



**REPUBLIC OF BULGARIA**  
**NATIONAL AIR, MARITIME AND RAILWAY TRANSPORT, ACCIDENTS**  
**INVESTIGATION BOARD (NAMRTAIB)**

9 Dyakon Ignatiy str., Sofia 1000  
tel. (+359 2) 940 9317  
fax: (+3592) 940 9350

[bskrobanski@mtc.government.bg](mailto:bskrobanski@mtc.government.bg)  
[bskrobanski@abv.bg](mailto:bskrobanski@abv.bg)

**FINAL REPORT**

of

**Investigation of railway accident – derailment of IDFT № 46660 between the stations Lyubenovo  
transmission station – Radnevo on 03.02.2024**



**Sofia 2024**

## **OBJECTIVE OF INVESTIGATION AND EXTENT OF RESPONSIBILITY**

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

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

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

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

## TABLE OF CONTENTS

<b>Nº</b>	<b>Title of section</b>	<b>Pg.</b>
<b>1.</b>	<b><u>Summary</u></b>	<b>5</b>
1.1.	<i>Brief description of the event</i>	5
1.2.	<i>Location and time of the event occurrence</i>	5
1.3.	<i>Factors determining and contributing the event</i>	7
1.4.	<i>Direct causes and consequences of the event</i>	7
1.5.	<i>Safety recommendations and addressees to which they are addressed</i>	7
<b>2.</b>	<b><u>Investigation</u></b>	<b>8</b>
2.1.	<i>Decision for starting the investigation</i>	8
2.2.	<i>Motives for the decision to initiate the investigation</i>	8
2.3.	<i>Scope and restrictions of the investigation</i>	8
2.4.	<i>Competences of the persons, involved in the investigation</i>	8
2.5.	<i>Communication and consultations with the persons and entities, involved in the event</i>	8
2.6.	<i>Degree of cooperation from the participating entities</i>	9
2.7.	<i>Methods and techniques of investigation and analysis</i>	9
2.8.	<i>Difficulties faced during the investigation</i>	14
2.9.	<i>Interaction with the judicial authorities</i>	14
2.10.	<i>Other important information for the investigation context</i>	14
<b>3.</b>	<b><u>Description of the event</u></b>	<b>17</b>
3.1.	<i>Information on the event and the context</i>	17
3.2.	<i>Factual description of the occurred</i>	25
<b>4.</b>	<b><u>Analysis of the event</u></b>	<b>28</b>
4.1.	<i>Participation and responsibilities of the entities, involved in the event</i>	28
4.2.	<i>Rolling stock and technical facilities</i>	40
4.3.	<i>Human factor</i>	41
4.4.	<i>Feedback and control mechanisms, including risk and safety management as well as monitoring processes</i>	46
4.5.	<i>Previous similar cases</i>	49
<b>5.</b>	<b><u>Conclusions</u></b>	<b>50</b>
5.1.	<i>Summary of the analysis for the event causes</i>	50
5.2.	<i>Undertaken measures after the event occurrence</i>	50
5.3.	<i>Additional findings</i>	50
<b>6.</b>	<b><u>Safety recommendations</u></b>	<b>51</b>

## ABBREVIATIONS, USED IN THE REPORT

SE NRIC – State enterprise „National railway Infrastructure Company“(railway infrastructure manager)  
„DB Cargo Bulgaria” EOOD – Railway undertaking for freight services  
RS – Railway section  
HSLC – Healthy and safe labour conditions  
RTA – Railway Transport Act  
TOU – Traffic organization unit at SE NRIC  
km – Kilometre along the rail track  
OCL – Overhead contact line (catenary)  
EoTC – End of transitional curve  
MoI – Ministry of Interior  
IDFT – International Direct Freight Train  
Ordinance № 59 – Ordinance on the rail transport safety management  
Ordinance № 58 – on the rules for the technical operation, train traffic and signalling in the rail transport  
NAMRTAIB – National Air, Maritime, and Railway Transport Accidents Investigation Board  
(Independent Specialized National Investigation Body)  
BoTC – Beginning of transitional curve of the rail track  
RAEA/NSA – Railway Administration Executive Agency, National Safety Authority  
TF – Task Force  
SE – Signalling equipment  
RRS – Rail Rolling Stock  
TOMR – Train operation management and reporting  
RWCO – Repair Workshop Central Office – Karlovo at „DB Cargo Bulgaria” EOOD  
RMoKD – Relay management of key dependence  
MSL – Manual switch locker  
SMS – Safety Management System  
ECM – Entity in Charge of Maintenance  
TRMS – Train resource management system  
TMWI – Technician mechanic wagon inspector  
TOSAMD – Train operation and station activity management Division  
DCCM – Device for communications, connections and messages in stations  
CDG – Central dispatching guide of the railway infrastructure manager at SE NRIC

## **1. Summary**

### ***1.1. Brief Description of the Event.***

On 03/02/2024 at 06:50 a.m., IDFT No. 46660, consisting of 32 wagons, 64 axles, 576 meters, 898 tons, served by locomotive No. 91523186012-2 of the railway company "DB Cargo Bulgaria" EOOD. At the Kapikule station, before the departure of the train, the inspector of wagons of the railway enterprise "DB Cargo Bulgaria" EOOD performed a technical inspection. The train arrived at 07:15 a.m. at the Svilengrad border station - Republic of Bulgaria. After the arrival of the train at the Svilengrad station, customs and border inspections were carried out and the locomotives were exchanged with another locomotive No. 91521688030-1. A "D" test of the automatic train brakes was performed before the train departure.

IDFT No. 46660 departed from Svilengrad station at 08:54 a.m., served by locomotive No. 91521688030-1 with a locomotive driver and an assistant locomotive driver, employees of "DB Cargo Bulgaria" EOOD. According to data from the station diaries of TOSAMD Plovdiv, the train arrived at Lyubenovo transfer station at 09:58 a.m. and, after a 7-minute stay, it departed at 10:05 a.m. for Radnevo station. For the passage of the train through the Radnevo station, the traffic manager on duty ordered at 10:10 a.m. with a telephone message to the switchman/crossing guard at Post No. 2 for the arrival of IDFT No. 46660 on the second free main track.

At 10:17 a.m., the switchman/crossing guard at Post No. 2 ordered a route and opened an entrance signal for the second track.

Switchman/crossing guard at Post No. 2 tracked the passage of the train. He saw that the wagon before the last one had derailed and tried to notify the traffic manager on duty in the station (according to his testimony).

When IDFT No. 46660 entered the second track at Radnevo station, the traffic manager on duty noticed heavy dusting and twisting of the last two wagons of the train. As the last two wagons passed through the technical canal of the track, a side door detached from the 31<sup>st</sup> wagon, then a second door fell, and the last 32<sup>nd</sup> wagon climbed onto the platform and tilted to the left in front of the station building. The engine driver sent the train pulling and made a quick stop.

The traffic manager on duty informed the train dispatcher about the occurred accident and submitted information to the national emergency number 112.

During the time of the movement, the train kept the section speed and reductions from Svilengrad station to Radnevo station.

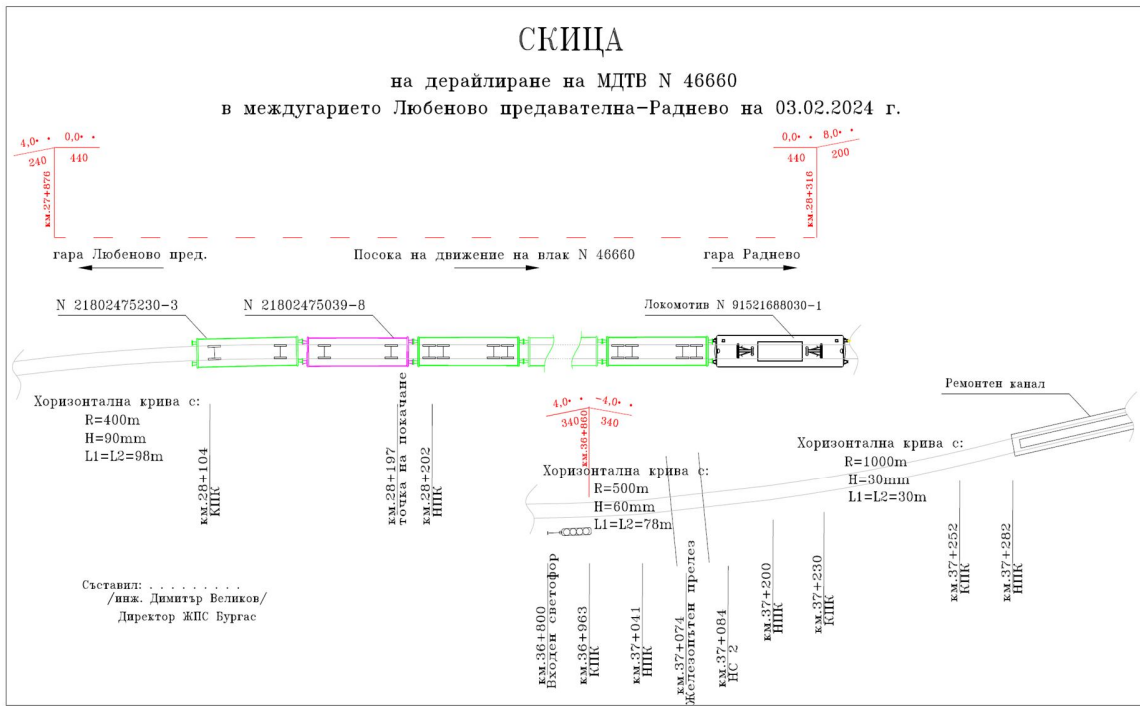
Because of the derailment, material damage was caused to the rail track, the railway switches and the signalling equipment at Radnevo station, as well as to the two derailed wagons. There were no injured personnel.

The train movement in the Simeonovgrad - Nova Zagora section was interrupted from 10:20 a.m. on 03/02/2024 to 15:00 p.m. on 04/02/2024.

The train movement in the Lyubenovo transfer station - Radnevo interstation in the derailment zone has been restored from 15:00 p.m. on 04/02/2024 at 25 km/h, the movement through Radnevo station has been restored on the fourth deviation track with a speed of up to 15 km/h and traffic in the Simeonovgrad - Nova Zagora section has been restored.

### ***1.2. Location and time of the event occurrence.***

The event occurred between the Lyubenovo transmission stations - Radnevo station at km 28+197 in a transitional curve at 10:28 a.m. on 03/02/2024. The derailment zone of the wagons is in a right curve with length  $L=98$  m, radius  $R=400$  m, super elevation  $H=90$  mm and profile  $=0$  ‰. The rail track is laid with rails type S49 – 25 meters, reinforced concrete sleepers mixed type ST-4 and ST-6, fasteners mixed type PAK-68I and SKL-14 (fig. 1.1 and 1.2.).



**Fig. 1.1. Scheme of the derailment location of IDFT № 46660**

The stations Lyubenovo transmission and Radnevo are located in the section Simeonovgrad – Nova Zagora on 83<sup>rd</sup> deviation. The line is conventional, single-track, electrified, with movement speed up to 60 km/h. The line performs between the 1<sup>st</sup> and 8<sup>th</sup> main conventional lines.



**Fig. 1.2. The area of derailment of wagon № 21802475039-8 of IDFT № 46660**

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

1.3.1. A cause-and-effect factor for the derailment is a combination of vertical forced oscillations of the wagon (galloping) caused by the beaten tracks of the rail track with horizontal movement of the second track axis of the penultimate wagon to the right (inner) rail, due to the appearance of a horizontal transverse force before exiting the transition curve.

1.3.2. A contributing factor is the low gross weight of the two-axle wagon (empty) and the characteristics of its spring suspension, filled with parabolic springs with bilinear characteristics.

### **1.4. Direct causes and consequences of the event.**

A combination of the vertical forced oscillations of the wagon (galloping) caused by the beaten tracks of the rail track with the horizontal movement of the second track axle of the penultimate wagon towards the right (inside) rail due to the appearance of a horizontal transverse force before exiting the transition curve, supplemented by the small gross weight of the two-axle wagon (empty) and the features of its spring suspension filled with parabolic springs with bilinear characteristics.

Because of the event, about 9 km of rail track between Radnevo station and Lyubenovo transmission line was slightly damaged, switches No. 2 and No. 4 at Radnevo station, part of the rail track on the second track at Radnevo station, damaged elements of the signalling equipment and partial damage to passenger platforms at Radnevo station.

### **1.5. Safety recommendations and addressees to which they are addressed.**

In order to prevent other similar accidents, the Chairman of the Investigation Commission proposes to the National Safety Authority (RAEA) safety recommendations related to the SE NRIC and "DB Cargo Bulgaria" EOOD.

- Recommendation 1, proposes that SE NRIC and "DB Cargo Bulgaria" EOOD familiarize the interested personnel with the content of this report.

- Recommendation 2, proposes that "DB Cargo Bulgaria" EOOD, when accepting rolling stock at the border stations, which will be served by the railway company, to increase the quality and control when performing technical inspections.

- Recommendation 3, it is proposes that SE NRIC analyses the data provided by the licensed independent body "TINSA" Ltd., measured with the Track Measuring Laboratory EM-120 on 14.11.2023 at the Lyubenovo transfer station - Radnevo interstation and take measures to remove the vertical deformations of the rails in the joints exceeding the requirements of class "C" for speed  $\leq 60$  km/h.

- Recommendation 4, proposes that SE NRIC harmonizes the differences in the parameters for permissible deviations in the level of the instructions between the "Instruction for the construction and maintenance of the superstructure of the rail track and railway switches" and the "Temporary instruction for the evaluation of the rail track with the Track measuring laboratory" EM-120 Plasser & Theurer" at different speeds.

- Recommendation 5 proposes that SE NRIC increases the control to the "Transportation Safety" service (Chief Inspector of the RITS) regarding the quality when preparing the reports under Appendix 7, as well as the precise, complete and accurate completion of the finding protocols according to the presented samples in Ordinance No. 59.

## **2. Investigation**

### ***2.1. Decision for starting the investigation.***

Decision to initiate a safety investigation was made by the member of Management Board of the NAMRTAIB in the Republic of Bulgaria, leading the investigation of railway accidents and incidents, given the severity of the accident and its impact on the railway safety. The investigation was focused on the organization of operation of platform wagons specialized for transport of BTC, aiming at the prevention of serious accidents

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

The member of the Management Board of the NAMRTAIB, leading the railway investigation section, took the decision to initiate the investigation based on art. 20, paragraph 2 (a) of Directive (EU) 2016/798, art. 115к, paragraph 1, item 2 of RTA, and art. 76, par. 1, item 2 of Ordinance No 59 dated 5.12.2006 after the performed inspections at the place of the accident and performed measurements of the rail track and the derailed RRS as well as the collected and analysed information.

### ***2.3. Scope and restrictions of the investigation.***

The scope of the investigation examined and analysed the rail system related to the maintenance and operation of freight wagons and the maintenance and operation of the rail infrastructure in the accident area of 83<sup>rd</sup> deviation, as well as the safety management system (SMS) of both entities.

The investigation is undertaken taking into account the circumstances and causes that led to the occurrence of the accident - derailment of two wagons from the composition of IDFT No. 46660, which led to material damage to the rail track, the signalling equipment at Radnevo station and the derailed two wagons owned by DB Cargo AG-Germany .

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

The member of the Management Board of the NAMRTAIB, head of the railway transport unit headed the Investigation Commission. The members of the Commission are independent external experts - qualified persons from higher transport educational institutions, scientific circles, experts with qualifications in the field of railway infrastructure and rail rolling stock, hired with civil contracts until the completion of the investigation.

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

The Commission determined the parameters of the investigation and coordinated its actions with the Task Force, which included representatives of the entities involved in the accident ("DB Cargo Bulgaria" EOOD and SE NRIC). The Task Force collected the necessary documents and samples, written statements of the personnel involved in the accident, the records from the recording devices of the train locomotive No. 91521688030-1, hauling the IDFT No. 46660. The materials and documents were handed over to the Chairman of the Commission for Investigation in the NAMRTAIB. The Chairman of the Investigation Commission requested and received from the railway enterprise "DB Cargo Bulgaria" EOOD the records from the GPS system, registered on 03/02/2024, to establish and confirm the movement of train locomotive No. 91521688030-1, hauling IDFT No. 46660. The Chairman of the Investigation Commission conducted on the spot an interview with the manager of the railway section responsible for the repair and maintenance of the rail track. An interview was also conducted with the central dispatching management of the train movement, as well as with the Unit for the operational movement of trains in Plovdiv, related to the accident. SE NRIC was requested and provided information about the actual movement of the train (a sample from the EMS system). Information about the repair and maintenance of the rail track in the Lyubenovo transfer station - Radnevo interstation was requested and provided by the SE NRIC. The latest measurements of the rail track were requested and provided by the licensed independent body "TINSA" EOOD with the EM-120 Track Measurement Laboratory in the section of the 83<sup>rd</sup> deviation Simeonovgrad - Nova Zagora. Information on the registration, ownership, repair and maintenance of the two derailed wagons was requested and provided by DB Cargo AG-Germany. An interview was conducted with the safety authority and with the management of the railway company "DB Cargo Bulgaria" EOOD.



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

During the investigation, the management of the railway company "DB Cargo Bulgaria" EOOD provided full assistance and the necessary materials and documents to the Investigation Commission at the NAMRTAIB. In RBCO-Karlovo of "DB Cargo Bulgaria" EOOD, weight measurements of the derailed wagon No. 21802475039-8 were carried out in the presence of the Task force and the Investigation Commission in the NAMRTAIB. In RBCO-Karlovo, full access was provided to the Investigation Commission and the Task Force during the measurements of the derailed wagon. The Investigation Commission was provided with documents and materials regarding the legal capacity and training of the personnel involved in the accident.

In accordance with the requirements of Ordinance No. 59, the Task force supported the work of the Investigation Commission. The Task force with the representatives of the entities involved in the accident prepared a report on the facts and circumstances of the accident according to a model, and the chair submitted, with a handover protocol, a report with the documents and materials collected to it to the chair of the Investigation Commission at the NAMRTAIB.

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

On 03/02/2024 at 10:49 a.m., the member of Management Board of the NAMRTAIB, with the competence to investigate railway accidents, was notified via mobile phone by SMS by the senior dispatcher on duty in the CDM at the railway infrastructure manager about an accident with the following text:

"At 10:21 a.m., upon entering Radnevo station, derailment of the last two wagons (empty) was detected. The Lyubenovo transmission station - Radnevo movement has been suspended."

Given the requirements of Ordinance No. 59 to officials on the safety of transport to the manager of the railway infrastructure, the initial information received about the accident was not analyzed, which prevented the notification of the member of Management Board of the NAMRTAIB with competence to investigate railway accidents and he did not classify the event. Chief Safety Inspector RI "Transportation Safety" Plovdiv appointed a Task force IInd category, without agreeing with the member of Management Board of the NAMRTAIB with competence to investigate railway accidents.

With which the requirements of Art. 71, para. 1 and para. 2 of Ordinance No. 59 were not met.

At 15:33 p.m. on 03/02/2024, IDFT No. 46660 with 30 wagons left Radnevo station for Giurgiu station (Republic of Romania).

On 04.02.2024, the member of Management Board of the NAMRTAIB with external experts on RRS and rail track left for the scene of the accident. Upon arrival at Radnevo station, the head of the investigation at the NAMRTAIB collected operational information from the Central Railway Station in Sofia and from the train dispatcher at the TOU - Plovdiv regarding the movement of IDFT No. 46660. An on-site interview was conducted with the safety representatives of the two entities. An interview was conducted with the traffic manager on duty at Radnevo station. During the inspection of the interstation, the point of rise of the right wheel of the second wheel-set of wagon No. 21802475039-8 was found on the head of the right rail at km 28+197. After 2.30 meters, the track derailed to the right of the rail thread in the direction of the train. In the presence of the Investigation Commission, a control measurement of the rail track in the derailment area was carried out. The train traveled for 9,450 meters with the derailed wheelset of the wagon. During the inspection of the train at Radnevo station, it was found that the penultimate wagon No. 21802475039-8 was the first to derail in the interstation with the second wheelset. When the wagon entered the second track, two side doors were consequently detached, because of passing through the technical canal of the second track at Radnevo station.

The last wagon No. 21802475230-3 was caught by the first derailed and it derailed with both wheel-sets while passing through the entrance switches and the technical canal of the second track and tilted to the left on the platform of the track, at which time the locomotive driver felt the pull of the train and initiated braking (Fig. 2.1).

On 04.02.2024, after the on-site inspections, the member of Management Board of the NAMRTAIB with the competence to investigate railway accidents, decided to initiate a safety investigation and notified the representatives of the two entities involved in the accident.



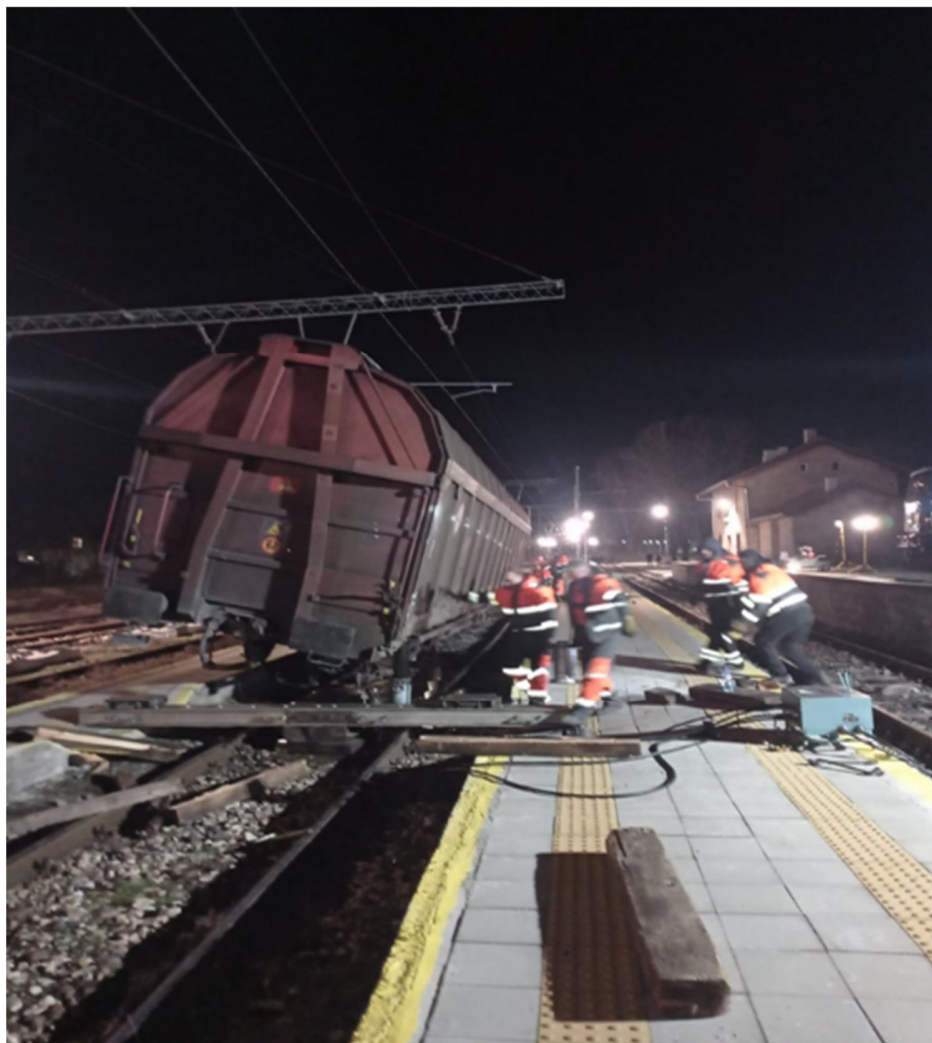
**Fig. 2.1. Derailed two last wagons of IDFT № 46660**

On 05.02.2024, at Radnevo station, the Task Force, in the presence of employees of the two entities, measured the parameters of the wheelsets of the two derailed wagons No. 21802475039-8 and No. 21802475230-3. The measured parameters of the wheelsets of the first derailed wagon No. 21802475039-8 in the interstation were within normal limits. All the sides of the wagon were badly dented and the draft gear was damaged. Movement of the wagon in that condition was impossible. That necessitated replacing the wheelsets in place with reversible wheelsets. During derailing, the four wheelsets boxes were "rotated", and in order to measure the other parameters of the wagon boxes, must have been placed under the springs.

On the same date, the Investigation Commission gave written permission to the railway company "DB Cargo Bulgaria" EOOD to safely move the derailed two wagons with No. 21802475230-3 and No. 21802475039-8 from Radnevo station to RBCO-Karlovo on "DB Cargo Bulgaria" EOOD.

On 07.02.2024 at 11:00 a.m. at Radnevo station on the 7th track with a slope of 0.5‰, Task Force with representatives of SE NRIC and "DB Cargo Bulgaria" EOOD, measured the parameters of the two derailed wagons. The results were reflected in ascertainment protocols for the technical condition of the

wagons. The Task force has decided to carry out new measurements on a straight and horizontal track with a slope of 0 ‰ after moving the wagons in RBCO – Karlovo.



**Fig. 2.2. Lifting the derailed two wagons from IDFT 46660**

On 07.02.2024, "DB Cargo Bulgaria" EOOD replaced the damaged wheelsets with reversible ones on the two wagons at Radnevo station for the purpose of safe movement to RBCO-Karlovo. After moving the wagons to Karlovo, they remained at the disposal of the Investigation Commission.

On 07.02.2024 at 17:21 p.m., by order of the train dispatcher, shunting train (ST) No. 30894 with the Radnevo - Karlovo route was assigned to the Plovdiv Railway Station. ST No. 30894 with the derailed two wagons departed from Radnevo station at 17:36 p.m. with locomotive No. 92521107613-6 and arrived at Karlovo station at 23:58 p.m.

On 15 and 16.02.2020, the Investigation Commission in RBCO-Karlovo, together with the Task Force of the two entities, carried out control measurements of the two derailed wagons and the results were reflected in the findings protocols.

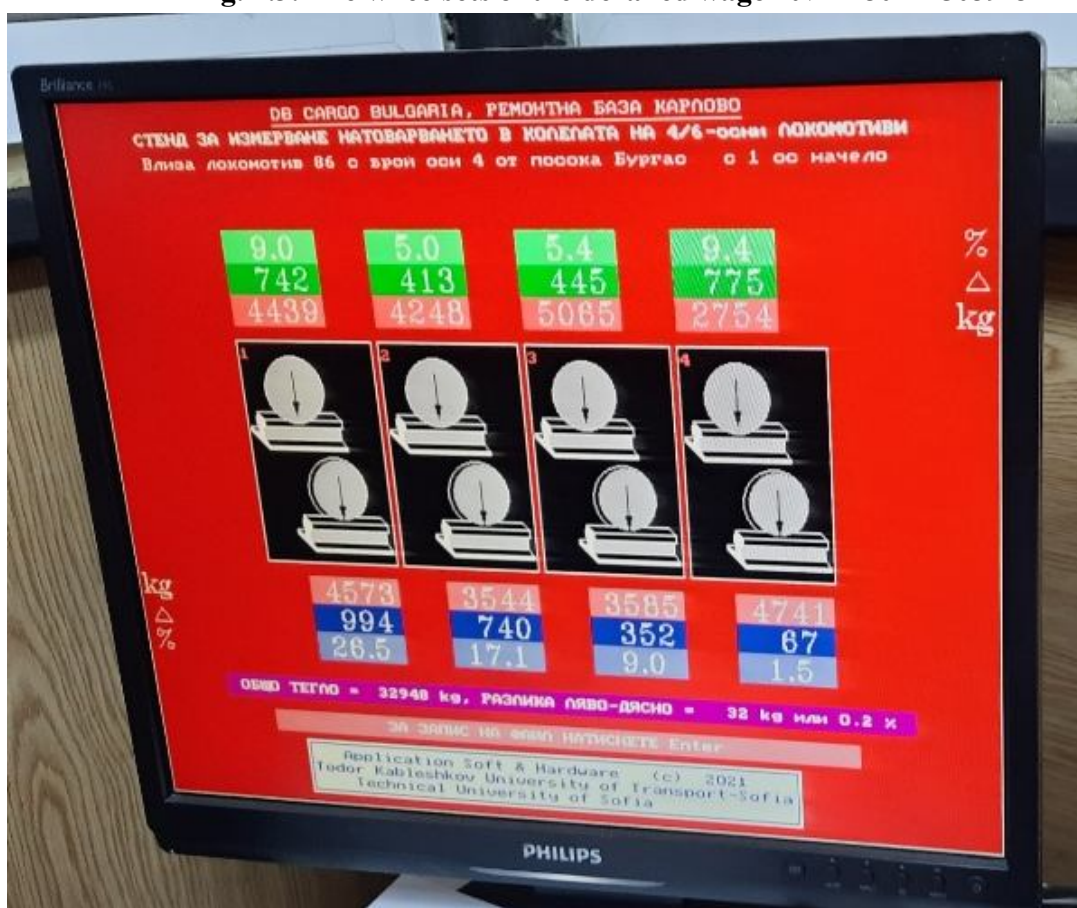
On 15.02.2024, in RBCO-Karlovo, the Investigation Commission initiated control measurements of static weighing on axles and wheels of the two wagons with installed turning wheelsets, on the certified electronic scale for measuring the static load of the locomotives owned by the railway company in the presence of the Task force and representatives of "DB Cargo Bulgaria" EOOD and SE NRIC:

- 31-st of the train composition was № 21802475039-8;
- 32-nd of the train composition was № 21802475230-3.

The established results were electronically registered in the protocol.



**Fig. 2.3. The wheelsets of the derailed wagon № 21802475039-8**



**Fig. 2.4. The measuring results of the static loading of the wheelsets of the derailed 31-st wagon № 21802475039-8 on 19.02.2024.**

The Commission accepted the results of the measurement for information and they could not serve as an evidence for the state of the static load of the wagons, due to the specifics of the electronic scale, which was designed for measuring four-axle locomotives (Fig. 2.4).

Differences in the loading of the wheels and wheelsets were found, which, because of the derailment, led to severe deformations and damage to the draft gears, as well as the missing two side doors on the left side of the wagon in the direction of the train's movement (Fig. 2.4).

On 19.02.2024, the Investigation Commission gave written permission to the railway enterprise



**Fig. 2.5. Wagon № 21802475039-8 in RBCO Karlovo after the performed repair of the draft gear**



**Fig. 2.6. The repaired draft gear of wagon № 21802475039-8 in RBCO Karlovo**

"DB Cargo Bulgaria" EOOD to start the recovery of the derailed 32nd wagon No. 21802475230-3 of the train. The Investigation Commission released the wagon from supervision and it was handed over to the railway company, the owner – DB Cargo AG-Germany.

On 09 and 10.05.2024, in the presence of the Investigation Commission in RBCO-Karlovo, after the recovery of the derailed 31st wagon No. 21802475039-8, new control static weight measurements of the electronic scale on wheels and axles were carried out for the purpose of establishing and comparing of the differences in the static load of the wheels, for which a protocol was drawn up with the reported control results (fig. 2.5, 2.6, 2.7).



**Fig. 2.7. Results from the measurement of the static loading of the wheels of № 21802475039-8 of RBCO Karlovo on 09.05.2024**

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

During the investigation of the accident, the representatives of the railway undertaking „DB Cargo Bulgaria“ EOOD, provided full assistance to the Commission for Safety Investigation. The representatives from the management level of the Transportation Safety in the SE NRIC, with their behavior, opposed unauthorized forms of interference in the work of the Investigation Commission.

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

Not applicable.

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

From the recording device of locomotive No. 91521688030-1, which served IDFT No. 46660 on 03.02.2024, the records of the train's movement were removed. The Chief Safety Inspector of the railway enterprise has handed over the records to the Chairman of the Investigation Commission in the NAMRTAIB. On the provided records from the recorder of the locomotive, the Investigation Commission performed a graphical and tabular interpretation of the movement of the train from Svilengrad station to Radnevo station.

The Investigation Commission requested and the railway company "DB Cargo Bulgaria" Ltd. handed over to the Investigation Commission the printouts taken from the GPS system for tracking the movement of locomotive No. 91521688030-1, serving IDFT No. 46660 on 03.02.2024. After decoding the data from The GPS system (Fig. 2.8, 2.9, 2.10, 2.11, 2.12) and the locomotive recorder (Fig. 2.13) were subjected to a data convergence analysis and small differences in the speed of the locomotive were found in the section from Simeonovgrad station to Radnevo station, which were within the permissible limits and it was established that the train did not stop at Lyubenovo transfer station, as reflected in the station diaries of the traffic manager on duty and the train dispatcher.



Fig. 2.8. Notifying letter from GPS Bulgaria on provision of data for the movement of locomotive № 91521688030-1 along the section from Simeonovgrad station to Radnevo station for the period from 09:30 a.m. to 10:30 a.m. on 03.02.2024

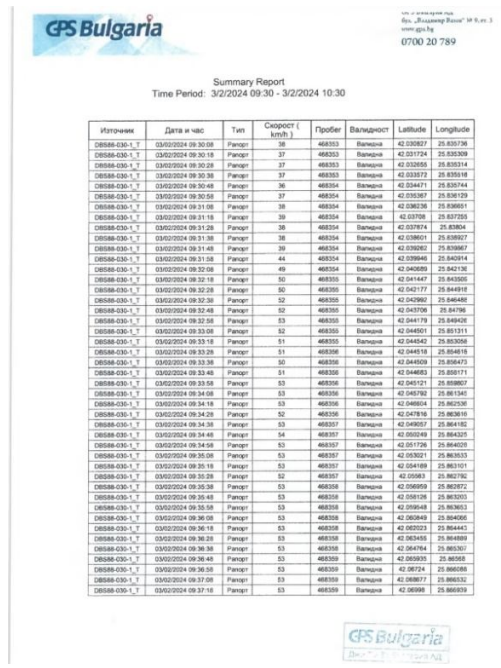


Fig. 2.9. Data on the movement of locomotive № 91521688030-1 in the section from Simeonovgrad station to Radnevo station for the period from 09:30 a.m. to 10:30 a.m. on 03.02.2024 (first part)

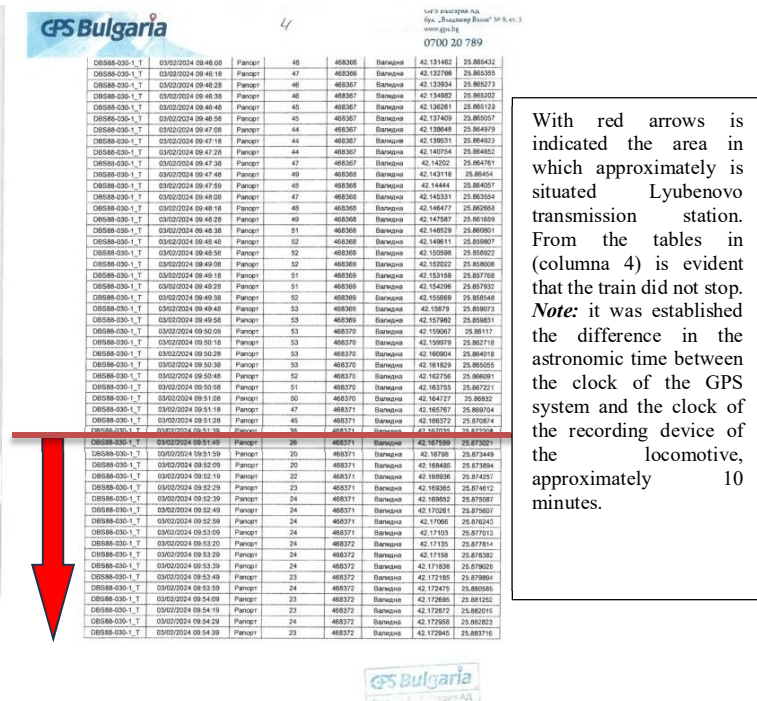


Fig. 2.10. Data for the movement of locomotive № 91521688030-1 in the section from Simeonovgrad station to Radnevo station for the period 09:30 a.m. to 10:30 a.m. on 03.02.2024 (second part)

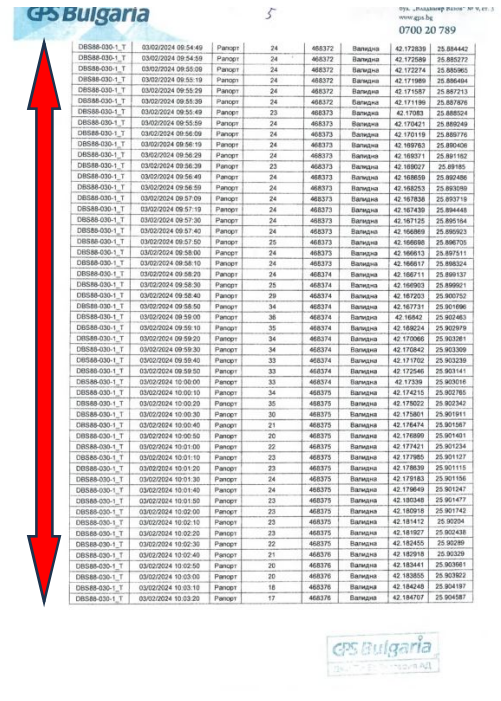


Fig. 2.11. Data for the movement of locomotive № 91521688030-1 in the section from Simeonovgrad station to Radnevo station for the period from 09:30 a.m. to 10:30 a.m. on 03.02.2024 (third part)

6

УФТ Изпитване АД  
бул. „България“ № 8, в. 3  
www.gps.bg  
0700 20 789

ID	Date	Time	Parcels	19	468376	Варшава	42.182054	25.304815
DBS88-030-1_T	03/02/2024	10:03:30	Parcels	19	468376	Варшава	42.182054	25.304815
DBS88-030-1_T	03/02/2024	10:03:40	Parcels	21	468376	Варшава	42.182052	25.305234
DBS88-030-1_T	03/02/2024	10:03:50	Parcels	21	468376	Варшава	42.182051	25.305656
DBS88-030-1_T	03/02/2024	10:04:00	Parcels	20	468376	Варшава	42.182443	25.306258
DBS88-030-1_T	03/02/2024	10:04:10	Parcels	22	468376	Варшава	42.182933	25.306899
DBS88-030-1_T	03/02/2024	10:04:20	Parcels	23	468376	Варшава	42.183436	25.307633
DBS88-030-1_T	03/02/2024	10:04:30	Parcels	23	468376	Варшава	42.188	25.308202
DBS88-030-1_T	03/02/2024	10:04:40	Parcels	24	468376	Варшава	42.188009	25.307185
DBS88-030-1_T	03/02/2024	10:04:50	Parcels	24	468376	Варшава	42.192047	25.307495
DBS88-030-1_T	03/02/2024	10:05:00	Parcels	24	468376	Варшава	42.189737	25.307877
DBS88-030-1_T	03/02/2024	10:05:10	Parcels	23	468376	Варшава	42.192236	25.308137
DBS88-030-1_T	03/02/2024	10:05:20	Parcels	22	468377	Варшава	42.192627	25.308418
DBS88-030-1_T	03/02/2024	10:05:30	Parcels	21	468377	Варшава	42.191272	25.308639
DBS88-030-1_T	03/02/2024	10:05:40	Parcels	19	468377	Варшава	42.191753	25.308889
DBS88-030-1_T	03/02/2024	10:05:50	Parcels	30	468377	Варшава	42.192176	25.309102
DBS88-030-1_T	03/02/2024	10:06:00	Parcels	22	468377	Варшава	42.192723	25.309384
DBS88-030-1_T	03/02/2024	10:06:10	Parcels	23	468377	Варшава	42.193258	25.309655
DBS88-030-1_T	03/02/2024	10:06:20	Parcels	24	468377	Варшава	42.193878	25.309958
DBS88-030-1_T	03/02/2024	10:06:30	Parcels	24	468377	Варшава	42.194396	25.310188
DBS88-030-1_T	03/02/2024	10:06:40	Parcels	24	468377	Варшава	42.194877	25.310412
DBS88-030-1_T	03/02/2024	10:06:50	Parcels	24	468377	Варшава	42.195351	25.310584
DBS88-030-1_T	03/02/2024	10:07:00	Parcels	23	468377	Варшава	42.196159	25.31127
DBS88-030-1_T	03/02/2024	10:07:10	Parcels	22	468377	Варшава	42.196728	25.310756
DBS88-030-1_T	03/02/2024	10:07:20	Parcels	23	468377	Варшава	42.197276	25.310212
DBS88-030-1_T	03/02/2024	10:07:30	Parcels	28	468377	Варшава	42.197645	25.310505
DBS88-030-1_T	03/02/2024	10:07:50	Parcels	37	468376	Варшава	42.19807	25.31128
DBS88-030-1_T	03/02/2024	10:08:00	Parcels	36	468376	Варшава	42.200468	25.311707
DBS88-030-1_T	03/02/2024	10:08:10	Parcels	38	468376	Варшава	42.201432	25.312346
DBS88-030-1_T	03/02/2024	10:08:20	Parcels	38	468376	Варшава	42.202202	25.312839
DBS88-030-1_T	03/02/2024	10:08:30	Parcels	38	468376	Варшава	42.203001	25.313571
DBS88-030-1_T	03/02/2024	10:08:40	Parcels	38	468376	Варшава	42.203877	25.314261
DBS88-030-1_T	03/02/2024	10:08:50	Parcels	38	468376	Варшава	42.204697	25.315148
DBS88-030-1_T	03/02/2024	10:09:00	Parcels	38	468376	Варшава	42.205152	25.316215
DBS88-030-1_T	03/02/2024	10:09:10	Parcels	38	468376	Варшава	42.205821	25.317501
DBS88-030-1_T	03/02/2024	10:09:20	Parcels	38	468376	Варшава	42.206544	25.318623
DBS88-030-1_T	03/02/2024	10:09:30	Parcels	41	468376	Варшава	42.206489	25.319827
DBS88-030-1_T	03/02/2024	10:09:40	Parcels	42	468376	Варшава	42.206936	25.321131
DBS88-030-1_T	03/02/2024	10:09:50	Parcels	38	468376	Варшава	42.207594	25.32225
DBS88-030-1_T	03/02/2024	10:10:00	Parcels	45	468376	Варшава	42.207874	25.323628
DBS88-030-1_T	03/02/2024	10:10:10	Parcels	47	468376	Варшава	42.208607	25.324826
DBS88-030-1_T	03/02/2024	10:10:20	Parcels	48	468376	Варшава	42.209498	25.326146
DBS88-030-1_T	03/02/2024	10:10:30	Parcels	50	468376	Варшава	42.210364	25.326923
DBS88-030-1_T	03/02/2024	10:10:40	Parcels	51	468380	Варшава	42.212262	25.328216
DBS88-030-1_T	03/02/2024	10:10:50	Parcels	51	468380	Варшава	42.213174	25.329511
DBS88-030-1_T	03/02/2024	10:11:00	Parcels	48	468380	Варшава	42.214056	25.330772
DBS88-030-1_T	03/02/2024	10:11:10	Parcels	47	468380	Варшава	42.215273	25.332061
DBS88-030-1_T	03/02/2024	10:11:20	Parcels	48	468380	Варшава	42.216411	25.333285
DBS88-030-1_T	03/02/2024	10:11:30	Parcels	43	468380	Варшава	42.217499	25.334562
DBS88-030-1_T	03/02/2024	10:11:40	Parcels	42	468380	Варшава	42.218449	25.335845
DBS88-030-1_T	03/02/2024	10:11:50	Parcels	41	468380	Варшава	42.219258	25.337173
DBS88-030-1_T	03/02/2024	10:12:00	Parcels	40	468381	Варшава	42.220217	25.338476

**Fig. 2.12. Data on the movement of locomotive № 91521688030-1 along the section from Simeonovgrad station to Radnevo station from 09:30 a.m. to 10:30 a.m. on 03.02.2024 (fourth part)**



**Fig. 2.13. Decoding of the record for movement of locomotive № 91521688030-1 in the period from 09:47 a.m. to 10:31 a.m. on 03.02.2024 along the section between Simeonovgrad station to Radnevo station with focus on the passing through Lyubenovo transmission station**



### **3. Description of the event**

#### **3.1. Information on the event and the context.**

##### *3.1.1. Description of the event type.*

On 03/02/2024, at the general station of Kapikule - Republic of Türkiye, IDFT No. 46660 was handed over for transportation to the railway company "DB Cargo Bulgaria" EOOD. A technical inspection of the train was carried out by a wagon inspector of the railway company "DB Cargo Bulgaria" EOOD. IDFT No. 46660, departed at 06:50 a.m. in a composition of 32 wagons, 64 axles, 576 meters, 898 tons, served by the locomotive of the railway company No. 91523186012-2. The train arrived at Svilengrad station at 07:15 a.m., - 45 minutes ahead of time. A customs and border inspection was carried out at the station. Train locomotive No. 91523186012-2 has been exchanged with another railway enterprise locomotive No. 91521688030-1. A "D" test of the automatic train brake was performed on the train before departure. The train departed from Svilengrad station at 08:54 a.m., 66 minutes earlier.

The train was moving in the direction from the Republic of Türkiye to the Federal Republic of Germany.

IDFT No. 46660 was served by locomotive No. 91521688030-1 with a locomotive driver and an assistant locomotive driver, employees of "DB Cargo Bulgaria" EOOD. A train arrived at Lyubenovo station at 09:58 a.m., - 62 minutes ahead of time, and departed at 10:05, -65 minutes ahead of time for Radnevo station (according to entries in the station diaries of the traffic manager on duty and the train dispatcher).

During the time of movement, the train respected the section speed and the reductions of the rail track, passing the Lyubimets, Harmanli, Simeonovgrad and Lyubenovo transmission stations without stopping (according to data downloaded from the GPS system and the digital recording device of locomotive No. 91521688030-1).

The Radnevo station is equipped with an RMoKD, which ensures mutual and forced locking of the switches and of entrance and exit signals. With the dispatch apparatus, the traffic manager on duty gave orders for the preparation of the route. The switches were turned manually by the switchman/crossing guard at Post No. 2 and were locked with the RSZ.

For the reception of IDFT No. 46660 at Radnevo station, the traffic manager on duty ordered at 10:10 a.m. with a telephone message to the switchman/crossing guard at Post No. 2 for the arrival of IDFT No. 46660 on the second free main track. At 10:17 a.m. the switchman/crossing guard at Post No. 2 prepared the route and opened the entrance signal for the second track. As the train entered, the switchman/crossing guard at Post No. 2 followed its passage and saw smoke coming from the last wagon and the penultimate 31st wagon derailed.

When IDFT No. 46660 entered the second track at Radnevo station, the traffic manager on duty noticed heavy dust on the last wagon. When the train passed through the entrance switches for the second track, the last 32nd car No. 21802475230-3 derailed with both wheelsets. Passing through the technical ditch/canal on the second track, its left wheels fell into the ditch and it veered to the left and, on exiting the ditch, destroyed the steps of the ditch. It continued its movement, with the left wheels moving in the gauge and the right wheels to the right of the track. On reaching the platform, the right wheels rose on it and the wagon tilted to the left. A door detached from the penultimate derailed wagon No. 21802475039-8 and fell between the first and second track, subsequently a second door from the wagon on the platform also fell. The locomotive driver at that moment felt the train pulling and initiated a rapid stop of the train. The traffic manager on duty notified the train dispatcher at the Plovdiv Railway Station about the derailment of the train. Around 11:20 a.m., the traffic manager on duty reported the accident to the national emergency number 112.

On 03/02/2024, at around 13:00 p.m., the chief safety inspector of RIBP Plovdiv and the safety inspector of the railway enterprise "DB Cargo Bulgaria" EOOD arrived at the scene of the accident.

On 03/02/2024, around 13:00 p.m., an inspector of wagons of "DB Cargo Bulgaria" EOOD arrived at Radnevo station. The last two derailed wagons were disconnected from IDFT No. 46660.

At 13:30 p.m., safety representatives of the two subjects conducted an alcohol test on the locomotive driver and the assistant locomotive driver with a "Dreger 7510" - the samples were negative.

On 03/02/2024, around 15:00 p.m., the accident was inspected by representatives of the two entities, who established the point of ascent of the derailed penultimate 31st wagon No. 21802475039-8 with the second wheelset at km 28+197 in the Lyubenovo interstation transmission station - Radnevo.

At 15:33 p.m., a wagon inspector performed a technical inspection of the 30 wagons of IDFT No46660, a new brake mass certificate (VP-11) was issued and the train left on the route +302 minutes late.

Because of the derailment, severe damage was caused to switches No. 2 and No. 4 for the second and third track at Radnevo station. Damage was caused to the rail track in the interstation, the safety equipment, the contact network and the derailed two wagons. Traffic through Radnevo station was interrupted.

After receiving a notification about the accident, a technician-mechanic arrived at Radnevo station, an employee of SE NRIC to carry out inspections of the control panel and facilities in the station and Post No. 2, as well as the technical condition of the electrical barrier in the area of Radnevo station and APU at km 35+ 800, for which the task force prepared findings protocols.

On 03/02/2024, at around 15:20 p.m., the safety inspector of "DB Cargo Bulgaria" EOOD, the head of the Yambol railway section and the railway manager from the SE NRIC arrived at the scene of the accident. During the inspection, they found the point of rise of the second wheelset of the penultimate 31st wagon No. 21802475039-8 at km 28+197 in the Lyubenovo transfer station - Radnevo.

Around 15:30 p.m., the task force carried out measurements of the rail track with a hand gauge for level and gauge. No measurements were made for hidden dips and flush differences on the rail track. A finding protocol was prepared for the state of the rail track, which was signed with a special opinion by the safety manager of "DB Cargo Bulgaria" EOOD.

On 04.02.2024 at 15:00 p.m., the head of the Yambol railway section entered in logbook II-76 for dispatcher orders at Radnevo station that he restored the movement of all vehicles in the Lyubenovo transfer station - Radnevo interstation from km 28+150 to switch No. 2 with speed 25 km/h and from switch No. 2 to switch No. 1 along the 4th track with a speed of up to 15 km/h.

At 15:01 p.m., by order of the train dispatcher at Plovdiv rail traffic operation unit, the movement of all vehicles was restored in the Lyubenovo transfer station - Radnevo interstation from km 28+150 to switch 2 at a speed of 25 km/h and from switch 2 to switch 1 on 4th track with a speed of up to 15 km/h.

By telegram, the head of the Task force II category on 04/02/2024 at 16:35 p.m. notified in writing both parties to the accident to ensure the presence of their representatives on 05/02/2024 at 12:00 p.m. at Radnevo station for measurement the parameters of the derailed wagons No. 21802475230-3 and No. 21802475039-8 from IDFT No. 46660.

On 05.02.2024, the operational group at Radnevo station carried out measurements of the track axles of the two wagons. The operational group proposes to the railway company to bring the displaced elements along the running part of the wagons (buckets and leaf springs) into a suitable technical condition, so that all parameters can be measured.

The measurements were also carried out on 07.02.2024 on the seventh track at Radnevo station, and subsequently after moving the wagons to RBCO-Karlovo.

### *3.1.2. Date, punctual time and location of the event.*

On 03/02/2024 at 10:28 a.m. in the Lyubenovo transfer station - Radnevo at km 28+197, the second wheelset of the penultimate 31st wagon No. 21802475039-8 from IDFT No. 46660 derailed. The place of derailment was in the right transition curve  $L=98$  m, with radius of the circular curve  $R=400$  m, elevation  $H=90$  mm and profile 0 ‰. The rail track in the area of the wagon derailment was laid with rails type S49 - 25 meters, reinforced concrete sleepers mixed type ST-4 and ST-6 and fasteners mixed type PAK-68I and SKL-14.

IDFT № 46660 was moving under schedule, on the main line № 1 and directed towards the secondary № 83.



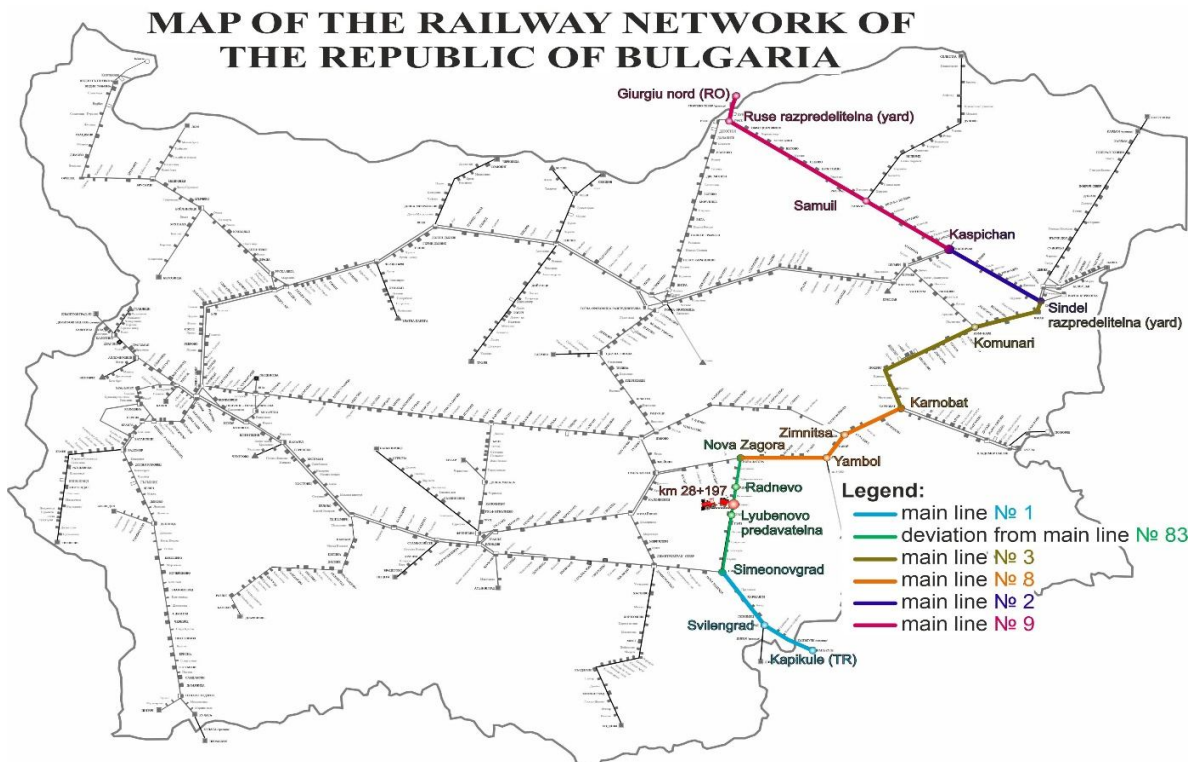
**Fig. 3.2. Movement alignment of IDFT № 46660 and the place of the accident**

- - Origin station of the train movement;
- - Main stations along the train alignment;
- - Final station on the territory of the Republic of Bulgaria – Ruse Nord;
- - Station of stopping and derailment of the wagons of IDFT № 46660 – Radnevo;
- Place of the accident – between the stations Lyubenovo transfer station and Radnevo;
- - Track that IDFT № 46660 has passed;
- - Track that IDFT № 46660 has passed after uncoupling and derailment of the wagons.

3.1.3. Description of the place of event:  
 Location of the accident place.  
 Geographic width: 42°13'5.95"N  
 Geographic length: 25°55'26.47"E (fig. 3.3).



**Fig. 3.3. GPS location of the place of the accident at km 28+197 between the stations Lyubenovo transfer station and Radnevo**



**Fig. 3.4. Route of IDFT № 46660 from Kapikule station to Radnevo station**

*3.1.3.1. Meteorological and geographical condition at the time of the event.*

- In the light part of the day – 10:28 a.m. (under the locomotive recording device data);
- Air temperature: +12° C;
- Wind speed and direction: 20 km/h, from southwest;
- Weather – cloudy with normal visibility of the signals;
- Radnevo station is geographically located in the Southeastern part of the rail network.

*3.1.3.2. Performance of construction activities on the site or in vicinity.*

No construction works have been carried out on 03.02.2024 in Radnevo station, and along the interstation Lyubenovo transmission station- Radnevo, in the area of the accident.

*3.1.4. Fatalities, injuries and material damages:*

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

None.

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

None.

*3.1.4.3. Passengers.*

None.

*3.1.4.4. External persons.*

None.

*3.1.4.5. Cargo, luggage or other property.*

None.

*3.1.4.6. Rolling stock, infrastructure and environment.*

- Material damages of locomotive № 91521688030-1 were not caused.
- Material damage of 32nd wagon № 21802475230-3 Hbbills series– derailed with both wheelsets, damages caused to the draft gear amounting to 6 590,00 BGN.;
- Material damage на 31st wagon № 21802475039-8 Hbbills series– derailed with both wheelsets, damages caused to the draft gear and to the bodyshell amounting to 7 040,00 BGN.;
- Material damages, caused to the rail track on the second track and to switches № 2 and № 4 in Radnevo station amounting to 16 203,00 BGN.;
- Material damages, caused to the signalling equipment in Radnevo station amounting to 3 103,50 BGN.;
- Material damages, caused to the catenary along the interstation Lyubenovo transmission station-Radnevo amounting to 166,90 BGN.;
- Material damages were not caused to the environment.

**Total damages: 33 103,40 BGN.**

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

In the period from 10:21 a.m. on 03.02 to 15:00 p.m. on 04.02.2024, the railway infrastructure manager and the railway undertaking generated other costs due to modification of the train operation schedule along the section Simeonovgrad – Nova Zagora.

- Deviated trains of the railway undertakings, two – 90,00 BGN.;
- Cancelled trains of the railway undertakings – none;
- Appointed trains of the railway undertakings – none;
- Delayed trains of the railway undertakings – none;
- Costs for rehabilitation means – 1 382 BGN.;

**Total other costs: 1472 BGN.**

**3.1.6. Identity of the participants and their functions.**

Railway infrastructure:

• SE National railway Infrastructure Company has a Safety Authorization № BG 21 2023 0001 with validity period 01.07.2023 г. ÷ 30.06.2028.

Personnel of SE NRIC involved in the accident:

- Traffic manager on-duty in Radnevo station on shift;
- Switchman/crossing guard in Radnevo station on shift;
- Head of railway section;

Railway undertaking:

„DB Cargo Bulgaria“ EOOD has:

License for railway transport services № 206, issued on 13.05.2010– unlimited;

Personnel of „DB Cargo Bulgaria“ EOOD involved in the accident:

- Locomotive driver of locomotive № 91521688030-1 of IDFT № 46660;
- Assistant locomotive driver of locomotive № 91521688030-1 of IDFT № 46660;
- Wagon inspector in Svilengrad station, serviced IDFT № 46660.

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

**3.1.6.1. Type of the track, railway switch, rail crossing etc.**

The event occurred between the Lyubenovo transfer station and Radnevo at km 28+197. The rail track is in a transition curve with length L=98 m and radius of the curve R=400 m, elevation H=90 mm and profile 0 ‰, jointed rail track with rails type S49 – 25 meters, reinforced concrete sleepers mixed type ST-4 and ST-6, with fastening type PAK 68I and SKL-14.

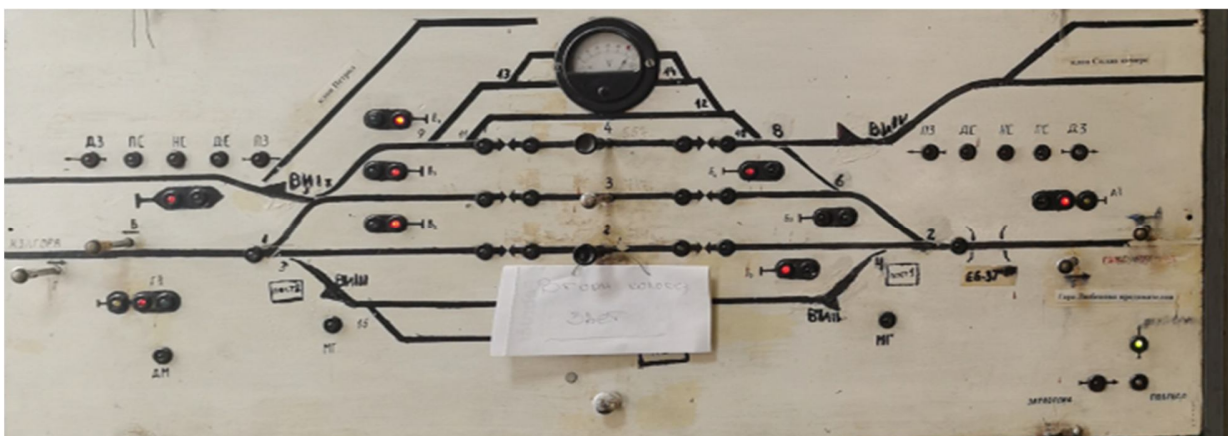
The second track is the main one at Radnevo station, a continuation of the current track to Lyubenovo transmission station and to Nova Zagora station. The useful length of the track is 616 meters. On the even side of Radnevo station, there are switches No. 2, 4, 6 and 8, on the odd side there are switches No. 1, 3, 5, 7 and 9 (Fig. 1.3 and Fig. 3.5.).

**3.1.6.2. Interstation block system, station interlocking, type of signalling and messages.**

Interstation block system:

The interstation Lyubenovo transfer station – Radnevo is equipped with automatic block system (ABS) with axle counters – functioning;

Station installation:



**Fig. 3.5. Station interlocking with RMokD in Radnevo station**

Radnevo station is equipped with RMokD with an order apparatus at the manager on duty and implementation apparatus at the switch points – functioning (fig. 3.5);

Type of signalling:

In Radnevo station the entrance and exit semaphores are under the speed signalling – functioning before the accident and with caused damages of the exit semaphore for the second track after the accident – technological canal of the track (fig. 3.6);



**Fig. 3.6. Technological canal on second track in Radnevo station**

Messages:

Radnevo station is equipped with a Communications, Connections and Messages Device (DCCM-8) for incoming and outgoing messages of the station with the neighbouring stations and a train dispatcher - working (fig. 3.7);



**Fig. 3.7. Communications, Connections and Messages Device (DCCM-8)**

3.1.6.3. Train protection systems.

In the section from Simeonovgrad station to Nova Zagora station, incl. and Radnevo station does not have a train protection system. The stations are equipped with a train dispatching radio communication (TDRC), through which the locomotive driver makes radio contact with the train dispatcher, with the traffic managers on duty in the stations and with the trains in the section.

Locomotive No. 91521688030-1 is equipped with an active type vigilance device, a Hasler Teloc 2200 type electronic recording device and a locomotive radio station for train dispatching radio communication (TDRC).

3.1.7. Other information referring the event.

Train documents „Way-bill“, „Nature sheet“, and „Brake mass certificate“ of IDFT № 46660, correspond to the hours of the actual movement of the train under the presented data of the locomotives encryption (fig. 3.7, 3.8, 3.9, 3.10).

The image shows the front part of a way-bill form for IDFT № 46660. The form is divided into several sections with handwritten entries:

- СЛУЖБА** (Service): ДПС - Бг
- ПЪТЕН ЛИСТ №** (Waybill No): 0069914
- ЛОКОМОТИВ №** (Locomotive No): 88-000
- СЛУЖБА ДПС** (Service DPC): БРС
- ДАТА** (Date): 02.02.2024
- ЛОКОМОТИВНА БРИГАДА** (Locomotive crew): Includes names like Димитър Д. Димитров, Георги Г. Георгиев, and others.
- ПЪТЯНЕ** (Route): Includes station names like С. Славово, П. Младина, and others.
- ОСВОБОДАВАНЕ** (Release): Includes times like 15:00 and 15:00.
- ПЪТЯНЕ БЕЗ СЛУЖБА** (Without crew): Includes times like 19:30, 20:30, etc.
- ПРИЕМАНЕ И ПРЕДАВАНЕ НА ЛОКОМОТИВА** (Locomotive handover): Includes times like 14:00, 14:30, 15:30.
- ДОПЪЛНИТЕЛНО ПОЛУЧЕНО ГОРИВО ИЛИ МАСЛО** (Additional fuel/oil): Includes amounts like 1400, 1200, 1300.
- ИНСТРУКТОРИ/ИНСПЕКТОР** (Inspector): Includes names like С. Славово, Георгиев.
- СТАРШИ КОНДУКТОР** (Senior Conductor): Includes names like С. Славово, Георгиев.
- СВЕРКА НА ЧАСОВНИЦИТЕ** (Clock check): Includes times like 14:00, 14:30, 15:30.
- ОБСЛУЖВАНЕ НА ВЛКОВЕТЕ И МАНЕВРЕНА РАБОТА** (Train service and shunting work): Includes times like 14:00, 14:30, 15:30.
- ДАНИИ ЗА СЪСТАВА НА ВЛКОВЕТЕ** (Train composition data): Includes numbers like 2, 4, 8, 52, 160, 14.

Fig. 3.8. Way-bill of IDFT № 46660 – front part

The image shows the nature sheet of IDFT № 46660. It is a detailed table with the following structure:

- ОТДЕЛЕНИЕ** (Department): ДПС - Бг
- КК** (Code): 03.02.2024
- НАТУРЕН ЛИСТ НА ВЛК №** (Nature sheet of train No): 46660
- ПРОПЪТНИЦИ** (Passengers): Table with columns for passenger names and counts.
- КОЛИЧЕСТВО НА ВЪЗРАСТНИТЕ ГРУПИ НА КОМПОНЕНТЕ** (Quantity of age groups of components): Table with columns for age groups and counts.
- ТАРА** (Tare): Table with columns for tare weights and counts.
- СЪСТАВИ** (Composition): Table with columns for component types and counts.

Fig. 3.9. Nature sheet of IDFT № 46660



Превозвач Ди Би Карго България ЕООД				Обр. ВП-11			
Удостоверение за спирачна маса							
Гара	К. Кутле			Влак №	46660		
Дата	03.03.2014						
Маса на влака	898 t				R: 550		
Спирачен процент	69 %						
Необходима спирачна маса	620 t						
Mg	X	оси	ABC (Автоматична влакова спирачка)	РС (Ръчна спирачка)			
R	X	оси					
P	64	оси	Спирачна маса, t	Оси бр.	Спирачна маса, t	Оси бр.	Забележка
G	X	оси					
Начална / останала маса / оси			850	64			
Допълнителна маса / оси							
Всичко: Налична спир. маса / оси			850	64			
Неплътност на локомотива			0,1 bar / min				
Неплътност на влака			0,3 bar / min (bar / 0,5 min)				
Влака натегнат / ненаатгнат			Извършил пробата на спирачките				
Дежурен ръководител движение			Зоранов Д. П. Ходничевски Д.				
№ на вагон	Спирачна маса	№ на вагон	Спирачна маса				
218024751164	29	218024750208	29				
218024751990	25	218024750851	26				
218024750257	25	218024752279	26				
218024751578	29	218024752496	29				
218024751390	29	218024752282	26				
218024752162	24	218024750133	26				
218024751503	29	218024752725	26				
218024750844	29	218024750302	26				
218024752078	29	218024752360	26				
218024752295	29	218024750786	26				
218024750075	29	218024751982	26				
218024751862	27	218024752592	26				
218024751172	29	218024750901	26				
218024752873	29	218024750398	18				
218024750471	27	218024752303	18				
218024751453	25						
218024752535	27	32 / 64		850			

Забележка: Ненужното се зачертава

Fig. 3.10. Brake mass certificate of IDFT № 46660

### 3.2. Factual description of the occurred.

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

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

• From the written testimony of the locomotive crew that served locomotive No. 91521688030-1 of IDFT No. 46660 and from the decoding of the train movement records, it is clear that the train from Svilengrad station to Radnevo station moved without stopping and without obstacles. The train route was

arranged and locked with a permissive indication of the entrance and exit semaphores for the main track (second) without stopping at Radnevo station. When the train entered the station, the traffic manager on duty gave a signal for the train to pass without stopping. The locomotive crew has felt the train pull, the assistant locomotive engineer looked out the locomotive window and saw that one of the last wagons was moving off the track. The locomotive driver, after that information, initiated a quick stop of the train at the station. The locomotive driver inspected the train and found that the penultimate 31st and last 32nd wagons of the train have derailed. The locomotive driver notified the dispatcher of the railway company about the accident that occurred.

● From the written testimony of the wagon inspector in the stations Kapikule and Svilengrad, serviced IDFT № 46660, is evident:

1. When the train entered Kapikule station, the wagon inspector "listened" to the train;
2. In Kapikule station, the locomotives of IDFT No. 46660 were replaced, locomotive No. 91523186012-2 of the railway company "DB Cargo Bulgaria" EOOD was attached;
3. The wagon inspector performed a technical inspection and test A of the automatic train brake at Kapikule station, prepared a certificate for the train's brake mass, and did not find any irregularities;
4. The wagon inspector accompanied the train in the locomotive cabin from Kapikule station to Svilengrad station;
5. Before the departure of IDFT No. 46660 from Svilengrad station, the wagon inspector performed a "D" test of the automatic train brake.

● In his written testimony, the traffic manager on duty at the Radnevo station reflected that at 10:05 a.m. IDFT No. 46660 left the Lyubenovo transmission station, at 10:10 a.m. he ordered the signalman/crossing guard at Post No. 2 to prepare the route for the train and opened the entrance signal without stopping at the station. The traffic manager on duty at Radnevo station has come out to meet the train on the station platform for the second track. When meeting the train, he saw a dusting from the last wagons, which intensified when entering the entrance switches. At 10:25 a.m. the train stopped. He found that the last two wagons had derailed with all the wheelsets and the last one had leaned on the platform. He notified the train dispatcher. The traffic manager on-duty reported the accident to the national emergency number 112. The traffic manager on-duty informed the concerned services and officials in writing about the accident that occurred.

#### *3.2.1.1. Rolling stock and technical facilities functioning.*

Before the accident, the rolling stock (locomotive and wagons) and the technical facilities of the railway infrastructure were functional.

IDFT No. 46660 was assigned under the TOS and moved in the direction of Kapikule - Nova Zagora - Karnobat - Komunari - Kaspican - Ruse - Giurgiu North - Munich North. On the territory of the Republic of Bulgaria, the train was served by the railway company "DB Cargo Bulgaria" EOOD.

From the decryption made by the Investigation Commission at the NAMRTAIB for the movement of MTTV No. 46660, it was established that when the train passed through the Radnevo station without stopping at the station, the speed changed in a short time, the locomotive driver felt the train pull and derailment of the last two wagons of the train. He stopped at the station

#### *3.2.1.2. Operational system functioning.*

At the time of the accident, the operational system for managing the train traffic in the Simeonovgrad - Nova Zagora section and in the Lyubenovo transfer station - Radnevo interstation was in good working condition and functioning normally.

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

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

On 03/02/2024, around 13:30 p.m., authorities of the RI Radnevo Ministry of Interior arrived at Radnevo station; the area was not restricted for access by other persons. On-site inspections were carried out. The authorities of the RD Radnevo Ministry of Interior took no procedural-investigative actions.

### *3.2.3. Actions of the emergency rescue services.*

Not applicable.

### *3.2.4. Actions of the emergency rehabilitation services.*

On 03/02/2024, around 14:30 p.m., specialized cars of "Restoration Service" Karnobat and Stara Zagora arrived at Radnevo station to lift the two derailed wagons at Radnevo station. The teams of the "Restoration Activity" Units from Karnobat and Stara Zagora to the railway infrastructure manager, together with representatives of "DB Cargo Bulgaria" EOOD, created an organization to lift the derailed wagons onto the rails of the second track at Radnevo station.

On 03/02/2024 at around 14:20 p.m., the safety manager of RIBP - Plovdiv received verbal permission to start emergency recovery actions. He is an employee of the manager of the railway infrastructure and did not coordinate the recovery actions with the the member of Management Board of the NAMRTAIB.

The requirements of Art. 89, (1), (2), item 1 of Ordinance No. 59.

Wagon No. 21802475039-8, the 31st of the train was lifted at 15:21 p.m. on 03/02/2024.

Wagon No. 21802475230-3, the 32nd of the train was lifted at 21:10 p.m. on 03/02//2024.

In order to carry out an inspection of the overhead contact line in Radnevo station and in the Lyubenovo transfer station - Radnevo interstation, the voltage was switched off in the period 15:50 ÷ 21:30 p.m..

On 07.02.2024, diesel locomotive No. 98521756710-8 of "DB Cargo Bulgaria" EOOD was assigned to traffic at TOU Plovdiv with a route from Karlovo station to Radnevo station to transport the two derailed wagons. At 17:21 p.m., by order of the train dispatcher, shunting train No. 30894 Radnevo – Karlovo was assigned to the Plovdiv railway station. The train departed at 17:36 p.m. as a 12-axle 92-meter, 83-ton train with locomotive No. 98521756710-8 and arrived at Karlovo station at 11:58 p.m. The two wagons have been submitted to the Central Office Repair Base of the railway company.

Traffic on the second main track at Radnevo station was interrupted from 10:28 a.m. on 03/02/2024 until 14:20 p.m. on 22/02/2024 at scheduled speed.

Traffic through switches No. 2 and No. 4 at Radnevo station was interrupted from 10:28 a.m. on 02/03/2024 and was restored at 3:00 p.m. on 02/04/2024 on the fourth diversion track.

On 03/02/2024 at 15:01 p.m., by order of the train dispatcher at Plovdiv railway station, the movement of all trains in the Lyubenovo transfer station - Radnevo interstation from km 28+150 to the beginning of switch No. 2 was restored, with a speed of up to 25 km/h. From the beginning of switch No. 2 to the beginning of switch No. 1 along the 4th track in Radnevo station, at a speed of up to 15 km/h.

## 4. Analysis of the event

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

#### 4.1.6. Railway undertaking.

##### Analysis of the movement of IDFT № 46660.

The 88.000 series locomotives are equipped with a Hasler Teloc 2200 recording device. It records analog and digital parameters in its built-in digital memory.

The digital device registers and records the speed of movement, the pressure in the main air duct, the values of the traction force and the acceleration acting on the locomotive and the train.

The data is recorded in tabular and graphical form and can be analyzed both by time and by the track traveled by the locomotive.

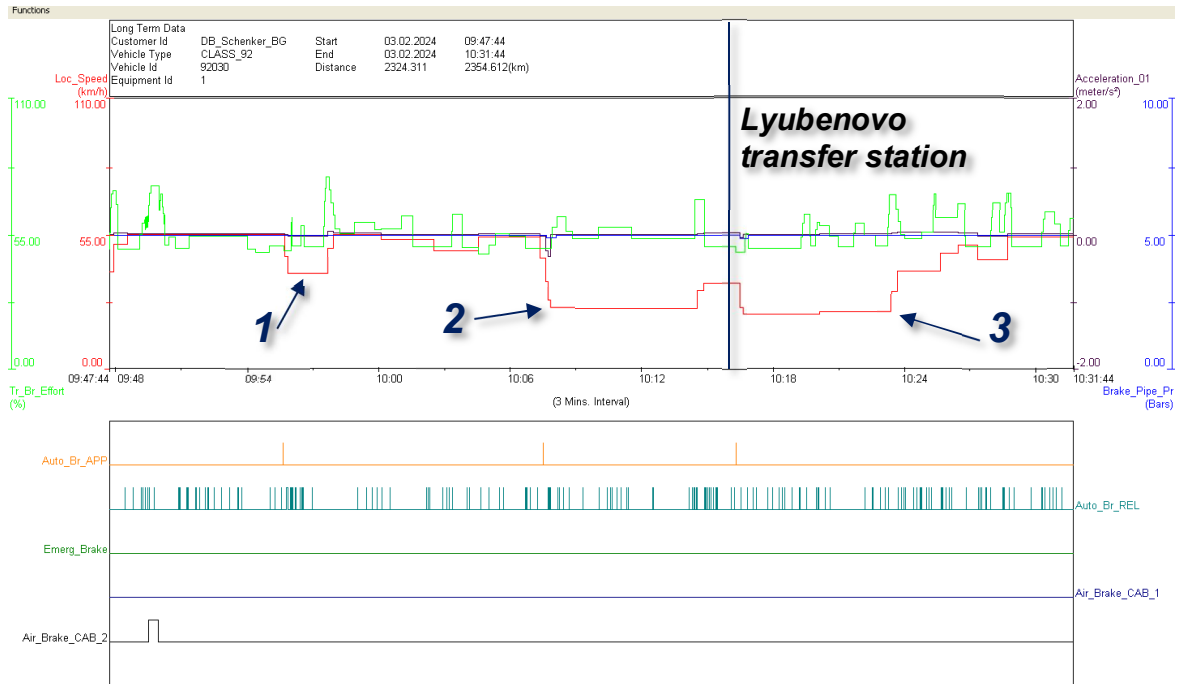
The analysis of the movement of IDFT № 46660 started from Svilengrad station (fig. 4.1).



**Fig. 4.1.**

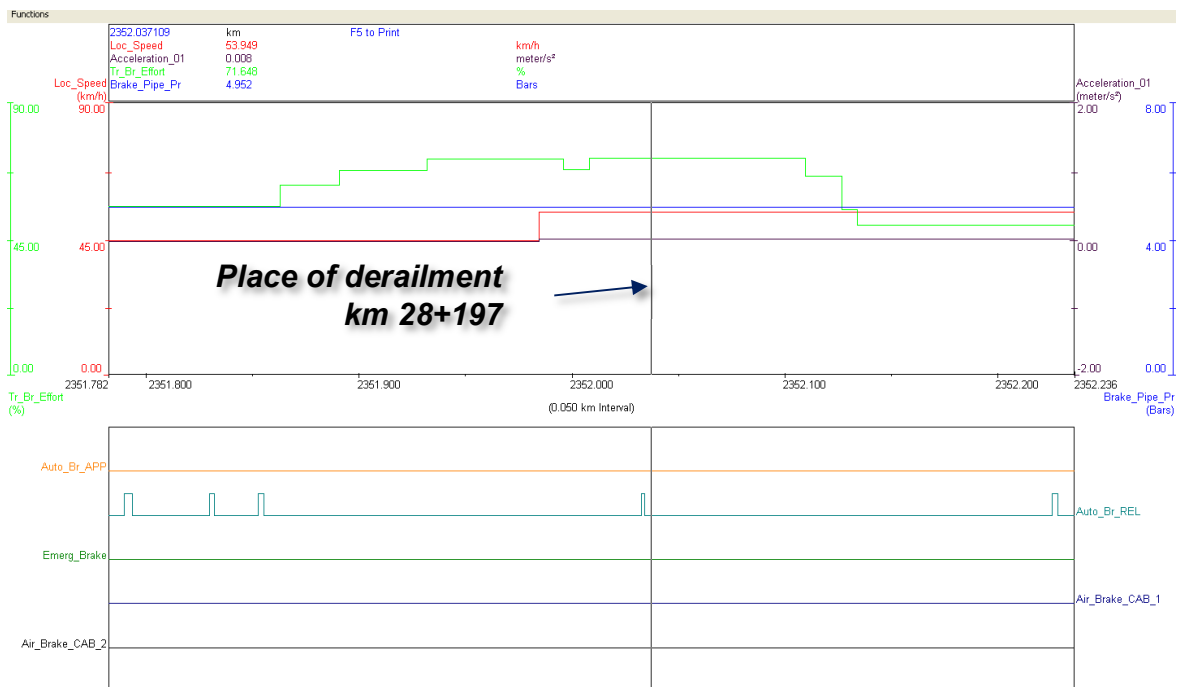
The train departed from Svilengrad station at 09:11 and ran without stopping to Radnevo station. After departure, the speed reached 99-100 km/h (Fig. 4.1, item 1). From 09:29:28 a.m. to 09:30:10 a.m., the speed decreased to 91.5 km/h without using the automatic train brake, after which it was again restored to 99.9 km/h (Fig. 4.1, pos. 2).

At 09:41:47 a.m. at km 2319.994 (on the locomotive odometer) the locomotive driver activated the automatic train brake, reducing the pressure in the main air duct from 4.916 to 4.059 bar (Fig. 4.1, item 3). Shortly thereafter, pressure in the main air duct was restored. The speed decreased from 100 km/h at 09:41:47 a.m. to 39 km/h at 09:43:02 a.m. The train traveled 2,065 m. At 09:48:33 a. m. the speed was increased to 54,674 km/h and so it traveled 6,487 m in 7 minutes 04 seconds.



**Fig. 4.2.**

At 09:55 a.m. the speed started to decrease to 38,76 km/h without using the automatic train brake as it continued until 09:57:57 a.m. (fig. 4.2, pos. 1).



**Fig. 4.3.**

At 10:07:23 a. m. the speed started to decrease from 53.7 to 45.37 km/h. At 10:07:38 a.m., the locomotive driver activated the automatic train brake, reducing the pressure in the main air duct from 4.952 to 4.855 bar, due to which the speed decreased further and reached a value of 24.798 km/h (Fig. 4.2, item 2). At that speed, the train moved until 10:14:31, when it rose to 35.286 km/h and maintained it during its passage without stopping through the Lyubenovo transfer station until 10:16:31 a.m., when it again decreased to 22-23 km /h (fig. 4.2, pos. 3). The movement continued until 10:23:26 a.m., after which the

speed increased to 50.6 km/h, at which speed the train continued its movement until 10:27:19 a.m. At

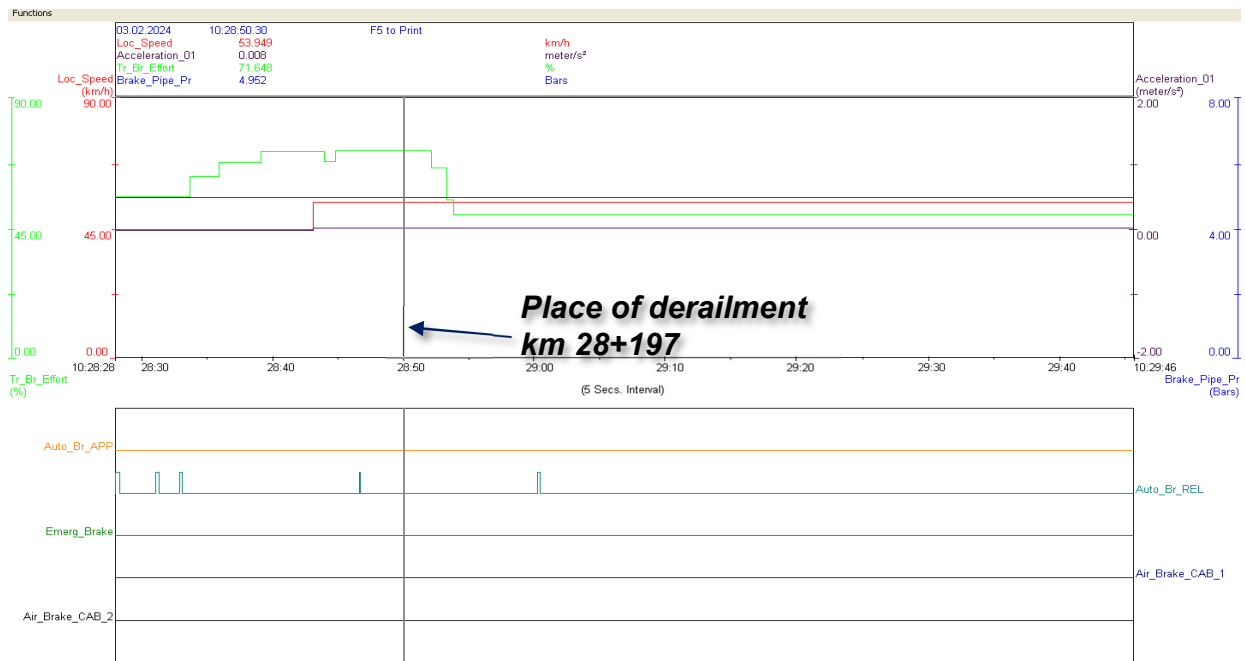


Fig. 4.4.

that point, the speed decreased to 45.51 km/h and the movement at that speed continued until 10:28:41 a.m. and increased to 53.95 km/h. In the interval of the train's movement, the second wheelset of the penultimate 31st wagon of the train's composition derailed (fig. 4.3, item 1). From the graphs in Fig. 4.3 and fig. 4.4 it can be seen that at the time of the train derailment, it was already moving in traction mode at a speed of 53.95 km/h, without shocks after increasing the speed for about 150 meters, before the moment when the rear right wheel went up on the head of the right rail of the 31st wagon of the train composition.



Фиг. 4.5.

Fig. 4.5.



Fig. 4.6.



Fig. 4.6.

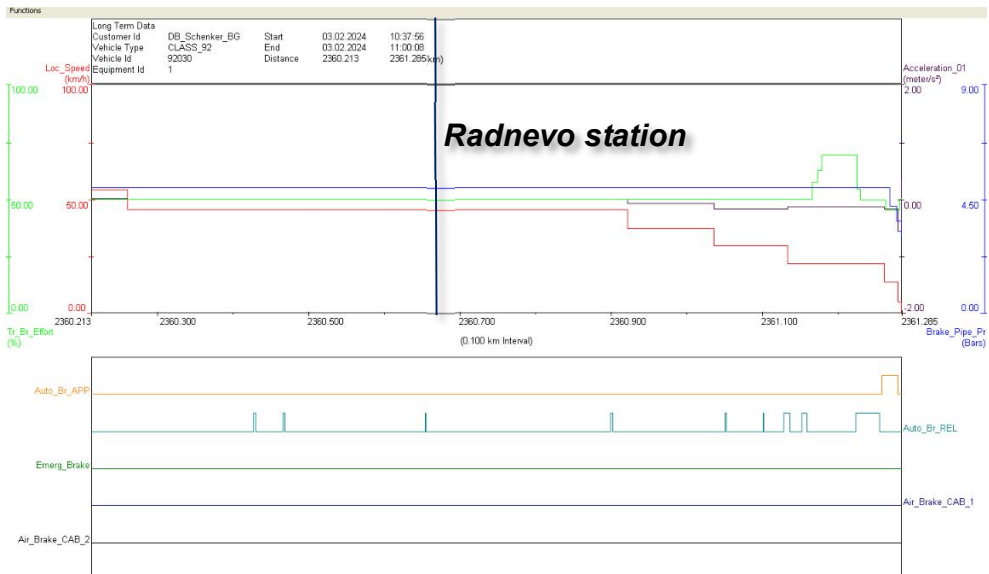


Fig. 4.8.

With a speed of 53.95 km/h, the train moved until 10:37:54 a.m., when it began to decelerate without activating the automatic train brake (Fig. 4.5). At 10:39:34 a.m. at a speed of 13.83 km/h, the pressure in the main air duct decreased due to the actuation of the automatic train brake by the locomotive driver (Fig. 4.6). IDFT No. 46660 settled in Radnevo station at 10:39:42 a.m. (fig. 4.7 and 4.8).

Causes for the accident occurrence

The wagon represents a complicated mechanical scheme with lots of freedom rates. For review

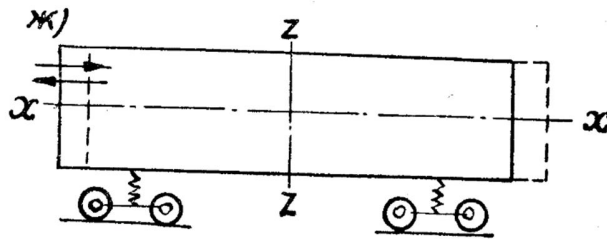


Fig. 4.9.

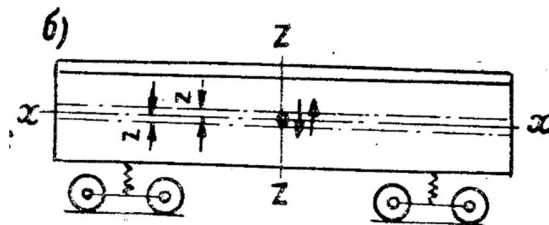


Fig. 4.10.

and analysis of the movement, the following summarized coordinates and names are used for the types of movement/replacement of the separate wagon nodes (bodyshell, bogies, wheelsets);

$y$  – transverse reflection (fig. 4.11);

$\varphi$  – galloping (fig.. 4.12);

$\theta$  – transverse sway;

$\psi$  – angle rotation.

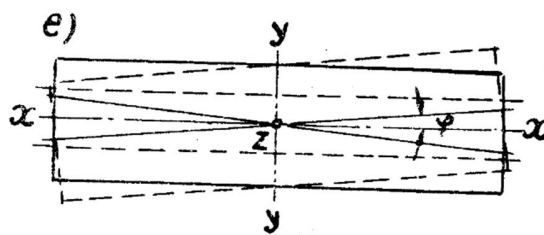


Fig. 4.13.

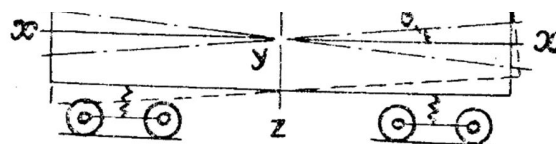


Fig. 4.12.

The combined motion along  $y$  and  $\psi$  is called yaw (Fig. 4.13).

The different types of vibrations and forces in the wagon were caused by disturbing factors of different origin and physical nature.

The main source of disturbing forces is the complex movement of track axles on the rail track. The causes for these movements were the result of the condition of the rail track and the design features



of the wagons. Obviously, the unevenness of the rail track was one of the main sources of disturbing effects. According to the nature of their impact, they can be divided into:

1. *Isolated irregularities* (protrusions, dips, crossings of switches, etc.) in a straight and curved section of the rail track. As a result, the wagon's **own oscillations** occur.

2. *Periodically recurring residual sags at the ends of the rail units* (at jointed track) which cause undulating wear of the rails. The defects on the wheelsets (local pitting, imbalance, etc.), as well as their winding movement, have a periodic effect. Because of these periodic disturbances, forced oscillations occur.

The unevenness of the rail track is one of the main factors causing the forced and self-oscillations, which is why it is necessary to clarify them in more detail.

In plan and profile, the rails are in undulating curves whose amplitudes and wavelengths change along the rail track.

The unevenness of the longitudinal profile of the rail track consists of:

1. *Geometric irregularities* determined by the distortion of the unloaded rails.
2. *Dynamic (force) irregularities* arising because of the different coefficient of elasticity of the rail base in different sections of the rail track (for example, due to the clearances between rails and sleepers, etc.).

Actual irregularities can be divided into two groups: *irregular and regular*.

Regular irregularities (for example, from the residual deformations in the joints of the rail track) have a length equal to the length of the rail unit (in this case 25 meters) and an amplitude that is a combination of the geometric and dynamic irregularities.

Irregular unevenness is due to the failure of a group of adjacent sleepers or unevenness along the railhead resulting from uneven wear or during its manufacture. They have long and short bumps. A wavelength of 1 - 3 m and an amplitude of 1 - 2 mm, and the short ones - with a wavelength of 0.05 - 0.3 m and an amplitude of 0.1 - 0.5 mm, characterize the long ones.

Research has led to a classification by type of irregularities and corresponding amplitudes. According to this classification, the most typical forms of unevenness are single humps - predominant for  $L=12,5$  m and double humps - predominant for  $L=25$ .

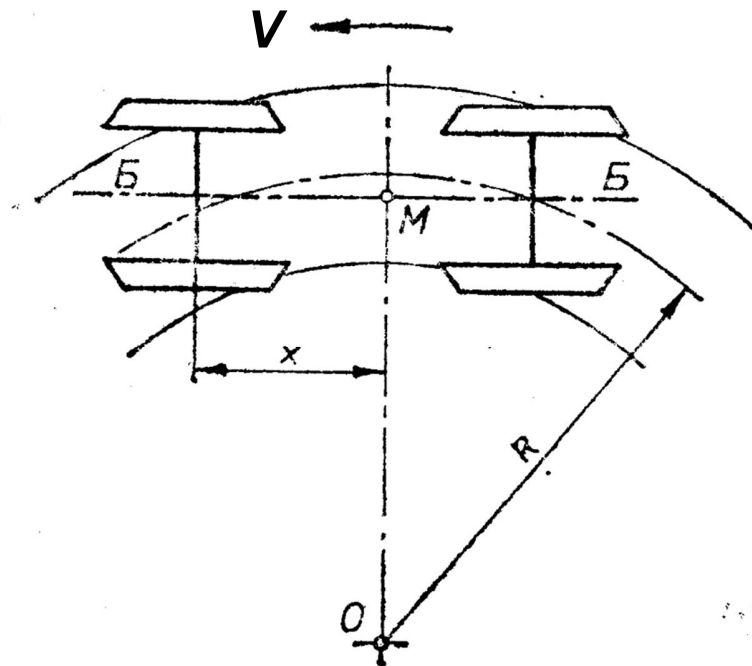


Fig. 4.14.

When passing through a curve, it is assumed that the wagon moves in a loop with center  $O$  and radius  $R$ . Due to the translational and rotational motion, the wagon rotates about the moment center  $M$  (called the pole), representing the heel of the perpendicular dropped from the center of the curve  $O$  to the frame  $B - B$  (i.e.  $OM \perp BB$ ). The distance  $x$  from the front guide wheelset to  $M$  is called the pole distance (Fig. 4.14)

Depending on the speed of movement, the vehicle can occupy the following positions in the curve (fig. 4.15):

- Maximum crossing –  $ab$ , typical for low speeds;
- Free settlement –  $ab_1$ ;
- Maximum displacement (chord layout) –  $ab_2$ , typical for high speeds.

The total clearance between the flanges and the rails is marked with  $\sigma$ , as  $\sigma = \Delta + \delta$ , where:

- $\Delta$  – the clearance in a straight section;
- $\delta$  – further extension in the curve.

The pole distance changes depending on the position of the vehicle in the curve. For its determination, Fig. 14.6 is used, in which  $2l$  is the base of the wagon, and  $\sigma_b$  is the distance between the outer rail and the flange of the rear wheelset, located in a general position relative to the rail track (free setting). Using the right triangles  $OaM$  and  $ObM$  and assuming with sufficient accuracy that  $Ob = R - \sigma_b$  and  $Oa = R$ , after transformation we get:

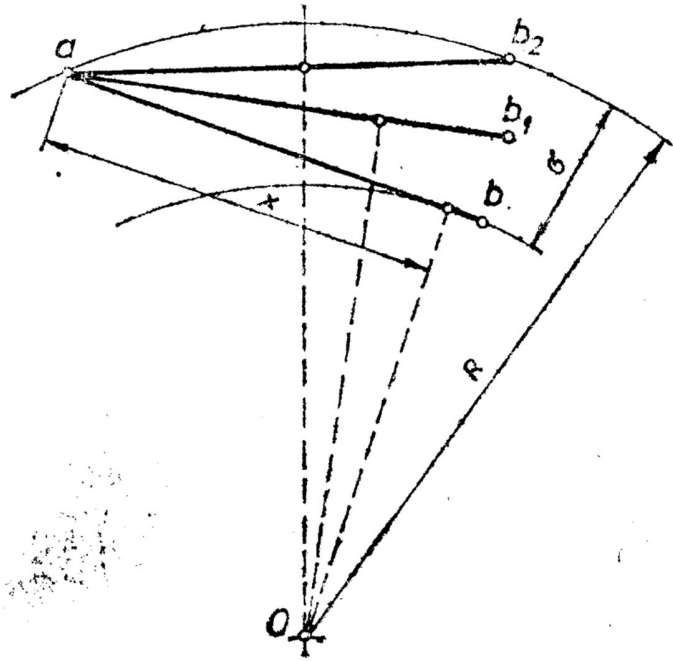
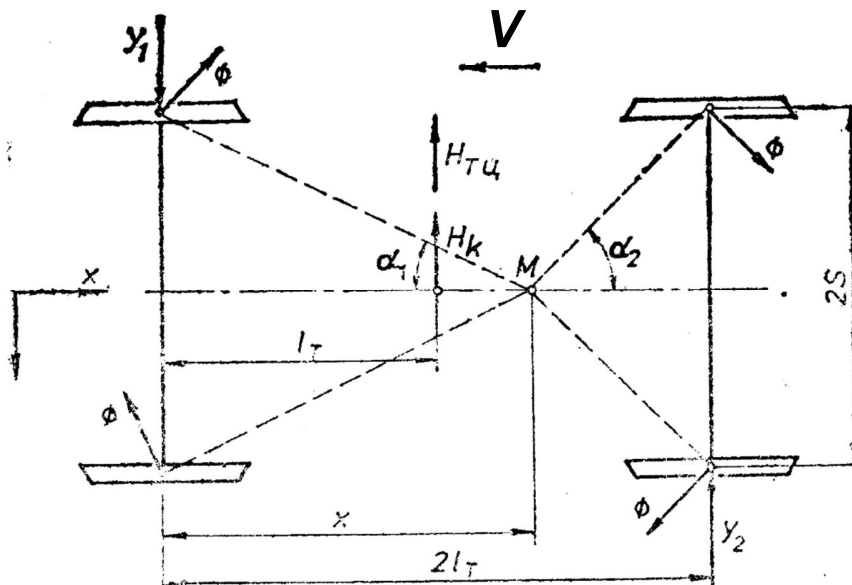


Fig. 4.15.

$$x = l_B + \frac{\sigma_b R}{2l_B}$$

The quantity  $\sigma_b$  can take values in the interval  $0 \leq \sigma_b \leq \sigma$ . The thresholds correspond to the positions of maximum crossing and maximum displacement.

$Y_1$  and  $Y_2$  are the guiding forces representing the reactions of the rails from the action of frictional forces, inertial forces and the action of the bodyshell (Fig. 4.16).



**Fig. 4.16. Principal calculation scheme for defining the guided forces while moving the bogie in a curve.**

The derailment of wagon No. 21802475039-8 occurred due to the superposition of two factors at the same time:

- Galloping of the wagon with a wavelength of 25 m (the length of the rail unit);
- Passing through a curve (transitional curve with a radius at the point of jumping of the wheel on the head of the rail 1200 meters).

The galloping of the wagon (Fig. 4.12) is caused by the natural irregularities of the rail track in the joints. In the finding protocol of the task force on the condition of the rail track, it is recorded that the level of the rail track at point -5 (NPC) is 12 mm, and at point -15 (on the straight) it is 23 mm, i.e. a difference of 11 mm for 10 meters is obtained. Given the characteristics of the wagon's spring suspension (parabolic spring) and its condition (empty), the amplitude of the oscillations resulting from the galloping of the wagon is 24 mm. Together with the maximum registered roughness of the rail track, the total vertical amplitude increases to 35 mm, a value reaching the maximum height of the flange and sufficient for the wheel to rise on the rail head at the appropriate moment.

In the calculations, it was found that the speed at which the train was moving at that moment (54 km/h) was critical, i.e. speed at which resonance occurs under certain conditions. Resonance is a phenomenon in which the amplitude of oscillations increases many times (in theory even to infinity) because of the superimposition of the natural and forced oscillation frequencies. That caused the wagon's second wheelset to jump and the possibility of it climbing onto the railhead and then derailing.

Simultaneously, the wagon moved in a curve. Calculations show that at a speed of 54 km/h and a base of the wagon  $2l = 10$  m, the rear wheelset occupies a position of maximum crossing (Fig. 4.15).

The position in which the second wheelset of the wagon is located at the point of rise is considered (Fig. 4.17).

The values of the forces acting in the situation are:

$2s=1,5$  m – расстояние между крговете на търкаляне на колоосите на вагона;

$Y_1=18$  kN – horizontal transverse guiding force acting on the attacking left wheel of the first wheelset at a speed of  $V=54$  km/h;

$Y_2=5,2$  kN – horizontal transverse guiding force acting on the right wheel of the second wheelset at a speed of  $V=54$  km/h;

$\Phi=11,04 \text{ kN}$  – frictional force occurring between the wheels and the rails at a speed of  $V=54 \text{ km/h}$ ;

$\Phi_x=1,56 \text{ kN}$  – frictional force occurring between the wheels and the rails along the  $x$  axis (longitudinal of the wagon) at a speed of  $V=54 \text{ km/h}$ ;

$\Phi_y=10,9 \text{ kN}$  – frictional force occurring between the wheels and the rails along the  $y$  axis (transverse to the wagon) at a speed of  $V=54 \text{ km/h}$ ;

$H=1,93 \text{ kN}$  – centrifugal force at the point of rise of the right wheel of the second wheelset at a speed of  $V=54 \text{ km/h}$ ;

$V=54 \text{ km/h}$  – instantaneous train speed;

The applied figure dimensions are:

$2l=10 \text{ m}$  – base of the wagon;

$l=5 \text{ m}$  – semi-base of the wagon and, by coincidence, the distance between the boarding point and the beginning (in this case, the end) of the transition curve;

$2s=1,5 \text{ m}$  – distance between the rolling circles of the wagon wheelsets;

$x=10,53 \text{ m}$  – pole distance.

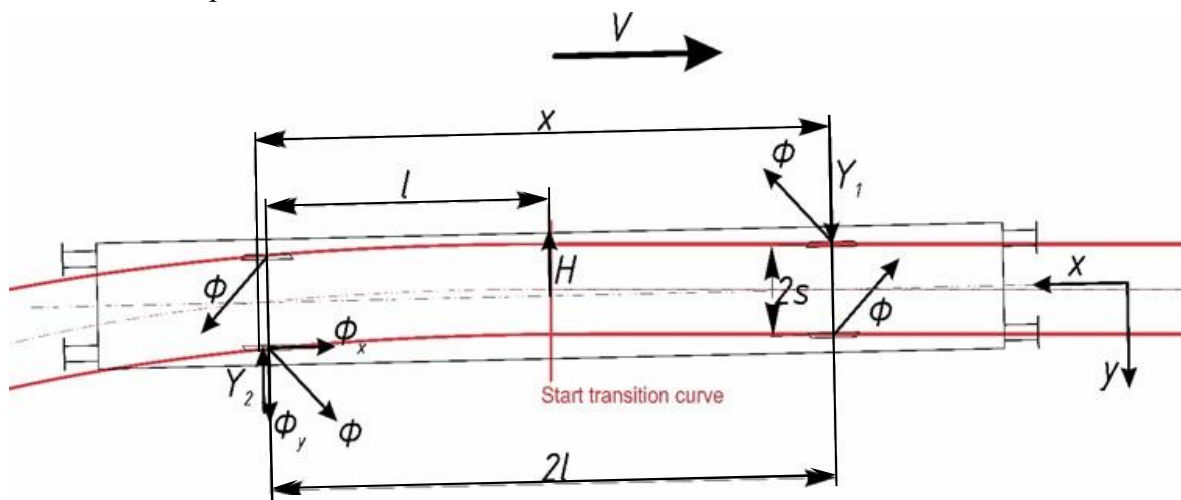


Fig. 4.17.

From the calculations made and from figure 4.17, it is clear that at the moment of ascent, the second wheelset touches the right rail, as a result of which the transverse guiding force  $Y_2$ , arising in the right wheel of the second wheelset in the direction of movement, is directed inward to the gauge, i.e. there is maximum crossing type wagon positioning. At the same time, the frictional force  $\Phi_y$  at the same point is directed outward from the gauge and has a greater value than the guiding force  $Y_2$ . All this causes a shift of the rear part of the wagon (its second wheelset) towards the center of the transition curve, i.e. inward (to the right) in the curve. The situation is combined with the galloping of the wagon, caused both by the rail track (whose parameters are within the thresholds set by the normative documents), and by the spring suspension (also within the thresholds set by the norms) and the small mass of the wagon (empty).

The result is an unfavorable combination of the angular rotation of the wagon about its central transverse axis (*galloping*) at the top of the half-wave of oscillation and its positioning in the transition curve (*maximum overshoot*) where the right wheel of the second wheelset touches the right rail with the predominant influence of the frictional force  $\Phi_y$ , directed inwards (to the right) towards the center of the transition curve at a speed of 54 km/h, which turns out to be critical and favors the development of both phenomena.

#### 4.1.7. Infrastructure manager.

##### Analysis of the railway infrastructure condition.

The place of the rise of the wheel was 5 m after the turn at km 28+192 and 5 m before the beginning of the previous curve at km 28+202. The flange moved along the head of the rail for 2.30 m

and at km 28+199.30 m the wheel slide off the right side of the right rail beyond the reach of the PAK-68I fastener connecting the rail to the sleepers. The derailment of the right wheel was followed by the sliding of the left wheel on the wheelset in the gauge on the inside of the left rail. At the time of the derailment of the second wheelset of the penultimate wagon, the locomotive was located around km 28+773. When the right wheel jumped on the second wheelset of the penultimate wagon (empty), the wheelset was located at km 28+197 at a distance of 5 m from the track at km 28+192 on the side of the Lyubenovo transfer station. At the same time, the first wheelset of the last wagon – also empty, was located at km 28+189.75 at a distance of 7.25 m from the second wheelset of the penultimate wagon and 2.25 m before the start of km 28+192. The ascertained vertical collapse because of the vertical deformation of the rails in the joints of the right and left rails in the direction of the train's movement, had values of 18 to 19 mm, when measured with the EM-120 track-measuring laboratory on 14.11.2023. The difference of 0,5 to 1,5 mm proved that in the transverse direction the rail track was above the required 17.5 mm for class "C" for speed  $\leq 60$  km/h, according to "Temporary instruction for evaluation of the rail track with the Track measuring laboratory EM- 120 Plasser & Theurer'.

After the derailment of both wheels on the second wheelset, the right went to the right of the right rail and the left in the gauge. During their movement, they did not damage the rail track because the wagon was empty. Thus, the derailed wheelset ran for 8.887 km to the beginning of the entrance switch No. 2 at Radnevo station at km 37+084. As the derailed wheelset entered switch 2, the right wheel moved to the right of the right guardrail and the intermediate inner diverter rail. The left wheel, after the tire stroke in the left open diverter switch point, moved into the gauge of the diverter track, to the right of the diverter switch point and the inner diverter intermediate rail. During that time, the first and second wheelsets of the last wagon moved normally along the straight element of the switch, but due to the distance of the derailed first wheelset was caused the derailment of the two wheelsets of the last 32nd wagon.

The left wheel on the second wheelset of the penultimate 31st wagon went airborne through the canal and hit the canal step head-on, while the right wheel was about 20 cm from the right side of the right rail of the second track. Due to the strong impact on the canal steps before the platform, two side doors from the penultimate wagon fell out.

The tracks from the first wheelset of the last 32nd wagon were outlined, with the left wheel running on the inside and the right wheel about 1m from the right side of the second track. The wheels on the second wheelset of the last 32nd wagon moved between the second and third tracks and the wagon subsequently tilted to the left. In the area of the platform, the derailed wheelsets also caused serious damage to the sleeper grid, where the first wheelset of the penultimate 31st wagon, attached to the 30th wagon of the train composition, also derailed.

Due to non-coordinated actions between SE NRIC and "DB Cargo Bulgaria" EOOD regarding the measurement of the rail track along the axis and hidden gaps, the parameters were not measured and there was no data about them in the finding protocol.

From the analysis of the graphic printout during the measurement of the rail track with the EM-120 track-measuring laboratory on 14.11.2023 from km 27+400 to 28+800, the following was found:

- Longitudinal sag of the right rail of 12 joints with a value of 18 to 19 mm at admissible 17.5 mm for the fifth category rail track speed for speed  $V \leq 60$  km/h
- Longitudinal sag of the left rail of 11 joints with a value of 18 to 19 mm at admissible 17.5 mm for  $V \leq 60$  km/h.

These values indicate that the vertical sags were due to vertical deformations of the rails at the ends of the joints. At these values, it is imperative to further limit the speed or take measures to repair the rail track, especially the joints.

Rail track measurement did not find that at the right wheel bounce point at km 28+197 was no any sag.

#### Assessment of the rail track condition

The assessment was prepared based on data from the finding protocol of the Task Force for the rail track level and gauge and a visual assessment of the condition of the rail track by axis and hidden gaps. The jumping of the right wheel of the second wheelset of the penultimate 31st wagon with a length

of 17.25 m and a mass of 17,800 kg (8,900 kg per wheelset) occurred at km 28+197. Two paired wooden crossbars support the structure. Two ST-6 reinforced concrete sleepers with SKL-14 elastic fasteners were replaced on both sides. The track gauge is 1430 mm (-5 mm). The joint is located in a transitional curve with a length of L=98 m, a circular curve R = 400 m and an overhang H= 90 mm.

State of the rail track under gauge:

The smallest track gauge was measured at km 22+192 with a value of 1430 mm, (-5 mm) with a permissible 1429 mm (-6 mm).

The clearance at point "O" – the point of the right wheel bounce is  $1362+30+30+X = 1439$  mm, where:

1362 mm is the distance between the inner surfaces of the right and left wheels of the second wheelset of the penultimate 31st wagon;

1439 mm is the gauge at point "O";

The thickness of both flanges is 30 mm.

The clearance between wheel and rail has a value of  $X = 17$  mm with an allowable range of 9 mm to 25 mm. That confirms that the right wheel bouncing was not due to the right wheel jamming with the working part of the right railhead in the direction of train travel.

The ballast prism around the derailment area was in good condition without tempering;

The sleepers are ST-4, with the exception of the paired joint at km 22+192, around which there were 2 reinforced concrete sleepers ST-6;

Rails type S49 with length L=25 m, supported joints without lateral and vertical engagement of the rails. In the joints, the rails have vertical deformations on both sides of the rail track with almost the same values, which was not with large differences in the transverse level of the rail track;

The thermal gap of the instruction at km 22+192 was 19 mm in norm;

There was no missing or loose fastener around the derailment area;

State of the rail track by level:

The base of the wagon is 10 m (distance between the two wheelsets).

p. „0“ = 24 mm, p.(-10) = 15 mm, Difference = 9 mm;

$K = \frac{L}{H} = \frac{10 \times 1000}{9 \text{ mm.}} = \frac{10\,000 \text{ mm.}}{9 \text{ mm.}} = 1111, \kappa = 1: 1111$ , within admissible 1:400 for speed greater than 50 km/h.

The inclination of the transition between the derailed second wheelset and the first wheelset of the last 32<sup>nd</sup> wagon, distance 7,25 m.

p. „0“ = 24 mm, p. 7 = 37 mm, Difference: 13 mm.

$K = \frac{L}{H} = \frac{7 \times 1000}{13 \text{ mm.}} = \frac{7000 \text{ mm.}}{13 \text{ mm.}} = 538, \kappa = 1: 538$

Within admissible 1:400 at  $V > 50$  km/h.

#### 4.1.8. Entities in charge of the technical maintenance.

SE NRIC has a Certificate of Entity in charge of maintenance with scope of activity –freight wagons, passenger coaches and specialized cars for dangerous goods transport;

"DB Cargo Bulgaria" EOOD has a Certificate of Entity in charge of maintenance, with a scope of activity - diesel and electric locomotives, freight wagons and specialized wagons for the transport of dangerous goods;

#### 4.1.9. Manufacturers or providers of rolling stock and railway products.

Non-applicable.

#### 4.1.10. National Safety Authority.

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

#### 4.1.11. Notified bodies or Risk assessment bodies.

"TINSA" EOOD owns Permit No. 002-2 for carrying out activities to evaluate activities of a subsystem or a part of a subsystem with the requirements of the national safety rules or with the technical rules, valid from 15.07.2021.

Scope of permission

Subsystems:

- Energy;
- Infrastructure;
- Control, command and signalling;
- Rolling stock - freight wagons;
- Rolling stock - locomotives and passenger rolling stock.

"TINSA" EOOD holds Certificate No. BG/36/0021/0001 for an assessment body for performing an independent assessment of the implementation of the risk management procedure and its results, valid from 02.05.2023 to 02.04.2026.

Scope of evaluation activities

Structural areas of the railway system:

- Infrastructure;
- Energy;
- Control, command and signaling on railway lines;
- On-board control, command and signalling;
- Rolling stock.

Functional areas of the railway system:

- Traffic operation and management;
- Maintenance;
- Telematic applications for freight and passengers.

Assessing the overall coherence of risk management:

- The organization;
- The methodology;
- Technical aspects necessary to assess the compliance and completeness of the risk assessments and the safety level of the system.

#### *4.1.12. Certifying bodies of the entities in charge of the technical maintenance.*

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

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

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

##### Railway infrastructure

- SE NRIC implements Safety Procedure SP 2.09 "Methodology for determining, assessing and managing of the risk" version 06 effective from 01.09.2021, part of the SMS.

##### Railway undertaking

- "DB Cargo Bulgaria" EOOD implements Procedures "PR 22-05 Risk assessment in case of changes in the transport system, PR 22-05-01 Hazard identification and risk calculation and PR 22-05-03 Control and assessment methods of risk.

#### **4.2. Rolling stock and technical facilities.**

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

Non-applicable.

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

Non-applicable.

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

Non-applicable.

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

Non-applicable.

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

Non-applicable.

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

Non-applicable.

#### **4.3. Human factor:**

4.3.1. *Individual human characteristics:*

4.3.1.1. *Training and development, including skills and experience.*

##### Railway undertaking:

• Locomotive driver of locomotive № 91521688030-1:

- Diploma No. 11215, "Railway technology - electric locomotives", training conducted in the period 18.05 ÷ 22.07.2009, training institution PQC at BDZ, issued by Railway Administration Executive Agency“;

- Locomotive driving license BG 71 2017 1295 issued by RAEA;

- Certificate № 158 for holding the position "Locomotive driver" in "DB Cargo Bulgaria" EOOD from 01.08.2016.

- Additional certificate issued by "DB Cargo Bulgaria" EOOD for rolling stock for which the driver is allowed to drive - series E 43.000, 44.000 and 45.000 from 03.08.2009 and series E 86.000 and 88.000 from 21.03.2014, valid from 23.08.2017 on the national railway infrastructure of the Republic of Bulgaria and at the border crossings of Kapikule and Dimitrovgrad (ZHS).

• Assistant locomotive driver of locomotive № 91521688030-1:

- Certificate of professional qualification № 25417, with acquired professional qualification "Locomotive driver", training conducted in the period 20.05. ÷ 21.07.2023 educational institution, VTU "Todor Kableshkov" - Sofia issued by Railway Administration Executive Agency;

- Certificate No. 397 for holding the position of "Assistant engine driver, locomotive" in "DB Cargo Bulgaria" EOOD from 01.10.2023.

• Wagon inspector in Svilengrad station:

- Certificate of professional qualification № 15881, with acquired professional qualification "Inspector wagons", training conducted in the period 10.10. ÷ 10.03.1992, training institution under 58950, issued under 58950 at the Ministry of Transport;

- Certificate № 370 for holding the position of "Inspector wagons" in "DB Cargo Bulgaria" EOOD from 30.08.2022.

##### Railway infrastructure:

• Traffic manager in Radnevo station:

- Diploma № 19135, acquired qualification "Railway Transport Operation", conducted training in the period 1978 ÷ 1981, issued by PZI, Todor Kableshkov - Sofia;

- Certificate № 1290 for holding the position of "Traffic Manager" in TOSAMD - Plovdiv from 16.03.2022.



- Switchman/crossing guard in Radnevo station:
  - Certificate of professional qualification № 5406, with acquired professional qualification “Crossing guard“, training conducted in the period 08.01. ÷ 16.02.2007, training institution PQC at SE NRIC, issued by RAEA;
  - Certificate № 62 for holding the position of Switchman/Crossing guard in TOSAMD - Plovdiv from 17.06.2022.

- Head of railway section:
  - Certificate of professional qualification № 4390, with acquired professional qualification, Construction technician“, training conducted in the period 28.11. 2005 ÷ 16.05.2006, training institution PQC at SE NRIC, issued by Railway Administration Executive Agency;
  - Certificate № 227 for holding the position „Head of section“ RRS in RS – Burgas from 06.02.2018.

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

Railway undertaking:

- Locomotive driver of locomotive № 91521688030-1:
  - Medical card dated 15.12.2022, issued by National multi-profile transport hospital Plovdiv.  
Conclusion: suitable for locomotive driver.
  - Psychological certificate № 932/15.09.2022, issued by National multi-profile transport hospital Plovdiv for locomotive driver.  
Conclusion: allowed for a period of 5 years until 29.07.2026.

- Assistant locomotive driver of locomotive № 91521688030-1:
  - Single health dossier № 1367 dated 01.06.2022, issued by National multi-profile transport hospital Sofia.  
Conclusion: suitable for Assistant locomotive driver.
  - Psychological certificate № 501/03.04.2023, issued by Psychological laboratory National multi-profile transport hospital Plovdiv for locomotive driver.  
Conclusion: allowed for a period of 5 years until 03.04.2028.

- Wagon inspector in Svilengrad station:
  - Medical card dated 26.05.2022, issued by National multi-profile transport hospital Plovdiv.
  - Conclusion: suitable for wagon inspector
  - Psychological certificate № 664/03.06.2022 issued by Psychological laboratory at National multi-profile transport hospital Plovdiv for locomotive driver.  
Conclusion: allowed for a period of 5 years until 03.06.2026.

Railway infrastructure:

- Traffic manager in Radnevo station:
  - Single health dossier dated 18.10.2023, issued by Psychological laboratory at National multi-profile transport hospital Plovdiv for traffic manager.  
Conclusion: allowed for traffic manager.
  - Psychological certificate № 1318/14.11.2023, issued by Psychological laboratory at National multi-profile transport hospital Plovdiv for traffic manager.  
Conclusion: allowed for a period of 3 years until 14.11.2026.

- Switchman/crossing guard in Radnevo station:
  - Medical card dated 07.04.2023, issued by National multi-profile transport hospital Plovdiv.  
Conclusion: suitable for Switchman/crossing guard.
  - Psychological certificate № 479/13.04.2022, issued by Psychological laboratory at National multi-profile transport hospital Plovdiv for switchman/crossing guard.  
Conclusion: allowed for a period of 5 years until 13.04.2027.

- Head of railway section:  
Medical card dated 12.10.2023, issued by Psychological laboratory at National multi-profile transport hospital Plovdiv.

Conclusion – suitable for „Head of section“ RRS.

#### *4.3.1.3. Fatigue.*

##### Railway undertaking:

- Locomotive driver of locomotive № 91521688030-1:

Rest: from 27.01.2024 hour 23 minutes 00 until 02.02.2024 hour 23 minutes 30

Started work: 02.02.2024 hour 23 minutes 30 – (144 hours and 30 min.)

- Assistant locomotive driver of locomotive № 91521688030-1:

Rest: from 27.01.2024 hour 23 minutes 00 until 02.02.2024 hour 23 minutes 30

Started work: 02.02.2024 hour 23 minutes 30 – (144 h. and 30 min.)

- Wagon inspector in Svilengrad station:

Rest: from 31.01.2024 hour 18 minutes 00 until 03.02.2024 hour 06 minutes 00

Started work: 03.02.2024 hour 06 minutes 00 – (60 hours and 00 min.)

##### Railway infrastructure:

- Traffic manager in Radnevo station:

Rest: from 31.01.02.2024 hour 19 minutes 00 until 03.02.2024 hour 07 minutes 00

Started work: 03.02.2024 hour 07 minutes 00 – ( 60 hours and 00 min.)

- Switchman/crossing guard in Radnevo station:

Rest: from 01.02.2023 hour 07 minutes 00 until 03.02.2024 hour 07 minutes 00

Started work: 03.02.2024 hour 07 minutes 00 – (48 h. and 00 min.)

- Head of railway section:

Rest: from 02.02.2024 hour 17 minutes 00 until 03.02.2024 hour 10 minutes 30

Started work: 03.02.2024 hour 10 minutes 30 – (17 h. and 30 min.)

#### *4.3.1.4. Motivation and attitudes*

Non-applicable

#### *4.3.2. Work related factors:*

##### *4.3.2.1. Tasks planning.*

##### Railway infrastructure:

- SE NRIC carries out maintenance, repair and operation of the railway infrastructure. Prepares timetables and schedules on requests submitted by railway undertakings/carriers for the movement of passenger and freight trains and vehicles on all main and branch lines of the railway network.

According to the issued Certificate of ECM, they carry out maintenance activities for freight and passenger wagons, RSPM and wagons specialized for the transport of dangerous goods;

##### Railway undertaking:

- "DB Cargo Bulgaria" EOOD carries out rail transportation of cargo according to the Plan for composing the trains, according to the Schedule for the movement of trains and additionally requested and assigned by request to the manager of the railway infrastructure. The railway company is certified by the National Safety Authority to perform repairs on freight wagons.

According to the issued ECM Certificate, they carry out maintenance activities for diesel and electric locomotives, freight wagons and wagons specialized for the transport of dangerous goods;

#### *4.3.2.2. Constructive particularities of the facilities that influence the connection human-machine.*

Non-applicable.

#### *4.3.2.3. Communication means.*

The communication links in Radnevo station, with the relevant switch posts in the station, with the adjacent stations and with the train dispatcher of the section are carried out with the DCCM 8. The station is equipped with a train dispatch radio link (TDRC),

The shift traffic manager on duty at the Radnevo station, as well as the locomotive crew of locomotive № 91521688030-1, are provided with official mobile phones.

The two cabins of locomotive No. 91521688030-1 are equipped with a locomotive radio station for train dispatching radio communication (TDRC)

#### *4.3.2.4. Practices and processes.*

Non-applicable.

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

The entities apply national and departmental normative acts and instructions in relation to the SMS.

#### *4.3.2.6. Working time of the involved personnel.*

The personnel of the two entities involved in the accident worked on a shift basis, for which a cumulative calculation of working time in a 12-hour work shift is applied. In accordance with the requirements for the working hours of the management and executive staff, who are engaged in ensuring the transport of passengers and cargo in railway transport, the activity is carried out in accordance with the provisions of Ordinance No. 50 of 28.12.2001. and the Labour Code.

#### *4.3.2.7. Risk treatment practices.*

##### Railway infrastructure

- SE NRIC applies safety procedure SP 2.09 „Methods of evaluation, assessment and management of the risk „version 06 effective from 01.09.2021, which is part of the SMS.

##### Railway undertaking

- "DB Cargo Bulgaria" EOOD implements Procedures "PR 22-05 Assessment of risk in case of change in the transport system, PR 22-05-01 Identification of hazards and calculation of risk and PR 22-05-03 Methods of control and Risk Assessment

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

Non-applicable.

#### *4.3.3. Organizational factors and tasks:*

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

In both entities SE NRIC and "DB Cargo Bulgaria" EOOD, the work and workload of personnel directly related to the safety of rail transport is planned in accordance with the requirements of national regulations, approved methodologies and good European practices.

##### *4.3.3.2. Communications, information and teamwork.*

Non-applicable.

##### *4.3.3.3. Recruitment, staffing requirements, resources.*

###### Railway undertaking:

- At "DB Cargo Bulgaria" EOOD, personnel selection is carried out in accordance with the "WP-4401-01/3 Manual for an integrated quality and safety management system", which includes a Personnel Selection Procedure. "DB Cargo Bulgaria" EOOD has a certified quality management system according to the ISO 9001:2015 standard; "Staff training and development plan". The railway undertaking carries out an annual staff development assessment.

###### Railway infrastructure.

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

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

The recruitment, selection and appointment of personnel is carried out by the "Human Resources Management" department, which is responsible for:

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

#### *4.3.3.4. Implementation management and supervision.*

##### Railway infrastructure:

###### SE NATIONAL RAILWAY INFRASTRUCTURE COMPANY

Bureau Veritas Certification Holding SAS – UK Branch certifies that the management system of the above organization has been assessed and found to be in compliance with the requirements of the management standard ISO 9001:2015 with initial certification 12-03-2009, the certificate is valid until 11-03-2027.

Scope of certification - Management of processes for the provision of railway infrastructure to licensed carriers, management and control activities of development, repair, maintenance and operation of railway infrastructure, collection of infrastructure fees, development of train timetables, management of train operations, railway infrastructure, preparation, maintenance and storage of a register for the land and sites of the railway infrastructure, implementation of an investment policy in the development and modernization, maintenance and repair of the railway infrastructure.

In the period 21.02.-22.02.2024, an audit was carried out by an independent auditor, "Bureau Veritas Bulgaria" EOOD, in the SE "NC Railway Infrastructure", which certifies that the management system in the railway enterprise has been assessed and compliance with the requirements has been established of the Quality Management System standard in accordance with the requirements of ISO 9001:2015. The certificate was renewed on 05.03.2024.

##### Railway undertaking:

###### DB CARGO BULGARIA EOOD

Bureau Veritas Certification Holding SAS – UK Branch certifies that the management system of the above organization has been assessed and found to be in compliance with the requirements of the management standard ISO 9001:2015 with initial certification 30-07-2013, the certificate is valid until 29-07-2025.

Scope of certification - Maintenance of rolling stock.

On 05/07/2024, a second supervisory audit was carried out at "DB Cargo Bulgaria" EOOD by an independent assessor Bureau Veritas Certification Holding SAS - UK Branch, which certifies that the management system in the railway enterprise has been assessed and compliance with the requirements of standard for Quality Management System in accordance with the requirements of ISO 9001:2015. The certificate was renewed on 18.07.2024.

#### *4.3.3.5. Compensation (remuneration).*

##### Railway undertaking:

• "DB Cargo Bulgaria" EOOD implements "Internal rules for salaries" in force from 01.05.2018, which regulate issues related to the salaries of personnel in the enterprise:

- General;
- Structure and organization of the salary;
- Procedure and method for determining and amending individual wages;
- Procedure and method for determining and amending the additional labour remuneration;
- Calculation of due wages;

- Protection of company secrets;
- Transitional and final provisions.

At "DB Cargo Bulgaria" EOOD, the staff involved in the operation is on a permanent basic employment contract. Remunerations are formed according to the employment contracts for each position. In the railway undertaking, there is an approved procedure in accordance with national regulations for additional pay considering the working conditions for each position.

Railway infrastructure.

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

- General provisions for the organization of the salary in the entity;
- Determining and distributing the funds for wages - sources, order and way of forming the remuneration;
- Determination and amendment of wages and additional remuneration;
- Regulation, order and method of payment of wages.

*4.3.3.6. Leadership, powers related issues.*

Non-applicable.

*4.3.3.7. Organizational culture.*

Non-applicable.

*4.3.3.8. Legal issues (including the respective European and national rules and provisions).*

Non-applicable.

*4.3.3.9. Regulatory framework conditions and safety management system application.*

Railway undertaking.

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

Railway infrastructure.

- Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety;
- Commission Delegated Regulation (EU) 2018/762 of 8 March 2018 establishing common safety methods on safety management system requirements pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulations (EU) No 1158/2010 and (EU) No 1169/2010;
- COMMISSION IMPLEMENTING REGULATION (EU) 2019/779 of 16 May 2019 laying down detailed provisions on a system of certification of entities in charge of maintenance of vehicles pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 445/2011;

- COMMISSION IMPLEMENTING REGULATION (EU) No 402/2013 of 30 April 2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009;
- Railway Transport Act;
- ORDINANCE No 59 dated 5.12.2006 on the railway transport safety management.

*4.3.4. Environmental factors:*

Non-applicable.

*4.3.4.1. Labour conditions (noise, illumination, vibrations).*

Non-applicable.

*4.3.4.2. Meteorological and geographic conditions.*

The Lyubenovo transmission and Radnevo stations are located in the southeastern part of the railway network;

Described in detail in item 3.1.3.1.

*4.3.4.3. Construction works, performed on the spot or in very proximity.*

Construction works on the railway infrastructure on 03/02/2024 at Radnevo station and at the Lyubenovo transfer station - Radnevo, in the area of the accident, were not carried out.

*4.3.5. Any other significant factor for the investigation objectives.*

Non-applicable.

***4.4. Feedback and control mechanisms, including risk and safety management, as well as monitoring processes:***

*4.4.1. Regulatory framework conditions.*

Commission Delegated Regulation (EU) 2018/761 of 16 February 2018 establishing common safety methods for supervision by national safety authorities after the issue of a single safety certificate or a safety authorisation pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No 1077/2012

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

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

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

*4.4.2.1. Railway undertaking.*

- "DB Cargo Bulgaria" EOOD implements IMPLEMENTING REGULATION (EU) No. 402/2013 OF THE COMMISSION dated April 30, 2013 regarding the general safety method for the determination and assessment of risk and for the repeal of Regulation (EC) No. 352/2009 and procedures from SMS: Process "OD 22-05-01/01 Risk Assessment", procedure Methodology for determining and assessing risks in the case of changes in the railway transport system in "DB Cargo Bulgaria" EOOD, "Manual for safety management";

- Changes in the activity of "DB Cargo Bulgaria" EOOD, related to the accident that occurred and which fell under the definition of "substantial" in the sense of IMPLEMENTING REGULATION (EU) No. 402/2013, were not carried out.

*Railway Infrastructure Manager*

- SE NRIC applies Safety Procedure SP 2.09 "Methodology for identification, assessment and risk management" version 06 in force from 01.09.2021, which is part of the SMS.
- Changes in the activity of SE NRIC, related to the accident that occurred and which fell under the definition of "substantial" in the sense of IMPLEMENTING REGULATION (EU) No. 402/2013, were not carried out.

#### *4.4.2.2. Entities in charge of the technical maintenance.*

##### Railway undertaking

- "DB Cargo Bulgaria" EOOD holds a Single Certificate for an entity in charge of maintenance of locomotives and wagons No. BG/31/0021/0002 with a validity period from 21/05/2021 to 20/05/2026.
- "Express Service" Ltd. has a Maintenance Function Certificate No. FM/BGRA/2020/0003 of an entity in charge of maintenance of diesel and electric locomotives and specialized railway maintenance machines with a validity period of 30.07.2020 until 16.06.2025.

##### Railway infrastructure

- SE NRIC has a Certificate of ECM No. BG/31/0023/0001 valid from 22/03/2023 to 21/03/2028.;

#### *4.4.2.3. Producers and all other participants.*

6.1.1. Owner of wagon No. 21802475039-8 – DB Cargo AG – derailed first from the composition of IDFT No. 46660 with regular registration in the European register of authorized vehicle types and Subject responsible for maintenance – TÜV SÜD Rail GmbH • Certification Body, Member State in which the vehicle is registered DE (Germany);

6.1.2. Owner of wagon No. 21802475230-3– DB Cargo AG – derailed second from the composition of IDFT No. 46660 with regular registration in the European register of authorized vehicle types and Entity responsible for maintenance – TÜV SÜD Rail GmbH • Certification Body, member state in which the vehicle is registered DE (Germany).

#### *4.4.2.4. Reports for independent risk assessment.*

"TINSA" Ltd. holds Certificate EIN BG/36/0021/0001 of an assessment body for carrying out an independent assessment of the application of the risk management procedure and its results, valid from 05/02/2021 to 04/02/2026. Provided report dated 14.11.2023 of the SE NRIC on measurements of the rail track in the section of the 83rd diversion Simeonovgrad - Nova Zagora.

#### *4.4.3. Safety management system of the involved*

##### Railway undertaking.

- "DB Cargo Bulgaria" EOOD implements the "Safety Management System Manual" effective from 05.05.2010, which includes Procedure "OD 22-05-01/01 Risk Assessment", procedure Methodology for determining and assessment of risks in the event of a change in the railway transport system in "DB Cargo Bulgaria" EOOD.

##### Railway infrastructure.

- SE NRIC implements a safety procedure SP 2.09 "Methodology for determining, assessing and managing the risk" version 06 effective from 01.09.2021, which is part of the SMS.

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

##### Railway undertaking.

- "DB Cargo Bulgaria" EOOD implements the "Safety Management System Manual" effective from 05.05.2010, which includes Procedure "OD 22-05-01/01 Risk Assessment", procedure Methodology for determination and assessment of the risks in the event of a change in the railway transport system in "DB Cargo Bulgaria" EOOD.

- "Express Service" Ltd. implements an Integrated Management System, "Working Procedure WP 05-0-01/19.04.2023. Entity in charge of maintenance of diesel and electric locomotives and freight wagons.

##### Railway infrastructure.

- SE NRIC implements Safety Procedure WP 7.01 "Regulations for maintaining the signalling system (Signalling equipment)", which is part of the SMS;
- SE NRIC implements approved "Rules for current maintenance of a rail track" in force from 2021.

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

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

##### *Railway undertaking:*

1. In the period from 04.03.2020 to 06.03.2020, the National Safety Authority (RAEA) conducted an audit of "DB Cargo Bulgaria" EOOD within the framework of the procedure for issuing a Single Safety Certificate. No discrepancies were found during the audit.

2. In the period from 11.10.2022 to 12.10.2022, the National Safety Authority (RAEA) conducted an audit of "DB Cargo Bulgaria" EOOD within the framework of the procedure for issuing a Single Certificate to the structure in charge of maintenance. No discrepancies were found during the audit.

3. On 18.05.2023, the National Safety Authority (RAEA) conducted an audit of "DB Cargo Bulgaria" EOOD regarding the procedure for implementing the issued license.

##### *Railway infrastructure:*

1. In the period from 25.04.2023 to 05.05.2023, the National Safety Authority (RAEA) carried out an annual planned supervision of the SMS of SE NRIC for the renewal of the Safety Authorization in accordance with Delegated Regulation (EU) 2018/762 of the Commission for the establishment of common safety methods in relation to the requirements for SMS according to Directive (EU) 2016/798, no inconsistencies were found.

2. In the period from 22.04.2024 to 15.05.2024, the National Safety Authority (RAEA) carried out an annual planned supervision of the SE NRIC to establish common safety methods in relation to the requirements of the SMS according to Directive (EU) 2016/798 no discrepancies found.

##### *Entity in charge of maintenance:*

1. In the period from 06.06.2023 to 07.06.2023, the National Safety Authority (RAEA) conducted an audit of "Express Service" Ltd. for the issuance of a new certificate of compliance for a structure in charge of maintenance of vehicles according to the requirements of Commission Regulation (EU) 2019/779. Issued Certificate No. BG/31/0023/0003 for a railway carrier, valid until 12.06.2028.

2. In the period from 06.06.2023 to 07.06.2023, the National Safety Authority (RAEA) supervised the activity as a person performing maintenance functions, according to the current Certificate FM BGRA/2020/0003, valid from 03.07. 2020 until 16.07.2025 with the scope of the functions "Development of maintenance", "Management of maintenance" and "Performance of maintenance" of locomotives.

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

- SE NRIC has a renewed Safety Authorization No. BG 21/2023/0001, valid from 01/07/2023 to 30/06/2028;

- "DB Cargo Bulgaria" EOOD has a Single Safety Certificate BG 10 2020 0019, valid from 27.05.2020 to 26.05.2025;

- "Express Service" Ltd. owns a Railway Carrier's Certificate No. BGRA/2019/0008 valid from 24/11/2019 to 23/11/2024.

- "TINSA" Ltd. holds Certificate EIN BG/36/0021/0001 of an assessment body for performing an independent assessment on the implementation of the risk management procedure, valid from 02.05.2021 to 02.04.2026.



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

Non-applicable.

*4.4.6.2. Entities in charge of the technical maintenance.*

- SE NRIC has a Certificate of an entity in charge of maintenance No. BG /31/0023/0001, valid from 22.03.2023 to 21.03.2028 with scope of activity - Specialized vehicles for maintaining the railway infrastructure, Passenger coaches, second-class Bm and Freight wagons for transportation and maintenance of the railway infrastructure;

- "DB Cargo Bulgaria" EOOD has a Single Certificate of an entity in charge of maintenance of locomotives and wagons No. BG/31/0021/0002 with a validity period of 21.05.2026.

- "Express Service" Ltd. holds the Maintenance Function Certificate No. FM/BGRA/2020/0003 of an entity in charge of maintenance of diesel and electric locomotives, specialized vehicles for railway maintenance and other specialized vehicles with a validity period from 30.07.2020 to 16.06.2025.

"Express Service" Ltd., under a framework agreement with "DB Cargo Bulgaria" EOOD, performs maintenance functions for electric locomotives series 86.000 and 88.000 and diesel locomotives series 53.000, 56.000 and 07.000, according to the requirements of Ordinance No. 59/5.12.2006 for rail safety management.

*4.4.7. Other system factors.*

Non-applicable.

**4.5. Previous similar cases.**

Investigating railway accidents in NAMRTAIB has not investigated an accident of a similar nature.

## **5. Conclusions**

### ***5.1. Summary of the analysis for the event causes.***

The Investigation Commission got acquainted with the documentation collected and provided by SE NRIC and "DB Cargo Bulgaria" EOOD on the maintenance and operation of the railway infrastructure, as well as on the maintenance and operation of the derailed two wagons in the train.

The Investigation Commission carried out several detailed inspections of the rail track in the derailment area. It carried out several inspections of the two derailed wagons, deciphering the speed of the train in the Svilengrad - Radnevo section and analysis of the data from the GPS system for the movement of locomotive No. 91521688030-1 with IDFT No. 46660. It conducted an interview with the staff of the two entities of SE NRIC and "DB Cargo Bulgaria" EOOD. Analyzed the circumstances related to the technical condition and parameters of the rail track and found that an unfavorable combination of the angular rotation of the 31st wagon about its central transverse axis (galloping) in the upper part of the half-wave of oscillation and its positioning in the transition curve resulted (maximum crossing), in which the right wheel of the second wheelset touches the right rail with the predominant influence of the friction force directed to the right towards the center of the transition curve at a speed of 54 km/h, which turns out to be critical and favors the development of both phenomena.

The signalling systems at the Lyubenovo transmission and Radnevo stations were technically sound and were working normally before the accident.

The Commission analyzed the technical condition of the derailed two wagons from the composition of IDFT No. 46660. After the measurements, the Commission found that the derailed first 31st wagon No. 21802475039-8 and 32nd wagon No. 21802475230-3 were technically sound before the accident.

The place of derailment of the first wagon from IDFT No. 46660 is at km 28+197 in the Lyubenovo transfer station - Radnevo interstation. Because of the derailment of the wagon, it also dragged the last wagon No. 21802475230-3, which, when passing through the technical canal of the second track at Radnevo station, derailed to the right of the rail track with both tracks and tilted towards the platform of the track.

The speed of movement according to the schedule of the train between the stations Lyubenovo transfer - Radnevo was 60 km/h, the registered speed of the train at the time of the accident was 54 km/h.

It can be seen from the provided vehicle documents that before the accident IDFT No. 46660 was technically correct, provided with the necessary brake mass. Wagons 31 and 32 of the train were equipped with an automatic train brake.

### ***5.2. Undertaken measures after the event occurrence.***

The head of the investigation from the NAMRTAIB, after the inspections and coordination of the actions with the two entities, gave permission for the movement of the two derailed wagons from Radnevo station to RBCO-Karlovo for measuring the technical parameters.

The manager of the railway infrastructure undertook the restoration of the rail track in the Lyubenovo transfer station - Radnevo interstation and the facilities of the signalling equipment at the Radnevo station, without coordinating the restoration actions with the head of the safety investigation at the NAMRTAIB.

### ***5.3. Additional findings.***

1. Control measurements of the parameters of the derailed two wagons at RBCO - Karlovo of "DB Cargo Bulgaria" EOOD were carried out in the presence of the Investigation Commission at the NAMRTAIB. The measured values were normal.

2. After the analyzes of the data downloaded from the technical means for the movement of IDFT No. 46660 (locomotive recording device No. 91521688030-1 and data from the GPS system for tracking the movement of the locomotive), as well as from the testimony of the locomotive crew, the Investigation Commission in NAMRTAIB found that IDFT No. 46660 passed Lyubenovo Transfer Station without stopping, despite the statements and entries in the station logs of the duty manager at Lyubenovo Transfer Station and the train dispatcher that the train stopped at the station and stayed for 7 minutes from 9:58 a.m. to 10 :05 a.m.

## 6. Safety recommendations

In order to improve the safety in the rail transport, the Investigation Commission at NAMRATIB proposes to the Railway Administration Executive Agency (RAEA) the following safety recommendations adapted to SE NRIC and "DB Cargo Bulgaria" EOOD.

- Recommendation 1, proposes that SE NRIC and "DB Cargo Bulgaria" EOOD familiarize the interested personnel with the content of this report.

- Recommendation 2, proposes that "DB Cargo Bulgaria" EOOD, when accepting rolling stock at the border stations, which will be served by the railway company, to increase the quality and control when performing technical inspections.

- Recommendation 3, it is proposed that SE NRIC analyses the data provided by the licensed independent body "TINSA" Ltd., measured with the Track Measuring Laboratory EM-120 on 14.11.2023 at the Lyubenovo transfer station - Radnevo interstation and take measures to remove the vertical deformations of the rails in the joints exceeding the requirements of class "C" for speed  $\leq 60$  km/h.

- Recommendation 4, proposes that SE NRIC harmonizes the differences in the parameters for permissible deviations in the level of the instructions between the "Instruction for the construction and maintenance of the superstructure of the rail track and railway switches" and the "Temporary instruction for the evaluation of the rail track with the Track measuring laboratory" EM-120 Plasser & Theurer" at different speeds.

- Recommendation 5 proposes that SE NRIC increases the control to the "Transportation Safety" service (Chief Inspector of the RITS) regarding the quality when preparing the reports under Appendix 7, as well as the precise, complete and accurate completion of the finding protocols according to the presented samples in Ordinance No. 59.

With reference to the requirements of art. 24, paragraph 2 of Directive (EU) 2016/798, and art. 91, paragraph 3 of Ordinance No 59 dated 5.12.2006, the member of the Management Board of NAMRATIB on 01.08.2023 provides a final report that contains information on the investigation of the accident with formulated and agreed safety recommendations in order to improve safety in railway transport.

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

### **Chairperson:**

**Dr. Eng. Boycho Skrobanski**

*Deputy President of the NAMRATIB AB*