pcs.;
- dismantling and installation of transformer cables for TCC – 6 pcs.;
- dismantling and installation of jumper cables for TCC – 14 pcs.;
- recovery of the activity of TCC – 2 pcs.;
- regulation and test of the signaling technique after the performed repair, switch/signal – 6 pcs.;
- installation of steel connector for traction current – 1 pcs.;
- bypass cable F10 – 200 kg.;
- fuel for illumination aggregate – 40 l.

The damages to "Signalling and Telecommunications" – amount to 7087,80 BGN with VAT;

9.2.5.3. Catenary:
- there were no damages.
9.2.5.4. Other failures and damages:

The damages to the transported cargo (coals) amount to 9 237,05 BGN with VAT.

9.2.6. Traffic interruption:
As a result from the occurred accident in Petarch station the traffic was interrupted in the section from 20:25 p.m. on 28.08.2016 until 02:45 a.m. on 30.08.2016.
9.2.6.1. Caused train delay:
Delayed trains:
BDZ – PT Ltd.;
- train No 10208 + 168 min. in Dragoman station;
- train No 10213 + 13 min. in Slivnitsa station;
- train No 292 + 118 min. in Dimitrovgrad ZS station;
- train No 490 + 24 min. in Dimitrovgrad ZS station;
- train No 10292 + 34 min. in Dragoman station;
- train No 10293 + 74 min. in Sofia station;
- train No 10285 + 18 min. in Sofia station;
- train No 10294 + 25 min. in Dragoman station;
- train No 10207 + 12 min. in Slivnitsa station;
- train No 10296 + 53 min. in Dragoman station;
- train No 10297 + 37 min. in Sofia station;
- train No 10299 + 17 min. in Sofia station;
- train No 10298 + 15 min. in Dragoman station;
- train No 10210 + 16 min. in Kostinbrod station;
- train No 10280 + 53 min. in Dragoman station;
- train No 10281 + 14 min. in Sofia station;
- train No 10212 + 18 min. in Kostinbrod station;
- train No 10282 + 27 min. in Dragoman station;
- train No 10213 + 14 min. in Slivnitsa station;
BDZ-Cargo Ltd.;
- train No 50509 + 2280 min. in Dupnitsa station;
- train No 46870 + 2300 min. in Dimitrovgrad ZS station;

Cancelled trains:
BDZ – PS Ltd.;
- train No 292 in Sofia – Dragoman section on 28.08.2016;
- train No 491 in Dragoman-Sofia section on 28.08.2016;
- train No 10208 in Sofia – Slivnitsa section on 28.08.2016;
- train No 10209 in Slivnitsa – Sofia section on 28.08.2016;
- train No 10210 in Sofia – Dragoman section on 28.08.2016;
- train No 10211 in Dragoman-Sofia section on 28.08.2016;
- train No 10212 in Kostinbrod – Dragoman section on 28.08.2016;
- train No 10213 in Slivnitsa – Sofia section on 28.08.2016;
- train No 293 in Dragoman-Sofia section on 29.08.2016;
- train No 292 in Sofia – Dragoman section on 29.08.2016;
- train No 490 in Sofia – Dragoman section on 29.08.2016;
- train No 491 in Dragoman-Sofia section on 29.08.2016;
- train No 10200 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10201 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10202 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10203 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10204 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10205 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10206 in Kostinbrod – Dragoman section on 29.08.2016;

- train No 10207 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10208 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10209 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10210 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10211 in Slivnitsa – Sofia section on 29.08.2016;
- train No 10212 in Kostinbrod – Dragoman section on 29.08.2016;
- train No 10213 in Slivnitsa – Sofia section on 29.08.2016;

BDZ-Cargo Ltd.;
- train No 50505 in Kostinbrod – Dupnitsa section on 28.08.2016;
- train No 46870 in Sofia – Dimitrovgrad ZS section on 28.08.2016;
- train No 46873 in Dimitrovgrad ZS – Iskar section on 28.08.2016;
- train No 48000 in Iskar-Dimitrovgrad ZS section on 28.08.2016;
- train No 44152 in Voluyak – Dimitrovgrad ZS section on 28.08.2016;
- train No 47041 in Dimitrovgrad ZS – Iliyantsi section on 28.08.2016;
- train No 40838 in Voluyak – Dimitrovgrad ZS section on 28.08.2016;
- train No 50502 in Dupnitsa – Stanyantsi section on 29.08.2016;
- train No 50503 in Stanyantsi – Dupnitsa section on 29.08.2016;
- train No 50505 in Stanyantsi – Dupnitsa section on 29.08.2016;
- train No 50510 in Voluyak – Stanyantsi section on 29.08.2016;
- train No 50509 in Stanyantsi – Dupnitsa section on 29.08.2016;
- train No 45002 in Ilyantsi – Dimitrovgrad ZS section on 29.08.2016;
- train No 46870 in Septemvri – Dimitrovgrad ZS section on 29.08.2016;
- train No 46873 in Dimitrovgrad ZS – Voluyak section on 29.08.2016;
- train No 45003 in Dimitrovgrad ZS – Iliyantsi section on 29.08.2016;
- train No 48000 in Iskar-Dimitrovgrad ZS section on 29.08.2016;
- train No 48001 in Dimitrovgrad ZS – Iskar section on 29.08.2016;
- train No 40838 in Voluyak – Dimitrovgrad ZS section on 29.08.2016;
- train No 46839 in Dimitrovgrad ZS – Voluyak section on 29.08.2016;
- train No 10930 in Sofia – Dragoman section on 29.08.2016;
- train No 11920 in Sofia – Stanyantsi section on 29.08.2016;

BRC AD;
- train No 47091 in Dragoman – Kurilo section on 28.08.2016;
- train No 45024 in Ilyantsi – Dimitrovgrad ZS section on 29.08.2016;

TBD CARGO PLC;
- train No 50532 in Pernik marshalling – Beli breg section on 29.08.2016;
- train No 50535 in Beli breg – Golemo selo section on 29.08.2016;
- train No 50536 in Pernik marshalling – Beli breg section on 29.08.2016;
- train No 50537 in Beli breg – Golemo selo section on 29.08.2016;

Assigned trains:
BDZ – PS Ltd.;
- train No 10293 in Kostinbrod – Sofia section on 28.08.2016;
- train No 10390 in Slivnitsa – Dragoman section on 28.08.2016;
- train No 10290 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10291 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10292 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10293 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10294 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10296 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10297 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10299 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10280 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10282 in Slivnitsa – Dragoman section on 29.08.2016;

- train No 10298 in Slivnitsa – Dragoman section on 29.08.2016;
- train No 10281 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10283 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10393 in Kostinbrod – Sofia section on 29.08.2016;
- train No 10394 in Sofia-Kostinbrod section on 29.08.2016;
- train No 10395 in Dragoman – Slivnitsa section on 29.08.2016;
- train No 10397 in Slivnitsa – Sofia section on 29.08.2016;

9.2.6.2. Costs for modifying the Train operation schedule**:**

Total damages from the TOS modification amount to – 11 439,30 BGN with VAT.

9.3. Rehabilitation vehicles movement.

9.3.1. Rehabilitation train:

- on 28.08.2016 rehabilitation train No 10431 departed at 20:50 p.m. from Kostinbrod station to the accident site and arrived at 20:55 p.m.

The generated costs for rehabilitation train amount to 2 200,00 BGN without VAT.

9.3.2. Other rehabilitation means:

- on 28.08.2016 at 16:40 p.m. from Sofia departed a specialized truck UNIMOG, which arrived on the accident site at 17:30 p.m.

The generated costs for specialized truck UNIMOG are 954,00 BGN without VAT.

- on 30.08.2016 at 00:47 a.m. FROM Kostinbrod station departed Rail self-propelled machine DM-14 and arrived on the accident site at 00:55 a.m. for regulation of the catenary.

The generated costs for the RCCM DM-14 amount to 750,00 BGN without VAT.

9.4. Other costs related to the elimination/taken away of the derailed wagons from the accident site:

- costs for materials, spare parts and labour – 6 723,68 BGN.
- costs for lifting the derailed wagons – 7 200,00 BGN with VAT.
- costs for insuring illumination/lightning on the accident site – 957,46 BGN with VAT.
- costs for elaboration of train possessions – 240,00 BGN with VAT.
- costs for ensuring traction rolling stock for rehabilitation activities – 11 304,96 BGN with VAT.

9.5. Total damages and costs from the accident amount to: 233 581,75 BGN

10. Causes for the accident.

After performed number of inspections on the accident site, led interviews to the railway personnel involved in the accident and analysis of the data from the performed technical expertise and submitted statements of the external experts Commission came to the conclusion that the original cause that led to train derailment is:

Detachment of the clamp of the axle box springs, which held the outer and inner springs for the wing of the left axle box of the second axle of the first bogie of the fourth wagon in row of the train. After the train passing through the second switch, the springs fell from the first bogie of the wagon. The same become misbalanced and the left wheel of the first wheelset of the bogie jumped and passed over the rail head without a trace just before the level-crossing plank-board flooring. After 1.75 m. derailed also the right wheel of the first wheelset.

11. Analysis of the causes that led to the railway accident occurrence.

From the performed inspections, additionally required materials from the Task Force, the prepared technical expertise and speedometer tapes of the two locomotives and part of the torn traction rod of the third wagon No 84 52 665 1056-7, as well as from the performed additional measurements of the track and derailed wagons, the Commission of technical investigation found the following:

- the derailment of seven loaded wagons of FT No 50505 in Petarch station occurred on 28.08.2016 at 16:10 p.m. at km 21^{+256}.

- the derailment of the wagons was realized between switch No 2 and the railway level-crossing in a straight horizontal section of the track without inclination.

- the train running speed at the moment of derailment was 70 km/h, within maximum permitted for train movement on the main track in the station 75 km/h.;

- on the accident site was found a torn of the traction rod of third wagon No wagon 84 52 665 1056-7;

- on the fourth wagon No 84 52 665 1054-2 was detached the clamp for the axle box spring, which held the outer and inner springs of the left axle box.

During the transit passing of the train through the station after switch No 2 at 2 m before the level-crossing flooring (plank board flooring) at km 21^{+253}, which is in the station region derailed the fourth in row wagon No 84 52 665 1054-2, as the two bogies remained to the wagon frame, and from the first bogie were dropped the two wheelsets. The second bogie was without evident failures and deformations (fig. 1).

Fig. 1

During the derailment there were no evident traces from jumping of the flange of the left wheel on the rail head, but only trace from the outer non-working part of the rail head (fig. 2). Moving away the wheel to the left and at a distance 1,75 m. from the derailed left wheel slid also the right wheel of the first wheelset of the first bogie. With the movement away to the left, the first derailed wheelset, after 7,20 m followed also an uphill of the left wheel of the second wheelset on the left rail, moving on the rail head approximately 0,8 m fell from the outer/external part of the rail and at approximately 0,7 m slid also the right wheel of the same wheelset. The traces from the derailed wheelsets of the first bogie were clearly defined on the flooring of the level-crossing, (Fig.3), as two of them were in the gauge and two to the left of the left rail. The train continued its running with the derailed first bogie of the fourth wagon, which moving away out of the ballast prism caused the derailment also of the second bogie of the wagon, after the level-crossing and subsequently slid after it the derailment of another six wagons of the train. As a result from the derailment the train detached between the third and fourth wagon of the composition. The detachment place was (the transition from square to round form) of the

Fig. 2

Fig. 3

Fig. 4

traction rod of the third wagon to the fourth (Fig. 4). The morphology of the destructed surface was visually inspected by the means of a microscope. From the performed visual observation of the test samples from the traction rod there were not noticed pores or other visual defects with unaided eye. Due to a technological or material defect and as a result from overloading appeared a crack in the traction rod, which because of the atmospheric and working conditions was strongly corroded. The thick and dense layer of corrosion showed that the traction rod was in such a condition for a long time. During the moving away from the track the derailed fourth wagon caused additional external pressures on the traction rod, which overloaded it and the same torn in an avalanche way. During the inspection of the derailed fourth wagon was found that from the first bogie of the second wheelset was detached the clamp of the axle box spring, which held the internal and external springs for the wing of the left axle box (Fig. 5). During the inspection on site, the springs of the left axle box were not found (were missing).

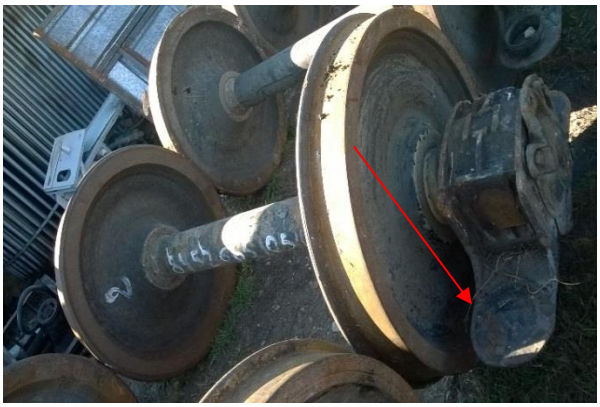

Fig. 5

There were caused serious damages and undercuts on the top/surface of the wheels flanges (Fig. 6) to both wheelsets of the first bogie. During the inspection of the track on the place of derailment was found that there were no missing or loosened fastenings as well as unfit/unusable sleepers. There were no found one-sided or twist subsidence. Based on the performed measurements of track were calculated the transitions before and after the place of derailment.

Fig. 6

I. Before the place of derailment

а) Based on centered bolts:

level in point „0“ = 8 mm; level in point „8“ = 11 mm; Difference 3 mm.

$$K = \frac{L}{H} = \frac{8000}{3} = 1:2666 \text{ (inclination)}$$

б) Based on the bogie axles:

level in point „0“ = 8mm; level in point „2“=12 mm; Difference 4 mm.

$$K = \frac{L}{H} = \frac{2000}{4} = 1:500 \text{ (inclination)}$$

II. After the place of derailment

а) Based on the central bolts:

level in point „0“ = 8mm; level in point „-8“ = 3 mm; Difference 5 mm.

$$K = \frac{L}{H} = \frac{8000}{5} = 1:1600 \text{ (inclination)}$$

б) Based on the axles of the bogie:

level in point „0“ = 8mm; level in point „-2“= 4 mm; Difference 4 mm.

$$K = \frac{L}{H} = \frac{2000}{4} = 1:500 \text{ (inclination)}$$

Based on the established/found facts and circumstances is evident that the derailment did not occur as a result from increased speed. Also from the performed measurements and calculations of the track, the same is within the norms as per the technical requirements. The detachment of the clamp of the left axle box spring, which held the external and internal springs for the axle box wing was the most probable cause for the derailment of the wagon. During the train running detached the clamp of the axle box springs and followed dropping of the springs,

which led to misbalance of the bogie within which the first wheelset was unloaded and the left wheel jumped freely the rail head and did not leave visible traces on the rail head.

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

1. The railway undertaking “BDZ Cargo” Ltd. shall strengthen the control on the proper loading of the wagons in the loading districts for bulk cargo.

2. There shall be increased the quality of the inspections of freight wagons, performed by the technical personnel of the railway undertaking “BDZ Cargo” Ltd. and of the owner of the wagons “Bobov Dol Thermal Power Plant” Plc., which are operated on the railway infrastructure .

Chairman:

Boycho Skrobanski
State investigating inspector at MTITC