



**РЕПУБЛИКА БЪЛГАРИЯ
МИНИСТЕРСТВО НА ТРАНСПОРТА,
ИНФОРМАЦИОННИТЕ ТЕХНОЛОГИИ И СЪОБЩЕНИЯТА**

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FINAL REPORT

from

**technical investigation of railway accident – derailing of wagon-cistern from the
composition of freight train Nr. 30582 in the section between Dalgopol & Komunari
stations on road Nr. 2 on 09 February 2017**



August, 2017

FINAL REPORT

Purpose of the Report and responsibility

In accordance with Directive 2004/49/EC of the European Parliament and the European Council on the safety of railway transport in the Community, the Railway Transport Act (RTA) of the Republic of Bulgaria and Ordinance Nr. 59 dt. 05.12.2006 on safety management in railway transport, the investigation of railway accidents aims to establish the causes having lead to the realization of accidents in view of their elimination and prevention in the future, **without searching for anybody's guilt or responsibility.**

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The investigation is carried out on the grounds of Art. 115k of the Railway Transport Act (RTA), Art. 76 of Ordinance Nr. 59/ 05.12.2006 and Order Nr. ПД-08-55/17.02.2017. Based thereupon, a Commission on the investigation of the railway accident is appointed at the Ministry of Transport, Information Technologies and Communication (MTITC). The Commission includes also external experts of the relevant professional expertise - representatives of “Todor Kableshkov” Higher Technical School, as well as experts with long professional experience in the sphere of railway transport. The Investigation Commission has performed multiple examinations of the place of accident and has interviewed the staff members having partaken in it, as well as the staff members having indirect relation with the accident.

In the progress of the investigation an analysis was made of the reports provided by the Operative Team, the collected documents related therewith, as well as all materials requested additionally by the Commission.

The Chairman of the Investigation Commission accepted the submitted opinions of the external experts in fulfillment of their entrusted tasks in relation with the accident.

In addition to all collected materials, the Investigation Commission at MTITC requested after the established order from the RRO - Provadia and obtained the prescribed complex technical expertise from the National Investigation Office:

- Complex technical expertise on caused property damages to the National Railway Infrastructure Company by freight train Nr. 30582 upon its trafficking after Boryana stop in the direction of Komunari station on 09 February 2017.

- Technical expertise on the condition of the railway line before and after the derailing of freight train Nr. 30582 in the section between Dalgopol and Komunari stations on 09 February 2017.

1. Summary.

On 08 February 2017, from Razdelna station to Karnobat station departed freight train Nr. 30582, composed of two electric locomotives pulling the train and twenty four wagons, of which 5 empty and 19 full ones. The train's transportation is carried out by the Bulgarian Railway Company A.D. (BDZ AD). At 00:41 h. the train passes in transit on the third acceptance & departure platform at the station of Komunari. Upon the movement of the train through the station the traffic controller on duty and the post switchman didn't notice any problems.

After going back to the control room the traffic controller saw “CUT” status flashing for point Nr. 3 on the board of the Route Relay Centralization System. For obtaining of topical information, the traffic controller sent the post switchman to inspect the point. He requested and received an order from the train dispatcher for breaking of the seal of the point recovery button, to recover the control over the point. A few minutes later after arriving at place the post switchman reported to the traffic controller that points Nr. Nr. 3, 5 and 103 had been destroyed and no trains could pass through them. The traffic controller informed immediately the train dispatcher about the conditions of the points at the station, and the latter on his part undertook quick actions for stopping of the train at the station of Zavet, for the performance of an examination of the train.

An examination of the train was carried out in the section between Dalgopol and Komunari stations on railway line Nr. 2 by a technician – team manager in the railway section of Dalgopol. He proved the availability of traces from a derailed wagon from the composition of freight train Nr. 30582 near Boryana stopping station, which had caused destructions on the railway line at a length of 4477 m and had destroyed points Nr. Nr. 3, 5 and 103 in the station of Komunari.

The cause for the occurrence of the accident is: The wagon-cistern is with obviously shifted gravity center in crosswise direction because of the established existing gaps in the runners of the two carts and the car, as well as the loosened press joint wheel – axis, which have disturbed the distances between the bandages of the first leading wheel axis of the wagon, and thus have obstructed the correct positioning of the cart in the bend of the railway line.

Three recommendations are rendered for improvement of safety of freights, addressed to the railway carrier the Bulgarian Railway Company A.D. and the National Railway Infrastructure Company.

2. Facts and circumstances established in the process of investigation.

On 07 February 2017 through Gjurgiu border control point of the Republic of Romania at Ruse – Razpredelitelna station at 19:15 h. there arrived freight train Nr. 48521. The train was transported by the Romanian railway carrier CFR SA and train Nr. 84537915420-4, Series Zagkks, full of propane-butane, was included in its composition. After the train's arrival at the station, the latter underwent through technical and commercial examination performed by the staff members of the railway carrier the Bulgarian Railway Company A.D. At 20:30 h. the train was accepted without any comments. At Ruse-Razpredelitelna station freight train Nr. 90681 was composed, in the composition of which wagon Nr. 84537915420-4 was also included. The train had departed at 16:55 h. on 08.02.2017 for Razdelna station.

On 08.02.2017 freight train Nr. 90681 arrived at 22:49 h. at Razdelna station, where the locomotive was removed from its composition and a new train was composed - freight train Nr. 30582. At 23:17 h. on 08.02.2017 the traffic controller at Razdelna station by telephone gram handled over the composition of freight train Nr. 30582 to a technical-mechanic, revision of wagons – a staff member of the Bulgarian Railway Company A.D., for the performance of technical examination and full testing “A” of the automatic train breakers.

After the completion of the technical examination the technician – mechanic, revision of wagons, issued Certificate on the breaking weight of the train. At 23:50 the technician – mechanic, revision of wagons, sent by telephone gram to the traffic controller the message for the train – “ready for departure”.

Freight train Nr. 30582 departed from Razdelna station in accordance with the Time Schedule on trains' trafficking at 23:55 h. on the route of Razdelna – Sindel – Razpredelitelna – Komunari – Karnobat (Figure 1). The train was serviced by two locomotives, a stand-by one of

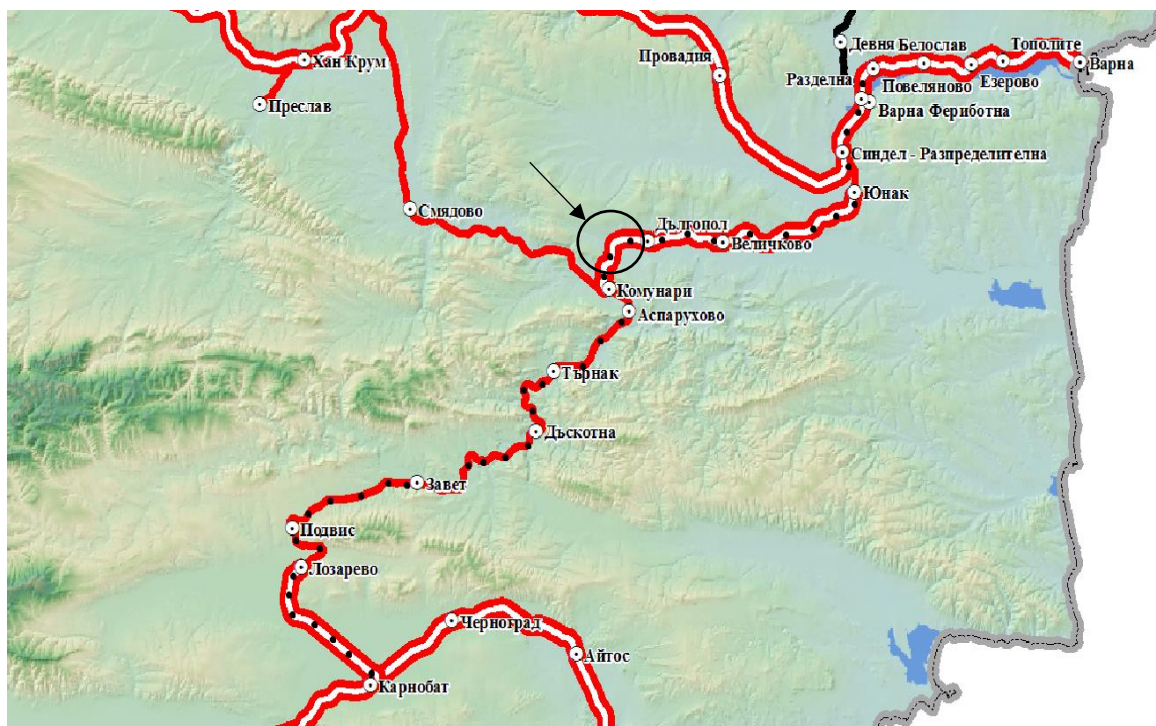


Figure 1

Nr. 87019.3, with locomotive machine driver – first person, and locomotive machine driver – second person, and train Nr. 87026.8 only with a locomotive machine driver. The train's composition was 24 wagons, of which 9 wagons of Rgs series, loaded with containers, 4 wagons Rgs series – empty, 10 wagons Zagkks series – full of propane-butane, and 1 wagon Eaos series – empty, for preliminary guarding purposes, totally 96 axes, gross weight 1532 tons.

After its departure from Razdelna station, the train travelled without stopping to Zavet station, where it was stopped out of schedule, upon tolerance for passing through the stations of - 1 to +2 minutes.

At 00:41 h. the traffic controller at Komunari station traced the transit movement of the train on the third acceptance-departure platform, without noticing anything out of order. After passing of the train, the traffic controller went back to the machine control room and saw on the

board of the signal scheme board of the Route Relay Centralization System flashing of indication for “CUT” status of point Nr. 3.

The traffic controller reported to the train dispatcher about the movement of freight train Nr. 30582, meanwhile informing him about the problem having occurred with point Nr. 3 after passing of the train.

In order to re-establish the control over the point, the traffic controller had requested and received an order from the train dispatcher, by which the train dispatcher granted him permission to break the seal and use button “Control recovery” (СВБ). Having completed his talk with the train dispatcher, the traffic controller looked for the post switchman next to the radio station, intending to send him for an examination of point Nr. 3. At that time the post switchman was close to the reception building, on his way back from examining of the point, at Dalgopol side. Upon observing the train coming closer, he stopped to follow its movement and didn't noticed anything irregular as well.

After the obtained instructions the post switchman returned back to the point's mouth, Dalgopol side, to perform a second examination of the points. About 20 minutes later he reported to the traffic controller that points Nr. Nr. 3, 5 and 103 had been destroyed and no train traffic through them was possible.

The traffic controller, after obtaining the above information from the post switchman about the condition of the points, informed the train dispatcher and the head of station thereabout. The train dispatcher, on his part, immediately searched for the traffic controller on duty at Daskotna station, but was unable to get into contact with him, as the latter had been transiting the passing train at that time. Then he ordered to the traffic controller on duty at Zavet station to stop freight train Nr. 30582 at the station and that the train would be examined by the locomotive drivers and the post switchman at the station for the availability of traces left from a derailed wagon.

About the forthcoming extraordinary stopping of the train at Zavet station the train dispatcher informed also the locomotive brigades by their mobile phones, and he informed also on a timely basis the train dispatcher of the Northern Circle at the CDR of NRIC about the situation having occurred with freight train Nr. 30582.

Freight train Nr. 30582 arrived at Zavet station at 01:34 h. and stayed for 46 minutes there, during which the locomotive brigades together with the post switchman performed an examination of the train without proving any traces from derailling of any of the wagons. After the completion of the examination they informed the traffic controller and the train dispatcher there were not any hindrances established for the continuation of the train's course.

Having received this information, the train dispatcher informed again the train dispatcher of the Northern Circle, and after concurring his instructions with him, instructed the traffic controller on duty at Zavet station that the train had to continue its course.

At the same time at Komunari station the Head of station, together with technician – team head from Dalgopol railway section, performed a detailed examination of points Nr. Nr. 3, 5 and 103, after that they started on the line on road Nr. 2 to Dalgopol station to establish the place of derailling. The Technician – Team Head informed on a timely basis the Head of Dalgopol railway section on the noticed damages of the points, as well as on the undertaken survey of the railway line between the stations. The latter, having arrived at Komunari station at 01:45 h., performed a detailed examination of the railway line and the damaged points at the station.

After completion of the examinations, the Head of the railway section returned back to the station and jointed the traffic controller on duty. At 02:20 h. he prescribed suspending of trains' trafficking through points Nr. 3, Nr. 5 and Nr. 103 and on the third platform at Komunari station, as well as on road Nr. 2 in the section between Dalgopol – Komunari stations.

A little while after the departure of the train from Zavet station, the train dispatcher was informed by the traffic controller on duty at Komunari station about the instructions prescribed by the Head of Dalgopol section. In this connection, at 02:30 h. the train dispatcher rendered instructions to the controllers on duty at the stations of Dalgopol and Komunari, by which the trains' traffic was suspended at the section between Dalgopol – Komunari stations, road Nr. 2, as well as through points Nr. 3, Nr. 5 and Nr. 103, and on the third platform at Komunari station.

After the completion of the actions on suspension of the trains' traffic, the train dispatcher rendered an order to the traffic controller on duty at Karnobat station for the performance of a

technical examination of train Nr. 30582 after its arrival at Karnobat station, to be performed by the technician-mechanic, revision of wagons.

At Karnobat station the train arrived at 03:08 h. and after the performed technical examination by the technician-mechanic, revision of wagons - a staff member of the Bulgarian Railway Company AD, it was proven that wagon Nr. 84537915420-4, series Zagkks, full of propane-butane, had damages on its wheel axes and the frame of the first cart in the direction of movement. The wagon was brought to the sixth platform at the station because of its incapability to continue trafficking as a result of the caused damages on its running parts.

The section between Dalgopol – Komunari stations, road Nr. 2, remains closed for trafficking of the regular trains due to the performance of repair and reconstruction works on the railway line.

As a result from the realized accident there are no staff members injured, but there are material damages caused on the railway stock and the railway infrastructure.

3. Personnel information.

3.1 Locomotive brigade:

3.1.1. “Locomotive engine driver” of electric locomotive Nr. 87019.3, an employee of the Bulgarian Railway Company AD – 26 years of service;

3.1.2. “Locomotive engine driver” of electric locomotive Nr. 87019.3, an employee of the Bulgarian Railway Company AD – 6 years of service;

3.1.3. “Locomotive engine driver” of electric locomotive Nr. 87026.8, an employee of the Bulgarian Railway Company AD – 40 years of service;

3.2. Station staff:

3.2.1. “Traffic controller” – first person at Razdelna station – employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 27 years of service;

3.2.2. “Traffic controller” – second person at Razdelna station – employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 16 years of service;

3.2.3. “Traffic controller” – Dalgopol station – employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 3 years of service;

3.2.4. “Traffic controller” – Komunari station – employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 27 years of service;

3.2.5. “Traffic controller” – Zavet station – employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 15 years of service;

3.2.6. “Post switchman” – Razdelna station - employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 20 years of service;

3.2.7. “Post switchman” – Razdelna station - employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 9 years of service;

3.2.8. “Post switchman” – Dalgopol station - employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 27 years of service;

3.2.9. “Post switchman” – Komunari station - employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 35 years of service;

3.2.10. “Post switchman” – Zavet station - employee at “Management of train trafficking and station activities” – Gorna Oryahovitsa, the National Railway Infrastructure Company – 10 months of service;

3.3. Other staff members:

3.3.1. “Technician – mechanic, revision of wagons” – Razdelna station – an employee of the Bulgarian Railway Company A.D. – 33 years of service;

3.3.2. “Technician – mechanic, revision of wagons” – Karnobat station – an employee of the Bulgarian Railway Company A.D. – 25 years of service;

3.3.3. “Technician – mechanic, revision of wagons” – Ruse station – an employee of the Bulgarian Railway Company A.D. – 10 years of service.

4. Death cases, injuries and property damages.

4.1. Death cases – none.

4.2. Injured persons with traumas – none.

4.3. Property damages:

4.3.1. Damages and costs on the derailed wagon Nr. 84537915420-4:

- cart without wheel axes, 1 pc. – BGN 2558, 23

- wheel axes 2 pcs. – BGN 4694,00

- transportation of cart and wheel axes to Karnobat – BGN 1441,45

- cleaning of the cistern’s tank – BGN 1505,99

- testing of the tank – BGN 616,08

- transportation of the wagon to the Internal Repair Workshop of Karnobat – BGN 146,69

- transportation of the wagon from the town of Karnobat to the Internal Repair Workshop – BGN 463,87

- maneuvering in the town of Karnobat – BGN 467,10

- use of equipment at the Internal Repair Workshop of Karnobat – BGN 276,03

- use of an auto crane for replacement of the cart – BGN 595,00

- lifting of the wagon for replacement of the cart – BGN 947,29

The damages and expenses for recovery of the derailed wagon amount to BGN 13711,73, VAT excluded.

4.3.2. Damages caused to the railway infrastructure:

- destroyed railroad of total length 4477 m and damaged 3 pcs. of railway points.

The expenses for caused damages and recovery of the railway infrastructure amount to BGN 488 980,90.

4.3.3. Expenses for changing of Train Trafficking Schedule – none.

4.4. The damages and expenses incurred from the accident are at the total amount of: BGN 502692,63.

5. Physical status of the staff members related with the accident.

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

5.1. “Locomotive engine driver”, first person on electric locomotive Nr. 87019.3, has rested from 18:45 h. on 07.02.2017 till 22:55 h. on 08.02.2017;

5.2. “Locomotive engine driver”, second person on electric locomotive Nr. 87019.3, has rested from 07:00 h. on 07.02.2017 till 22:55 h. on 08.02.2017;

5.3. “Locomotive engine driver”, first person on electric locomotive Nr. 87026.8, has rested from 06:30 h. on 07.02.2017 till 22:55 h. on 08.02.2017;

The locomotive brigade have undergone through pre-shift instructions at Razdelna station, rendered by the traffic controller/ freight controller at the Bulgarian Railway Company A.D. They have declared by their signatures in the instruction records that they were of fresh standing, well rested and had not used any alcoholic drinks or any other drug substances.

The staff members related with the accident possess valid certificates from psychological examination.

6. Professional capability documents.

The staff members from the National Railway Infrastructure Company (NRIC), related with the accident, possess the requested professional capability documents, documents for professional qualification and occupying of the relevant job positions.

The locomotive staff of the Bulgarian Railway Company A.D., having driven electric locomotives Nr. 87019.3 and Nr. 87026.8, possess the requested professional capability documents, documents for occupying of the relevant job positions, as well as the requested qualification for driving of the relevant series of locomotives.

7. Actions performed by the staff members before and during the accident.

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

The staff members from the Bulgarian Railway Company A.D., immediately before and during the accident, have acted in conformity with the established normative regulations and internal rules regulating safety of freights in the railway transport.

8. External circumstances preceding the accident and status of the railway infrastructure and rolling stock before the accident.

8.1. The meteorological data on the weather conditions, exercising influence over the visibility of signals:

- during the dark hours of the day;
- negative ambient temperature;
- clear weather.

8.2 Railway and points – in operational readiness, as per documentation.

8.3. Station and inter-station safety equipment and its condition before the accident:

- the section between Dalgopol – Komunari stations is equipped with Semi-Automated Blocking System, in good operational condition and of no relevance to the permitted railway accident.

- The two stations of Dalgopol and Komunari are equipped with Route-Relay Centralization Systems, which are in good technical order and have no relevance to the permitted railway accident.

8.4. Catenary – in good technical condition.

8.5. Train composition station – Razdelna.

8.6. Communication equipment and telecommunication links – in good technical condition.

8.7. Profile, geometry and layout of the railway line at the area of derailing:

- the section between Dalgopol – Komunari stations of road Nr. 2, km 88⁺³⁵⁹ is in the left bend in the direction of the train's movement, with no inclination.

8.8. Traction rolling stock:

Electric locomotives Nr. 87019.3 and Nr. 87026.8, having serviced freight train Nr. 30582, had running parts, breaking systems, light and audible signaling equipment in good operational condition, in conformity with the technical norms and requirements, which is evidenced by the records kept in the relevant logbooks, copies of which are provided together with the Report of the Operative Team.

8.9. Non-traction rolling stock:

Total number of wagons included in the composition of the train: 24 pcs., of which:

- Series Rgs, 4-axes– 13 pcs., of which 9 with GTK containers and 4 pcs. empty ones;
- Series Zagkks, 4-axes –10 pcs. full of propane-butane;
- Series Eaos, 4-axes – 1 pc., empty one, used for guarding purposes.

Before the accident wagon Nr. 84537915420-4 most probably was admitted for inclusion in the composition of freight train Nr. 30582 and travelling upon the availability of defects, cited in Art. 190, par. 1, item 1 and item 9 of Ordinance Nr. 58.

9. Observance of the procedures from the safety management systems of the National Railway Infrastructure Company and the Bulgarian Railway Company A.D. before and during the accident.

9.1. Observance of the procedures from the safety management systems of the National Railway Infrastructure Company:

The procedures and technologies of operation from the safety management systems at “Management of train trafficking and station activities” Sub-division – Gorna Oryahovitsa, operating within the structure of the National Railway Infrastructure Company, before and during the accident have been complied with. This is evidenced by the Report of the Operative Team and the additionally requested materials to the Report, as well as the interview performed by the Investigation Commission with the staff members at the stations related with the accident.

9.2. Observance of the procedures from the safety management systems of the Bulgarian Railway Company A.D.:

Freight train Nr. 30582 is composed on the sixth platform at Razdelna station, a technical examination was carried out on the train, as well as full testing of the automatic train breaker system, the train is provided with the requested tripping weight, it is accompanied by the requested train transport documents, and has departed on time in accordance with the developed traffic schedule.

The railway carrier the Bulgarian Railway Company A.D. disposes of a developed and well established safety management system in fulfillment of the requirements of the national and the European legislation. The Bulgarian Railway Company A.D. holds License for the performance of railway transport services Nr. 201/21.03.2011, as well as Safety Certificates, Part A: BG1120130001 and Part B: BG1220130001.

The “Railway Administration” Executive Agency, in its capacity of a national safety authority, performs auditing of the National Carrier on an annual basis. The last supervision audit performed on the activity of the company, as a certified body responsible for the maintenance of transport vehicles, is carried out on 07.11.2016. As a result from the performed audit, established were discrepancies for which the “Railway Administration” Executive Agency have issued recommendations and have defined deadlines for their elimination by the Bulgarian Railway Company A.D. The Bulgarian Railway Company A.D. have informed the “Railway Administration” Executive Agency about the measures undertaken for the fulfillment of the recommendations on the elimination of the established discrepancies – about partially fulfilled recommendations.

Based on the examination of the technical documentation on locomotives Nr. 87019.3 and Nr. 87026.8, no violations of the applicable Rules on plant and depot repair and maintenance of electric locomotives were established and registered.

Based on the additionally requested technical documentation from the Bulgarian Railway Company A.D. and the check made in the Register of transport vehicles it was proven that GRUP FEROVIAR ROMAN SA is the owner of the derailed wagon Nr. 84537915420-4. The latter has been subjected to an average-scale repair on 30.06.2014 by REVA – S.A. SIMERIA.

The performed review of the procedures from the safety management systems of the railway carrier the Bulgarian Railway Company A.D. proved that the staff members directly related with the realized accident have not fulfilled the requirements, stipulated thereby, namely:

- not fulfilled are the requirements of Art. 14, item 4 from the Instructions on operation of machine operators, locomotive engine drivers and assistant locomotive engine drivers (ФКО 4.2.3-1/4-2, in force as of 01.04.2016).

- not fulfilled are the requirements of Art. 5, item 1 of the Instructions on the requirements and obligations of technician-mechanics, wagon examiners (УПЖПЦ/ДВ 302-2016, in force as of 01.04.2016), in connection with Art. 190, par. 1, item 1 and item 9 of Ordinance Nr. 58/5.09.2006.

The locomotive brigades in the two locomotives, having serviced the train, were equipped with mobile phones provided by the Company.

10. Status of the railway infrastructure and rolling stock after the accident, violation of the train trafficking schedule.

10.1. Status of the railway infrastructure and rolling stock after the accident.

10.1.1. Caused damages to derailed wagon Nr. 84537915420-4:

- damaged cart – 1 pc.
- damaged wheel axes – 2 pcs.

10.1.2. Caused damages to the railway infrastructure:

10.1.2.1. Railway line and facilities:

- destruction of the railway line between the stations of Dalgopol and Komunari, road Nr. 2 from km 88⁺³⁵⁹ to km 83⁺⁸⁸², of total length 4477 m;
- damaged 3 pcs. of railway points – Nr. 3, Nr. 5 and Nr. 103 at Komunari station.

10.1.2.2. Communication equipment and communications, radio links and electric power supply – no damages caused.

10.1.2.3. Catenary – no damages caused.

10.2. Interruption of traffic and violation of the train trafficking schedule.

10.2.1. Interruption of traffic:

- as a result from the realized accident the train traffic at the section between Dalgopol and Komunari stations on road Nr. 2 is interrupted and at the time of completion of the present Report the repairing works on the railway infrastructure are still in progress.

10.2.2. Violation of the train trafficking schedule:

- train Nr. 30582 of the railway carrier the Bulgarian Railway Company A.D. + 11 minutes at Zavet station and + 59 minutes at Karnobat station;
- train Nr. 30583 of the railway carrier the Bulgarian Railway Company A.D. + 11 minutes at Asparuhovo station, + 8 minutes at Komunari station and + 16 minutes at the section between Dalgopol and Komunari stations;
- train Nr. 90570 of the railway carrier “Bulmarket Rail Cargo” EOOD + 18 minutes at Asparuhovo station and + 25 minutes at Dalgopol station;
- train Nr. 30161 of the railway carrier BDZ Passenger Transport EOOD + 12 minutes at Komunari station.

11. Direct causes for the accident.

After the performed examinations of the place of the occurrence, measurement of the parameters of the railway line and the derailed wagon Nr. 84537915420-4, the performed interview with the railway staff members having partaken in the accident, and discussing the submitted opinions of the external experts, the Technical Investigation Commission came to the conclusion that the technical cause having lead to the occurrence of the accident is: **The wagon – cistern is of visibly shifted center of gravity at a crosswise direction because of the two-sidedly established gaps in the running units of the two carts and the car, as well as the loosening of the press mounting “wheel – axis”, which have violated the distances between the bandages of the first leading wheel axis of the wagon, and thus have obstructed matching of the wagon’s cart with the bend of the railway line.**

12. Analysis of the causes having lead to the occurrence of the railway accident.

Based on the performed examinations, the additionally requested materials, as well as the additional measurements of the railway line and the derailed wagon Nr. 84537915420-4, the Technical Investigation Commission at the Ministry of Transport, Information Technologies and Communication established the following facts and circumstances:

- the derailing of the first cart of the 22-nd wagon from the composition of freight train Nr. 30582 has occurred at about 00:37 h. on 09.02.2017 at km 88⁺³⁵⁹ in the section between the stations of Dalgopol and Komunari on road Nr. 2;

- the derailing is realized at a horizontal section of the railway line in a left bend in the direction of movement of the train with radius $R=800$ m and length of 1100 m;
- the speed of train movement at the section between the stations was not excess, as the maximum permissible speed is 80 km/h (as evidenced by the complex technical expertise);
- after the derailing of the cart of the wagon the train has continued to move in the same way, and upon its passing through the entrance points Nr. 101, Nr. 3 and Nr. 5 at Komunari station the derailed cart has climbed on point Nr. 5 again on the rails.
- after climbing of the cart the train has continued its movement to Karnobat station, where the wagon was taken off from the composition of the train. Meanwhile the train was stopped out of schedule at Zavet station, for the performance of technical examination.

12.1. Analysis of the railway line.

For establishing of the causes having lead to the derailing accident, the place of derailing was subjected to detailed survey and additional measurements in respect of the technical condition of the railway line, which is located in a bend with radius $R=800$ m in a horizontal section (Figure 2).

Per its structural type the railway line is joined, clad on reinforced concrete sleepers and joint timber sleepers at the places of the joints. The individual units are made of rails, type S49, 25 m long, and reinforced concrete sleepers, 40 pcs. in one unit. Fixing of rails to sleepers is carried out via fixing units of ПAK-68И type, and the joints are connected via iron connectors with 4 pcs. joint bolts each.

The joints are supported by joint timber sleepers, with the exception of a floating joint near point (-5), which has 4 joint bolts and has no vertical and horizontal overlaps between the connected rails on the two sides of the joint. The fixing sets of the railway line are found in a good technical state and no fixing sets are missing. The railway line is well ballasted, without visible mudding of the ballast prism. The major geometric parameters determining the technical condition of the railway line are: distance between rails, level (longitudinal and crosswise), situational layout of the railway line, as well as wear and tear of rails (sidedly and vertically), especially in bends with radiuses smaller than $R=500$ m on the external rail parts, which are attacked by the leading wheels of the wheel axes of the carts.



Figure 2

12.1.1. Distance between rails:

Based on the measured values of this parameter, registered in the Protocol of Findings on the measurement of the railway line, elaborated by the Operative Team, it becomes clear that the maximum registered distance between rails is 1460 mm at point 13 and point 14, located respectively at the 12-th and the 13th meter from the point of raising/climbing (point "0"). The value of 1460 mm in the two points does not contradict with the requirements stipulated by the Instructions on the arrangement and maintenance of the upper structure of the railway line and the railway points, where provided are up to 1465 mm for railway lines of the 1-st and the 2-nd class.

12.1.2. Level of the railway line

For attenuating of the centrifugal (side) accelerations in the bends, provided is normal (surpass) height, calculated after the formula:

$$H = 8 \frac{V^2}{R};$$

where,

V = traffic speed in the relevant section between stations;

R = radius of the relevant bend.

In the case, the traffic speed in the section according to the book schedule is $V=80$ km/h and the radius of the bend is $R=800$ m. According to the requirements of the Instruction, the height of the bend shall be $H = 65$ mm.

For calculating of the transitions on the basis of central roll bearers and on the basis of the cart of the derailed wagon, the values of the height have to be adjusted with the measured covered lowerings, as follows:

Point (0) = remains with unchanged height $H=63$ mm because of the equal covered lowerings;

Point (8) = upon measured $H=58$ mm becomes 56 mm

Point (2) = upon measured $H=62$ mm becomes 61 mm

Point (-2) = upon measured $H=64$ mm becomes 66 mm.

Calculated transitions on the basis of central roll bearers:

a) before raising:

Point (0): $H=63$ mm; point 9: $H=57$ mm, Difference = 6 mm

$$K = \frac{L}{H} = \frac{9\text{m}}{6\text{mm}} = \frac{9000\text{mm}}{6\text{mm}} = 1500; \text{Inclination } K = \mathbf{1: 1500}$$

b) after raising:

Point (0): $H=63$ mm; point (-9) = 61 mm, Difference = 2 mm

$$K = \frac{L}{H} = \frac{9\text{m}}{2\text{mm}} = \frac{9000\text{mm}}{2\text{mm}} = 4500; \text{Inclination } K = \mathbf{1: 4500}$$

Calculated transitions on the basis of derailed cart:

a) before raising:

Point (0): $H=63$ mm, point 2 = 62 mm, Difference = 1mm

$$K = \frac{L}{H} = \frac{1,8\text{m}}{1\text{mm}} = \frac{1800\text{mm}}{1\text{mm}} = 1800; \text{Inclination } K = \mathbf{1: 1800}$$

b) after raising:

Point (0): 63 mm, point (-2) = 66 mm; Difference = 3 mm

$$K = \frac{L}{H} = \frac{1,8\text{m}}{3\text{mm}} = \frac{1800\text{mm}}{3\text{mm}} = 600; \text{Inclination } K = \mathbf{1: 600}$$

Calculated transitions on the basis of central roll bearers:

a) before derailling:

Point (-6): $H=67$ mm, point 3 = 62 mm, Difference = 5 mm

$$K = \frac{L}{H} = \frac{9\text{m}}{5\text{mm}} = \frac{9000\text{mm}}{5\text{mm}} = 1800; \text{Inclination } K = \mathbf{1: 1800}$$

On the basis of first cart

b) after derailling:

Point (-6): $H=67$ mm, point (-4) = 67 mm, Difference = 0 mm.

Based on the measured parameters of the railway line, expressed in 29 points in the interval between point (-8) and point (20), the mean arithmetical value of the (surpass) height in the bend is $H=60$ mm.

On this basis, the measured values for the level of the railway line, reaching maximum value of 67 mm and minimum value of 52 mm at the measured points exhibit that per its level the railway line is in conformity with the requirements stipulated in the Instructions. The performed calculations prove also fulfilling of the requirements on the inclination of the transition at height of the railway line.

12.1.3. Situational layout of the railway line:

The situational layout of the railway line is controlled through Flesh measurement differences. As the bend is of radius $R=800$ m, for Flesh measurement a cord of length $S=20$ m is used, and for assessing the condition of the bend data from the Flesh measurements at each 10 m is used. Here the first point with measured Flesh is point Nr. 4 and all remaining points up to point Nr. 20. The measured values from point 3 to point -20 are not taken into consideration, as upon

the measurement one of the metering devices is fixed at the area where the railway line is destructed.

The Protocol of Findings of the Operative Team on the condition of the railway line exhibits that the greatest difference, calculated after the formula $\Delta f = |f_1 - f_2|$ at two neighboring points for the ring bend is between point 4 with Flesh = 59 mm and point 14 with Flesh = 87 mm, with difference of 28 mm. This value is smaller than the permissible limit value of 31 mm for speeds $V = 60 - 80$ km/h, in accordance with the Instructions on the arrangement and maintenance of the upper structure of the railway line and the railway points.

12.1.4. Wear and tear of rails:

From the performed measurements of the railway line it becomes evident that before the point of raising (point 0) the maximum side wear at point 8 is 8 mm, and the vertical wear is 1 mm at points 2, 6, 7, 8, 9, 10. There are no bigger values than these ones before and after the derailing accident. The permissible side wear a_c of the rail head depends on the vertical wear a_b , namely upon vertical wear of 1 mm the permissible side wear is up to 13 mm for rails of S49 type. The permissible wear, where there is no vertical wear, is up to 13,5 mm.

Wear values are calculated after the following formula:

$$a_{np} = a_b + k \cdot a_c,$$

where,

$k = 0,36$ for rails of type 41 and heavier ones (in the case, of S49 type).

Let's consider points 6 and 7 before raising, where $a_c = 7$ mm and $a_b = 1$ mm. These are the points of the greatest side and vertical wear.

$$a_{np} = a_b + k \cdot a_c = 1 + 0,36 \cdot 7 = 1 + 2,52 = 3,52 \text{ mm.}$$

Based on the performed calculations, the wear of rails is much smaller than the maximum permissible wear – 11 mm for speed of $V=80$ km/h, which for the particular case is within the standard limits, in accordance with the requirements of the Instructions on the arrangement and maintenance of the upper structure of the railway line and the railway points.

12.1.5. Description of the derailing accident

It's well known that upon the movement of rolling stock at railway bends, the ledges of the external wheels of the relevant cart closely touch the working internal part of external rails.

What's particular in the case is that initially at point "0" the left wheel of the first wheel axis climbs on the head of the left rail in the direction of traffic, but later first derails the leading right wheel, because of the following circumstance.

The leading right wheel of the first wheel axis of the first cart is with closely pressed ledge to the working part of the head of the right rail. The situation of the ledge of the left wheel of the same wheel axis is directly dependent on the value of the measured distance between rails at the point of raising/climbing, as well as on the gap between the ledge and the working side of the left rail.

At the point of raising/climbing – point "0", upon width of wheel bandage of 136 mm of the first leading wheel axis according to the measured distance between rails of 1452 mm, thickness of ledge of the left wheel of 29 mm and width of the head of rail – 67 mm, the gap between the working side of the left rail and the external edge of the ledge is 28 mm, while at the point of derailing this gap is 25 mm.

Upon the above parameters, for derailing of the right wheel first requested is side shifting of 106 mm, and for derailing of the left wheel - requested is side shifting of 121 mm, which confirms that the right wheel has derailed first, and in view of the great speed - thereafter immediately the left wheel has derailed as well. After 1,60 m between point 7 and point 8 the second wheel axis of the same cart has derailed as well.

The performed several surveys of the place of the accident, the executed measurements of the railway line and calculations evidence that the railway line is in conformity with the norms and standards, as stipulated by Ordinance Nr. 58 and the Instructions on the arrangement and maintenance of the upper structure of the railway line and the railway points.

12.2. Analysis of the rolling stock.

The Technical Investigation Commission at the Ministry of Transport, Information Technologies and Communication got comprehensively acquainted with the technical condition of the derailed wagon Nr. 84537915420-4, type Zagkks, the circumstances preceding the derailing accident, as well as the actions of the locomotive brigades and the staff members of the National Railway Infrastructure Company.

For establishing of the technical condition of the wagon after the derailing accident, the Commission performed several field comprehensive examinations and measurements of the wagon-cistern and after the replacement of the derailed cart the measurements of the major controlled parameters of the wagon and the wheel axes were repeated.

Upon front viewing of the wagon from the buffer side, while standing on a straight horizontal railway platform, it became noticeable that the car and the frame of the wagon stay inclined (Figure 3) on one side (on the left). Later it was established that this is the side where the damaged wheel is found at the first axle box of the first wheel axis (Figure 4).

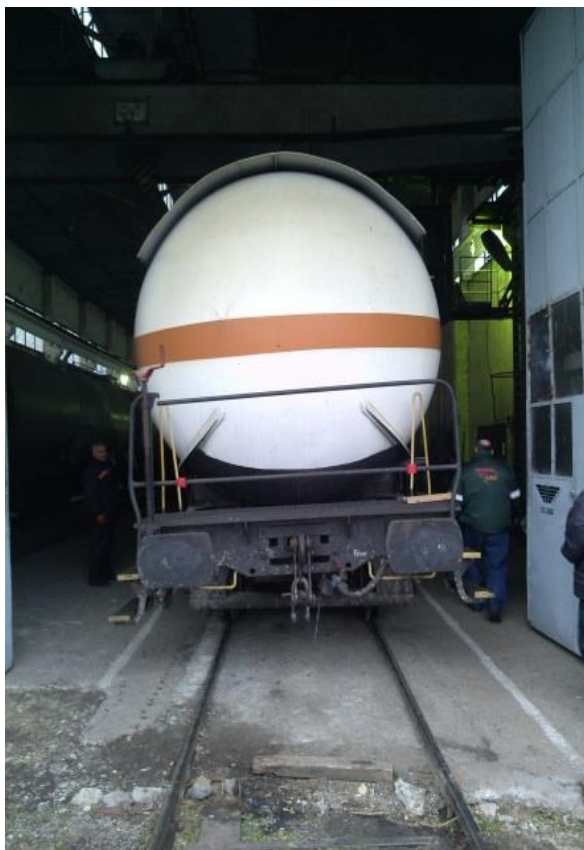


Figure 3



Figure 4

From the performed detailed examination of the wagon's running parts it was proven that the runners (the supports on which the wagon's car and frame lay on the cart's frame) on the side of the damaged wheel are strongly worn out and damaged on the first cart (Figure 5), as well as on the second cart (Figure 6).



Figure 5



Figure 6

At the same time the gap (the distance) between the runners on the other side of the wagon is more than 30 mm, which is much more than the maximum permissible value, as stipulated by Ordinance Nr. 58 (Figure 7).



Figure 7



Figure 8

All these factors have lead to the inclination of the wagon's car on one side, and in such manner the wagon has travelled for a long time, a proof of which are the established old traces on the runners having caused their deformation. In the process of examination it was proven that the frames of the wagon and the derailed cart are covered with white-colored dust from the ballast prism. Also there were stones left on the cart's frame, there were distorted elements from the beams of the wagon's frame (Figure 8), as well as torn parts from the lever breaking system (Figure 9). All these damages are caused by the derailling of the cart and the next long travel over the ballast prism of the railway line. The Commission examined the condition of the wagon's wheel axes and proved that the ledges of the wheels of the derailed cart are hurt with the movement on the ballast prism and the sleeper' grid on the railway line, which makes them improper for operation (Figure 10). A substantial fact, proven upon the examination, was the condition of the right wheel on the first wheel axis of the wagon's first cart. It was established that the press joint which holds the wheel to the axis, has defected, as a result of which the wheel has shifted to the outside from its normal position in an axial direction at several millimeters (Figure 11).

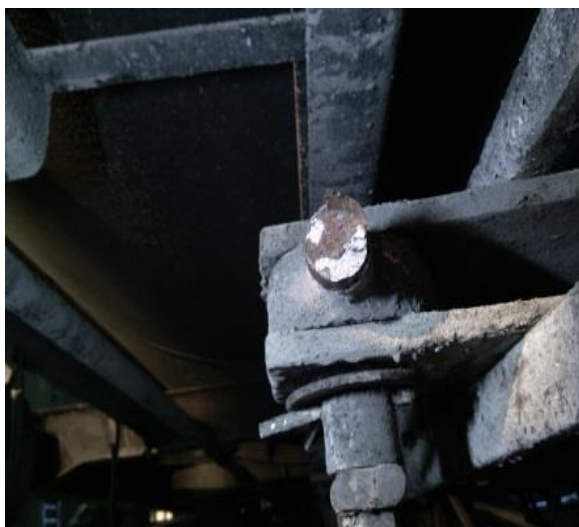


Figure 9



Figure 10

This fact was confirmed also upon the measurement made by the Operative Team, working at field at the same time, and was documented by the Protocol of Findings on the condition of the derailed wagon.

The values of all measured parameters are not in conformity with the parameters stipulated by Ordinance Nr. 58.

The cause having lead to the derailing of the cart is complex, determined by several substantial elements:

- The increased distance between the wheels of the wheel axis;
- Problematic rotation of the cart, resulting from the deteriorated condition of the runners;
- Shifted center of gravity of the wagon-cistern at crosswise direction because of the worn runners and the centrifugal force acting upon the wagon in the bend where the accident has occurred.



Figure 11

Because of the combined impact of the above mentioned elements, the first wheel axis of wagon Nr. 84537915420-4 has occupied a position where, instead of the external (right) wheel in the direction of movement touching the rail, this was made by the internal (left) wheel. As a result of the decreased loading of the left wheel and because of the action of the centrifugal force, it has raised/climbed over the rail's head. As the cart had not had the requested torque, which was to direct it on the longitudinal axis of the wagon, it has continued its movement on the same trajectory. Because of the exhaustion of the reserve gap, including the width of the wheel (136 mm) and the distance between the rail lines, and because the internal (left) wheel was free from the horizontal reaction, as the ledge was moving over the head of the internal rail, at a particular moment the external (right) wheel has dropped on the ballast prism and has started rolling over it. After a while the internal left wheel also falls on the sleeper's grid outside the space between rails and starts rolling over the sleeper's grid and the ballast prism. At a next moment the whole cart is on the sleeper's grid, and thus the wagon has been moving for 4477 km. The whole process is evidenced by the traces left on the ledges of the wheels of the first cart. Upon its entrance in Komunari station, the cart passes through points Nr. 103, 3, 5 by consecutively climbing on and falling from the railway. The position of the above points has favored this process, and finally, upon passing through point Nr. 5 in its crosswise part, the wagon is found again on the rails, thus continuing its unprevented movement.

As evidenced by the elaborated technical expertise based on the speed metering installations of the two locomotives, it was established that the locomotive engine drivers have observed the permissible speed, have not performed any abrupt pulls and have not activated the

breaking system for adjusting the speed of the moving train, which has trafficked with comparatively constant speed in the railway section of consideration.

13. Recommendations and proposals for measures preventing other accidents of a similar nature.

For preventing the occurrence of other accidents of a similar nature in the future, in relation with the requirements of Art. 94, par. 1 of Ordinance Nr. 59 dt. 05.12.2006 on safety management in the railway transport, issued by the Minister of Transport, the "Railway Administration" Executive Agency shall order to the Bulgarian Railway Company A.D. and the National Railway Infrastructure Company the fulfillment of the rendered safety recommendations.

1. Refreshing the knowledge and drawing the attention of staff members from the Bulgarian Railway Company A.D., responsible for the performance of technical examinations in the border transit points upon entry of railway transport vehicles, owned by foreign railway carriers, operating on the railway infrastructure of the Republic of Bulgaria.

2. The locomotive engine drivers shall look for any peculiarities having occurred during movement of the trains driven on their part, and when observing any irregularities in the rolling stock, the locomotive engine drivers shall take timely measures for stopping of the rolling stock, aimed at prevention of accidents and incidents.

3. Implementation on the railway infrastructure of an automated monitoring and control system of the rolling stock in movement, to signal for any damages having occurred on the running parts of the rolling stock (wheel axes, axle/grease boxes, suspension and unevenly loaded wagons).

In connection with the requirements of Art. 94, par. 3 of Ordinance Nr. 59 dt. 05.12.2006 on safety management in the railway transport, up to 30.10.2017 the "Railway Administration" Executive Agency, the Bulgarian Railway Company A.D. and the National Railway Infrastructure Company shall inform in writing the Chairman of the Investigation Commission at the Ministry of Transport, Information technologies and Communication on the undertaken measures on the fulfillment of the rendered safety recommendations.

Chairman,

D-r Eng. Boycho Skrobanski

State investigation inspector at MTITC

I, the undersigned, Ventseslava Mihailova Mishlyakova certify the truthfulness of the translation made by me from Bulgarian into English of the enclosed document. The translation consists of 18 pages.

Sworn translator:

Ventseslava Mihailova Mishlyakova

