



MINISTRY OF TRANSPORTS AND INFRASTRUCTURE
ROMANIAN RAILWAY AUTHORITY - AFER

ROMANIAN RAILWAY INVESTIGATING BODY



INVESTIGATING REPORT

on the railway accident
occurred on the 31st of December 2010 in the railway station CFR Sinaia



*Final EDITION
the 22nd of February 2011*

NOTICE

With reference to the railway accident occurred on the **31st of December 2010**, at **5:25 a.m.**, on the range of activity of **CFR Bucharest Regional Branch**, the running section Ploiesti Vest-Brasov (double line electrified), **in the railway station CFR Sinaia**, on the switch no.7, consisting of **the derailment by the first axle of the locomotive EA 40-0622-7 towing the freight train no. 60760**, belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest followed by its restoration on the rails, Romanian Railway Investigating Body carried out an investigation, according to the provisions of the Government Decision no. 117/2010. Through the investigation, the information on the respective accident was gathered and analyzed, the conditions were established and the causes determined.

Romanian Railway Investigating Body investigation did not aim to establish the guilty or the responsibility in this situation.

Romanian Railway Investigating Body considers necessary to take corrective measures in order to improve the railway safety and to prevent the accidents, so it included in the report a series of safety recommendations.

Bucharest, the 22nd of February 2011

Approved by,
Dragoş FLOROIU
Director

*I agree the compliance with the
legal provisions on the
investigation performance and
drawing up of this Investigation
Report, that I submit for approval*

Chief Investigator
Sorin CONSTANTINESCU

This approval is part of the Report for the investigation of the accident occurred on the 31st of December 2010, at 5:25a.m., on the range of activity of CFR Bucharest Regional Branch, the running section Ploiesti Vest-Brasov (double line electrified), in the railway station CFR Sinaia, on the switch no.7, consisting of the derailment by the first axle of the locomotive EA 40-0622-7 towing the freight train no. 60760.

CONTENT

| | |
|--|-----------|
| I. Preamble | 4 |
| I.1. Introduction | 4 |
| I.2. Investigation process | 4 |
| | |
| A. <u>Brief presentation of the accident</u> | 5 |
| A.1. Brief presentation | 5 |
| A.2. Direct cause, contributing factors and root causes | 5 |
| A.2.1. Direct cause | 5 |
| A.2.2. Underlying causes | 5 |
| A.2.3. Root causes | 5 |
| A.3. Severity level | 5 |
| A.4. Safety recommendations | 6 |
| | |
| B. <u>Investigating report</u> | 6 |
| B.1. Description of the accident | 6 |
| B.2. Circumstances of the accident | 7 |
| B.2.1. Involved parties | 7 |
| B.2.2. Forming and equipments of the train | 8 |
| B.2.3. Railway equipments | 8 |
| B.2.4. Means of communication | 9 |
| B.2.5. Triggering the railway emergency plan | 9 |
| B.3. Consequences of the accident | 9 |
| B.3.1. Deaths and injuries | 9 |
| B.3.2. Material damages | 9 |
| B.3.3. Consequences of the accident in railway traffic | 10 |
| B.4. External circumstances | 10 |
| B.5. Investigation course | 10 |
| B.5.1. Summary of the involved staff statements | 10 |
| B.5.2. Safety management system | 11 |
| B.5.3. Norms and regulations. Sources and references for the investigation | 12 |
| B.5.4. Work of the technical installations, of the infrastructure and of the rolling stock | 12 |
| B.5.4.1. Data found on the line | 12 |
| B.5.4.2. Data found on the work of the rolling stock and on its technical installations | 15 |
| B.6. Analysis and conclusions | 16 |
| B.6.1. Conclusions on the technical condition of the railway superstructure and geometry | 16 |
| B.6.2. Analysis and conclusions on the occurrence of the train derailment | 16 |
| B.7. Causes of the accident | 18 |
| B.7.1. Direct cause | 18 |
| B.7.2. Underlying cause | 18 |
| B.7.3. Root causes | 18 |
| | |
| C. <u>Safety recommendations</u> | 19 |

I. PREAMBLE

I.1. Introduction

With reference to the railway accident occurred on the **31st of December 2010**, at **5:25 a.m.**, on the range of activity of **CFR Bucharest Regional Branch**, the running section Ploiesti Vest-Brasov (double line electrified), **in the railway station CFR Sinaia**, on the switch no.7, consisting of **the derailment by the first axle of the locomotive EA 40-0622-7 towing the freight train no. 60760**, belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest followed by its restoration on the rails, Romanian Railway Investigating Body carried out an investigation, according to the provisions of the Government Decision no. 117/2010, in order to prevent accidents with similar causes, by establishing the conditions and determining the causes.

OIFR investigation did not aim to establish the guilty or the responsibility in this situation, its objective being to improve railway safety and to prevent railway incidents or accidents.

I.2. Investigation process

According to the provisions of the art. 48, paragraph 1 of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, on the 31st of December 2010 Romanian Railway Investigating Body decided to start an investigation on the accident occurred on the range of activity of **CFR Bucharest Regional Branch**, the running section Ploiesti Vest-Brasov (double line electrified), **in the railway station CFR Sinaia**, on the switch no.7, consisting of **the derailment by the first axle of the locomotive EA 40-0622-7 towing the freight train no. 60760**, belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest (TFG) followed by its restoration on the rails.

Taking into consideration that the occurrence is defined as accident according to the art. 3 point 1 of the Law 55/2006 on railway safety and that this accident is relevant for the railway system, in accordance with the article 19 paragraph (2) of the Law no. 55/2006 on railway safety, corroborated with the art. 49, paragraph 2, letter a of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, the OIFR director decided to start an investigation. So, through the decision no. 43 from the 3rd of January 2011, of the OIFR director, the investigation commission was appointed consisting of:

- | | |
|------------------|---|
| ▪ STOIAN Eduard | - main investigator |
| ▪ DRĂGHICI Marin | - investigator |
| ▪ PAUL Sever | - investigator |
| ▪ TOADER Doru | - investigator |
| ▪ FLORIAN Lucian | - head of Regional Inspectorate SC- CF Bucharest Regional Branch |
| ▪ ANDREI Dumitru | - head of operation service TFG |

A. BRIEF PRESENTATION OF THE ACCIDENT

A.1. Brief presentation

On the **31st of December 2010**, at **5:25 a.m.**, on the range of activity of **CFR Bucharest Regional Branch**, the running section Ploiesti Vest-Brasov (double line electrified), **in the railway station CFR Sinaia**, passing over the switch no. 7, occurred the **derailment by the first axle of the locomotive EA 40-0622-7 towing the freight train no. 60760**, belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest followed by its recovery to its initial position (restoration on the rails).

The freight train no. 60760 belonging to the railway freight undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest, was running on the distance Blaj-Ploiesti Est and had in composition a secondary locomotive type DA 60-1006-0 by which were linked a number of 23 empty tank wagons.

Both were served by staff belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest.

There were no deaths or injuries.

A.2. Direct cause, contributing factors and root causes

A.2.1. The direct cause of this accident occurrence was the loss of guiding capacity of the first axle in the running direction of the locomotive (the driving axle) due to the rotation occurred under the circumstances of passing of the locomotive from duty braking regime to towing regime, at the running on a line in curve – counter-curve and in slope of 24.53%.

Contributing factors

- amplification of rotation phenomenon of the locomotive by its superposing over the rotation effect given by the system of the horizontal guiding forces of the rails on the two bogies, at the entrance in curve of the first axle from the first bogie in the running direction;
- the sinuous path in the area of the accident composed of two curves of opposite direction, without alignment and with different radii, the first bogie of the locomotive being on a curve and the second bogie on the other curve;
- the value of the rail twisting of 13 mm (to 12.5 mm admitted at the railway maintenance) measured at the base of 2.5 m;
- the switch no. 7 on which occurred the locomotive derailment had the slope of 24.53% towards the X end of the railway station CFR Sinaia;

A.2.2. Underlying cause

None.

A.2.3. Root cause

None.

A.3. Severity level

According to the provisions of the art. 3, letter l of the Law no. 55/2006 on railway safety, the event by its consequences is categorized as railway accident.

According to the provisions of the art. 7, paragraph (1), letter b of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, the event is categorized as railway accident.

A.4. Safety recommendations

None.

This report will be sent to the Romanian Railway Authority, to the Romanian Railway Safety Authority, to the manager of the public railway infrastructure CNCF “CFR” SA and to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest.

B. INVESTIGATING REPORT

B.1. Description of the accident

On the 30th of December 2010 the freight train no. 60760, belonging to the railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest, was sent from the railway station CFR Blaj in the path of the train 60608, at 10:10 p.m., having as destination the railway station CFR Ploiesti Est.

The train was composed of the towing locomotive EA 40-0622-7, followed by the secondary locomotive DA 60-1006-0, then were 23 empty tank wagons. The train belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest was driven and served by staff belonging to the same railway undertaking.

The running of the train since formation to the moment of the accident occurrence was without technical or railway safety problems, this having stops and stationing in the railway stations CFR Sighisoara, Brasov, Predeal and in the flag station Azuga (the last before the occurrence of the accident).

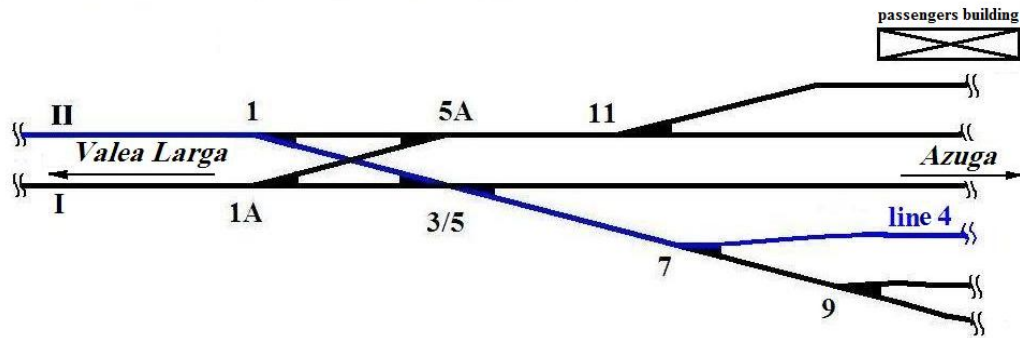
In the railway station CFR Sinaia, at 5:22 a.m., the freight train no. 60760 had passing path from the running wire II Busteni-Sinaia on the deviated line 4 with output on the running wire II Sinaia-Valea Larga, command performed with the help of the installation of centralization with which is equipped the railway station Sinaia.

For the passing path with output from the deviated line 4 to the running wire II Sinaia-Valea Larga the switches were handled in the installation CED as follows:

- switch no. 7 was handled on the position “on deviation”,
- TDJ no. 3/5 on the position on direct with access on the diagonal 1-3/5 from the leg 1-3/5-1A-3A;
- switch no. 1 was handled on the position “on deviation” with access on the running wire II Sinaia-Valea Larga.

The switches no. 7 and no. 1 were attacked from the heel and the TDJ no. 3/5 was attacked on the direction II-IV

The railway station CFR Sinaia X end



Passing over the switches from the X end of the railway station, in the area of the km 124+050 the driver and the driver assistant felt strong shakes followed by noises specific to the derailment. That moment the locomotive driver took actions to close the controller and to quick brake. During the period from the moment of the entry into action of the automatic brake and to its effect, the locomotive EA 40-0622-7 ran for about 80 m, the first axle derailing and returning on the rails several times.

When the train stopped the locomotive EA40-0622-7 was on the direct of the leg 1-3/5-1A-3A corresponding to the running wire I Valea Larga – Sinaia and the secondary locomotive DA 60-1006-0 was accordingly to the train path, respectively on the diagonal 5/3-1 from the leg with access to the running wire II Sinaia-Valea Larga having all the wheels on the rails.

The wagons in the composition of the train did not derail.



B.2. Circumstances of the accident

B.2.1. Involved parties

The running section where the railway accident took place is managed by CNCF “CFR” SA and maintained by its employees.

The railway infrastructure and superstructure are managed by CNCF “CFR” S.A. and maintained by the employees of the Lines district 7 Sinaia in Section L5 Campina, CF Bucharest Regional Branch.

Installations signaling, centralization and blocking (SCB) in the railway station CFR Sinaia are managed by CNCF “CFR” SA and maintained by the employees of the Section CT 4 Ploiesti, CF Bucharest Regional Branch.

The installation of railway communications between the H.m. Valea Larga and the railway station CFR Sinaia is managed by CNCF “CFR” SA and maintained by the employees of SC TELECOMUNICATII CFR S.A.

The installation of power and electric traction (IFTE) is managed by CNCF “CFR” SA and is maintained by the employees of S.C. ELECTRIFICARE CFR SA.

The installation of railway communications on the locomotive is the property of the railway undertaking S.N.T.F.M. “CFR Marfa” S.A. and is maintained by its employees.

The locomotive involved in the derailment is the property of the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest.

The investigation commission questioned the locomotive driver and the driver assistant who on the date of the accident drove and served the locomotive EA 40-0622-7 which towed the train.

B.2.2. Forming and equipments of the train

The freight train no. 60760 belonging to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest, was composed of 23 empty tank wagons having 92 axles, 643 gross tones, of which automatically braked according to the service book 322 tones, real automatically braked 602 tones, hand braked according to the service book 209 tones and real hand braked 586 tones and had a length of 365 meters.

The automatic brake of the train was active, the safety and vigilance equipments (DSV), the equipment for the point control of the speed and hitchhiking (INDUSI) in the equipment of the traction locomotive were active and instructionally working, the handle from the enclosure of the INDUSI installation which was on the position “M” corresponding to the freight trains.

B.2.3. Railway equipments

Description of the railway path

The railway oath in plan, in the area of the railway accident occurrence is composed of an assembly of two curves of opposite direction without alignment between them, the first in the running direction of the train (opposite direction to the mileage) being a curve with cart handle with left deviation having the radii $R_3=695$ m, $R_2=1250$ m, $R_1=735$ m and the other having right deviation was the curve of the switch no. 7 with radius $R=300$ m, the inflection point being composed of the joint of heel of the core of this switch.

In the profile along the railway path, in the area of the railway accident occurrence, is in slope of 24.53‰ (gradient in the running direction of the train).

The passage from the cart handle curve in the X end of the deviated line 4 to the circular curve of the switch no. 7 is made through a parabolic curve of connection with the length of 25 m.

Between the heel joint of the core of the switch no. 7 and the beginning of this curve there is no alignment.

The point where occurred the rail escalation from the outer wire of the curve of the switch no. 7 by the wheel on the right of the first axle of the locomotive (in the running direction of the train) is placed on the curve of this switch.

Description of the railway superstructure

In the area of the accident occurrence the railway superstructure is built of rail type 49, wooden sleepers, indirect clamping type K, path with joints.

The switch no. 7 on which area occurred the escalation of the rail from the outer wire of the curve of the switch by the wheel on the right of the first axle of the locomotive (in the running direction of the train) has the following features: type 49, radius $R=300$ m tangent $tg=1:9$, left deviation, flexible.

Description of the safety installations to control railway traffic

The flag station Valea Larga and the railway station CFR Sinaia are provided with installations signaling, centralization and blocking type CR2 with automatic line block.

The installation of railway traffic control on the running wire I between the flag station Valea Larga and the railway station CFR Sinaia is type automatic line block (BLA) bidirectional double line.

Description of the installations of force and power supply

The contact line, component of the installation of force and power supply, is composed of the catenary suspension and of its support system on the metallic pillars.

Between the flag station Valea Larga and the railway station CFR Sinaia wire I the catenary suspension is type complete compensated.

B.2.4. Means of communication

The communication between the locomotive driver and the movement inspectors and between the locomotive driver and the train party was provided through radiotelephone installations.

B.2.5. Triggering the railway emergency plan

Immediately after the occurrence of the railway accident, triggering the intervention plan to remove damages and to restore trains traffic was performed according to the provisions of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, after which were present representatives of the manager of the public railway infrastructure (CNCF "CFR" SA - CF Bucharest Regional Branch), of the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest, of the Romanian Railway Authority - AFER and of the Operative Department of Railway Transports Police.

B.3. Consequences of the accident

B.3.1. Deaths and injuries

None.

B.3.2. Material damages

The amount of the material damages according to the estimates prepared by the owner of the rolling stock and by the manager of the public railway infrastructure is the following:

- | | |
|---|---------------------|
| • at the locomotive EA 40-0622-7 | |
| according to the estimate no. 234/E/d/11/2011 | 5 584.50 lei |
| • at the lines | none |
| • at the installations | none |
| Total amount of the damages | 5 584.50 lei |

B.3.3. Consequences of the accident in railway traffic

The railway traffic was affected as follows:

- from 5:23 a.m. to 7:45 a.m. was closed the railway traffic on the running wire I and II Valea Larga-Sinaia;
- at 7:45 a.m. was reopened the railway traffic on the running wire II Valea Larga-Sinaia, with speed restriction of 10 km/h in deviation over the TDJ no. 3/5 and the switch no. 7;
- from 10:55 a.m. the railway traffic over the TDJ no. 3/5 was closed to replace the curved spring of the direction IV and at 11:52 a.m. after these works and the remove of the locomotive EA 066 the railway traffic on the wire I Valea Larga-Sinaia and TDJ no. 3/5 was reopened without speed limit;

Train delays: - 5 passenger trains with a total of 535 minutes.

B.4. External circumstances

On the 31st of December 2010, between 5:00 a.m. - 7:00 a.m. the visibility was good and the air temperature was of about -8⁰ C.

The visibility of the light signals was in accordance with the specific regulations in force.

B.5. Investigation course

B.5.1. Summary of the involved staff statements

The locomotive driver of the locomotive EA 40-0622-7, which towed the freight train no. 60760, stated as follows:

- on the 31st of December 2010 around 5:22 a.m. in the railway station CFR Sinaia the freight train no. 60670 had normal passing command from the running wire II Azuga-Sinaia with entry in deviation at the line 4 and exit from the line 4 in deviation on the running wire II Sinaia-Valea Larga;
- passing over the output switches in the X end of the railway station CFR Sinaia he felt a strong noise, moment when he took actions to quick braking;
- after he stopped the train and insured it with the automatic brake and with the hand brake, he went down from the locomotive and he checked its condition, finding that the locomotive he was driving was on the path corresponding to the running wire I Vale Larga-Sinaia and the secondary locomotive DA 60-1006-0 and the wagons in the composition of the train were on the line on the ordered path, respectively on the diagonal with access to the running wire II Sinaia-Valea Larga;

- even the locomotive he was driving was not derailed he found derailment signs at the wheels of the first axle of the first bogie in the running direction;
- the traction couple between the towing locomotive and the secondary locomotive was stretched to maximum;
- the general air pipeline was not broken;

The locomotive driver assistant from the locomotive EA 40-0622-7, which towed the freight train no. 60760, stated as follows:

- passing over the switch no. 7 he heard a strong noise, the locomotive inclined to the left, it started to vibrate, the locomotive entering a process of pitching until its stop by the locomotive driver who operated the quick braking system and the direct brake;
- after the train was stopped and insured against movement, he went down from the locomotive and he performed its outer inspection. After this inspection he found that the wheels of the first axle in the running direction had specific derailment signs. Also he found that the axle no. 3 had lost the cover on the right and the vertical dumper on the right of this axle and the one on the right of the axle no. 3 had friction signs;
- from the departure of the train from the railway station CFR Blaj to the occurrence of the accident were not recorded incidents in the running of the locomotive and implicitly of the train.

B.5.2. Safety management system

At the moment of the railway accident occurrence, CNCF “CFR” SA as manager of the railway infrastructure had implemented its own railway safety management system, according to the provision of the Directive 2004/49/CE on community railway safety, of the Law no. 55/2006 on railway safety and of the Order of the Minister of transport no. 101/2008 on granting the security authorization to the administrator / management of railway infrastructure in Romania, being in the possession of:

- Safety Authorization - Part A with the identification no. ASA09002 – through which the Romanian Railway Safety Authority from AFER confirms the acceptance of the safety management system of railway infrastructure manager;
- Safety Authorization - with the identification no. ASB9007 – through which the Romanian Railway Safety Authority from AFER confirmed the acceptance of the provisions adopted by the railway infrastructure manager to meet specific requirements necessary to ensure safety of rail infrastructure, in the design, maintenance and operation, including where appropriate, maintenance and operation of traffic control and signaling system.

At the moment of the railway accident occurrence, SNTFM “CFR Marfa” SA Bucharest as railway undertaking had implemented its own safety management system, according to the provisions of the Directive 2004/49/CE on community railway safety, of the Law no. 55/2006 on railway safety and of the Order of the Transport Minister no. 535/2007 on granting the safety certificate to perform railway transport services on Romanian railways.

On the 21st of April 2010 the railway undertaking entered in the possession of the following documents regarding its own railway safety management system:

- Safety certificate - Part A with the identification no. CSA0020 - through which the Romanian Railway Safety Authority from AFER confirms the acceptance of the safety management system of the railway undertaking;
- Safety certificate - Part B with the identification no. CSB0013 - through which the Romanian Railway Safety Authority from AFER confirmed the acceptance of the provisions adopted by the railway undertaking to accomplish the necessary specific requirements for safe operation on the relevant network in accordance with the Directive 2004/49/CE and with the applicable national legislation.

B.5.3. Norms and regulations. Sources and references for the investigation

In the investigation of the railway accident one took into account:

norms and regulations

- Railway Technical Operations Regulations no. 002, approved by the Order of the Minister of Transport, Constructions and Tourism no. 1186 on the 29th of August 2001;
- Order of the General Traction Directorate no. 310/4/a/2800/col. 1993 – Technical operation conditions for the axles of the electric locomotives – CFR;
- Instruction for setting terms and order for the rail inspections no. 305 approved by OMT no. 71 on the 17th of February 1997;
- Instruction for the lineman head of district for the rail maintenance no. 323/1965;
- Instruction for the activity of the foreman for the maintenance of the line no. 322/1972;
- Instruction for the flagmen and rail or dangerous points inspectors no. 321/1972;
- Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989;

sources and references

- copies of the documents required by the members of the investigation commission submitted as annexes to the investigation file;
- photos taken immediately after the railway accident by the members of the investigation commission;
- photos taken at the involved locomotive EA 40-0622-7, taken at the place of the accident and also at SC Locomotives Repairs Brasov SA-Repairs Section Brasov;
- documents on the lines maintenance provided by the responsible with their maintenance;
- results of the measurements performed immediately after the occurrence of the railway accident at the railway superstructure;
- inspection and interpretation of the technical condition of the elements involved in the accident: infrastructure, railway installations and train;
- questioning of the staff involved in the occurrence of the railway accident;

B.5.4. Work of the technical installations, of the infrastructure and of the rolling stock

B.5.4.1. Data found on the line

Technical condition of the line and of the path devices before the occurrence of the railway accident

The last maintenance work performed on the switch no. 7 in the railway station CFR Sinaia was performed in November 2010 and consisted of the replacement of the simple core of the switch on the existing sleepers in the path.

The last inspection of the switch no. 7 at which were performed checks of the gauge and of the cross level with the rail measuring pattern were performed in November 2010. The measured values at the respective moment did not exceed the tolerances admitted by the Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989.

Findings and measurements performed at the line after the occurrence of the derailment and the lift of the wagons

- a) the switch no. 7 – the place of the first sign of escalation of the rolling surface of the rail corresponding to the outer wire of the curve of the switch no. 7

The sleepers on the area of the switch were in appropriate condition, the clamping was complete and active.

The first sign of leave of the rolling surface of the rail head was found on the connection rail corresponding to the outer wire of the curve of the switch no. 5 at a distance of 1020 mm after the top joint on the left (in the running direction of the train). Starting from this point on the rolling surface of the rail head was found a sign left by the bandage rim of the wheel on the left of the first axle of the locomotive. This sign is on a length of 1170 mm then the wheel on the left derailed and fell outside this rail and the wheel on the right between the railway wires near the rail head of connection on the right.

The locomotive ran derailed by the first axle, its wheels rolling with the bandages rims on the rods ends of the vertical screws and on the beams between the counter-needles and the needles.

In the area of the 3rd sliding (counted from the top of the needles towards their heel) on the right counter-needle was found a sign of rolling of the bandage on its head on a length of 1100 mm.



b) the diagonal between the switch no. 7 and the cross with double junction TJD no.3/5

The line portion between the switch no. 7 and the TJD no. 3/5 is built of two panels of rail type 49, wooden sleepers, indirect clamping type K, path with joints.

On this line portion on the top ends of the rods of the vertical screws on the left of the left rail and on the left of the right rail were found rolling signs of the bandages rims.

Also were found slight signs of grinding of the edge of the metallic cover plates and of the ends of their horizontal screws.



c) *the cross with double junction TJD no. 3/5*

On the metallic parts of the TJD no. 3/5 were found several signs of hit, escalation and fall. The first signs were found on the direction IV, at the simple core of the switch no. 5 in the composition of the cross with double junction, on the top side of the 2nd support from the checkrail near the core and at the end of the elbow rail from the switch no. 7.

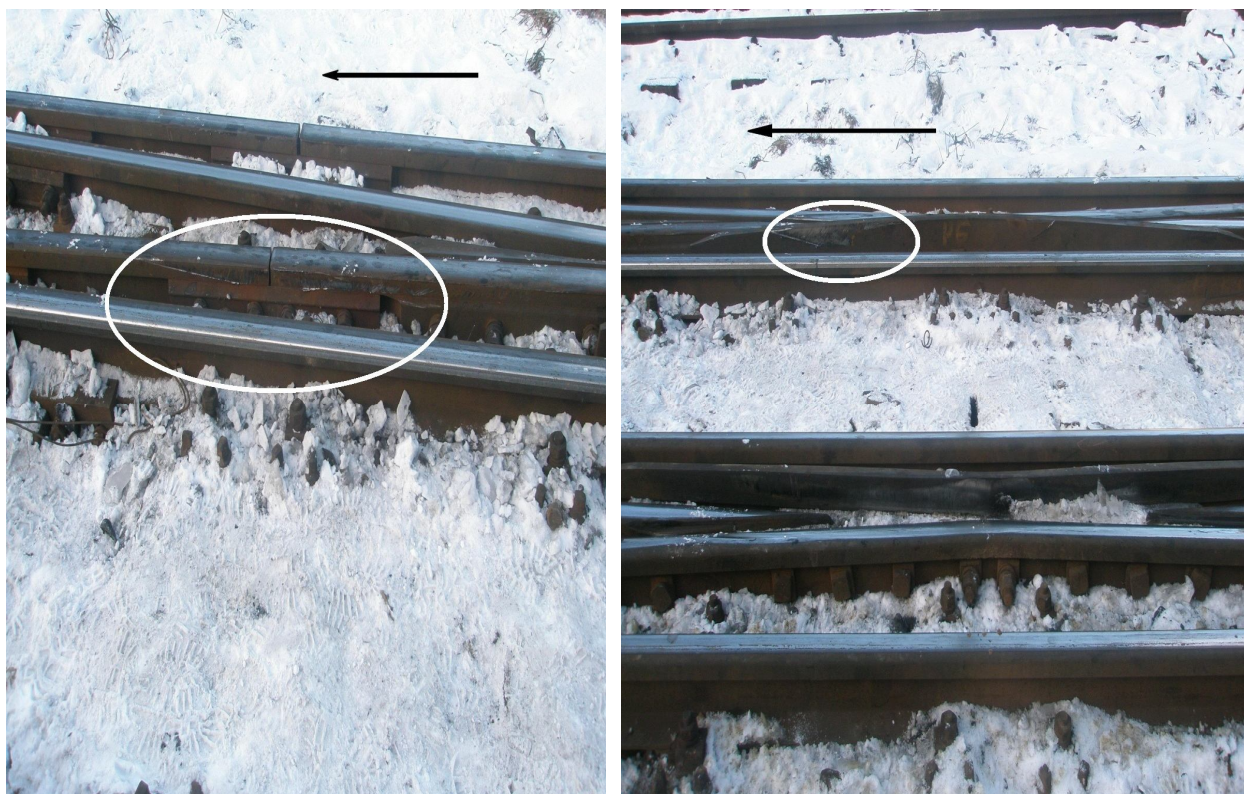


On the rolling surface of this crossing core were found also signs of rolling of the bandage rim of the wheel on the right.

Near the top joint of this core, which is also top joint for the top of the needles were found signs of rolling of the wheel on the left on the top side of the rods of the vertical screws on the left of the curved counter-needle, corresponding to the direction IV-I.

Near the heel joint of the curved needle of the direction IV wheel on the right of the first axle derailed, hit and curved this needle.

Specific signs of derailment were found also in the area of the heel joint of the needles on the direction IV and in the checkrail of the double core on the right.



d) *measurements performed at the line*

- from the place of the first sign found on the side surface between the railway wires of the rail corresponding to the inner wire of the curve, in the opposite of the running direction of the train, were performed with the rail measuring pattern checks of the gauge (E) and of the cross level of the path (N), in points marked at an equidistance of 2.5 m;

| No. point | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-----------------|-----|----|----|----|----|----|----|----|----|
| gauge (E) | 18 | 12 | -1 | 7 | 21 | 17 | 9 | 14 | 21 |
| cross level (N) | -16 | -3 | +4 | +2 | -1 | -7 | -1 | +5 | +4 |

Between the points 1 and 2 the value of the path twisting is of 13 mm to 12.5 admitted by the provisions of the Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989.

In the majority of the points the gauge has values bigger than the mounting ones, but the maximum value admitted in operation of 1470 mm (+35 mm) is not exceeded.

B.5.4.2. Data found at the work of the rolling stock and of its technical installations

Preliminary findings performed in the railway station CFR Sinaia at the locomotive EA 40-0622-7

The locomotive was stopped near the rhomb of the leg in the X end of the railway station Sinaia, all its wheels being on the rails.

At the wheels of the axle no. 1 were found specific signs of derailment.

Findings performed at the locomotive EA 40-0622-7 at SC Locomotives Repairs Brasov SA-Repairs Section Brasov

- the wheelbase of the locomotive is of 10300 mm;
- the distance between the extreme axle and the intermediate axle of the bogies is of 2250 mm;
- the distance between the intermediate axle and the inner axle of the bogies is of 2100 mm;
- there were performed measurements of the bandages rates of the locomotive wheels, inclusively the rate "D", in 3 points, the measured values being within the instructional values provided;
- after the measurement of the loads on the axle and of the mechanic strokes were not found exceeding of the values provided;
- there were not found construction or functional defects of the cross coupling, the couple length being of 977 mm;
- there were also found signs of hit of the bandages rims of the wheels on the left of the axles no. 4 and no. 5;
- the distance from the rolling surface of the rail head to the traction hook from the station no. 2 (towards the secondary locomotive) was of 999 mm;
- at the axle no. 1 the stroke of the brake cylinders was of 150 mm and at the axles 2-6 it was within 14 mm-150 mm.

B.6. Analysis and conclusions

B.6.1. Conclusions on the technical condition of the railway superstructure and geometry

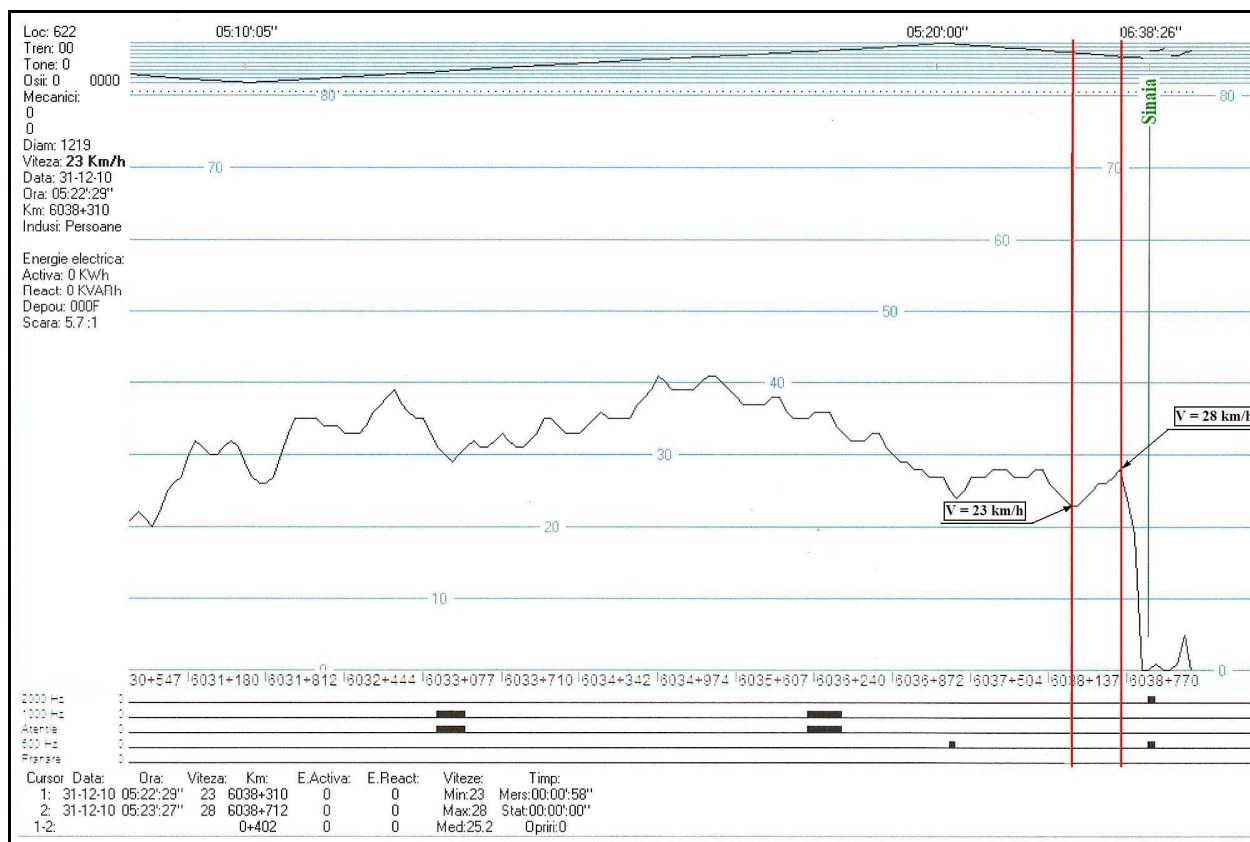
- according to the provisions of the art. 15, point 4, letter "a" of the Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989 between the last joint of the switch no. 7 and the curve after it there should be a portion in alignment $g \geq V/5+3$ m, respectively an alignment of minimum 9 m;
- the switch no. 7 is placed in slope of 24.53‰ (gradient in the running direction of the train);
- the heel joint of the core of the switch no. 7 in deviation (the last joint) in an inflection point for the assembly curve – counter-curve, composed of the curve after the switch (left deviation in the running direction of the train) and the curve of this switch (right deviation in the running direction of the train);
- the curve after the switch no. 7 is a curve composed of 3 circular curves of the same direction with parabolic connections in the ends and between them. The radius of the circular curve after the switch no. 7 has the value $R_3=735$ m and the radius of the switch has the value $R=300$ m;
- in the point where occurred the rail escalation on the outer wire of the curve of the switch no. 7, the railway twisting measured at the base of 2.5 m is of 13 to 12.5 mm admitted by the provisions of the art.7, point A.4;

B.6.2. Analysis and conclusions on the occurrence of the train derailment

On the 31st of December 2010 the freight train no. 60760 had passing command from the running wire II Busteni-Sinaia to the deviated line 4 in the railway station CFR Sinaia with output in the running wire II Sinaia-Valea Larga.

Taking into consideration that the access to the deviated lines in the railway stations is made with the maximum speed of 30 km/h the locomotive driver took in time actions of braking so that at 5:18 a.m. the train passed by the signal announcing the railway station CFR Sinaia (PrY) with the speed of 35 km/h, at 5:21:16" a.m. passed by the Y input signal with the speed of 25 km/h. Then the train ran in deviation on the line 4 with speeds within 23 km/h and 28 km/h.

At 5:22:29" a.m. the locomotive driver increased the speed from 23 km/h to 28 km/h, increasing implicitly the traction force. At that moment the locomotive was with the 2nd bogie on the curve with left deviation and the radius of 735 m and with the first bogie on the curve of the switch no. 7 with right deviation (in the running direction of the train) having the radius of 300 m and in slope of 24.53‰ (gradient).



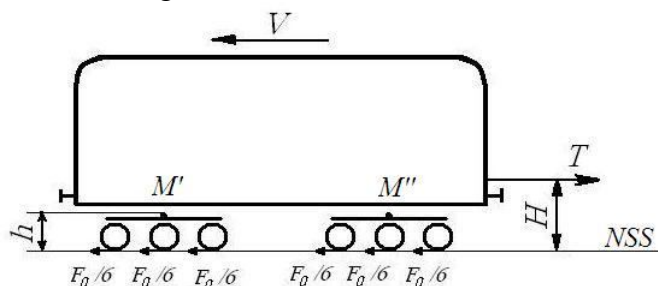
Due to the rotation phenomenon inherent to the electric locomotives with the separate operation of the axles, phenomenon that discharges the appeal wheel and charges appropriately the one in the back, under traction conditions, after a duty brake, at the running on a portion of line in curve and in slope with gradient of 24.53‰, the driving force of the appeal axle reduced considerably, which favored the escalation of the rail from the outer wire of the curve of the switch no. 7 by the wheel on the left of the axle.

The rotation couple, which has the tendency to discharge the front side of the locomotive and to charge the back side, is produced by the horizontal and opposite direction forces that occur at the distance "H" (the height of the hook to the top level of the rail).

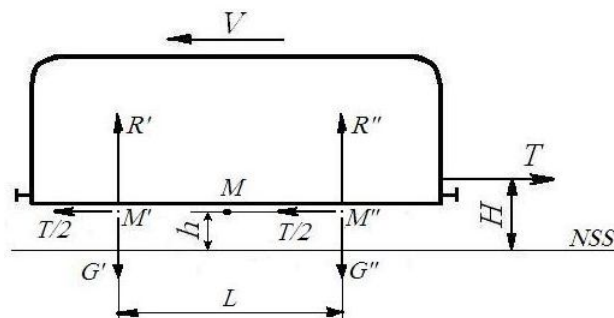
The locomotive rotation is the result of the overlap of the effects given by the box rotation and the bogie rotation.

The locomotive box is exposed to two couples that have to equilibrate, namely:

- a couple due to the fact that the force from the hook and the motor forces applied at the pivots are not at the same height;



- a couple due to the fact that the weight of the locomotive box, in traction regime, is unequally distributed at the two supports ($R' < R''$)



At the separate operation of the axles from the locomotive, under the effect of the traction force a discharge of the axles (decrease of the adherent weight) occurs, due to the rotation couple.

In traction regime the locomotive is exposed at two horizontal forces:

- the traction force (resistant) T , applied at the hook;
- the traction force at rim F_0 (for each motor axle comes $F_0/n - n = \text{number of motor axles}$);

When the locomotive driver increased the speed from 23 km/h to 28 km/h, the wagons and the secondary locomotive opposed a resistance at traction, this having as consequence the increase of the rotation effect of the locomotive which was towing the train.

The locomotive rotation cumulated with the railway geometry led to the escalation by the wheel on the left in the running direction of the rail corresponding to the outer wire of the curve of the switch no. 7.

B.7. Causes of the accident

B.7.1. The direct cause of this accident occurrence was the loss of guiding capacity of the first axle in the running direction of the locomotive (the driving axle) due to the rotation occurred under the circumstances of passing of the locomotive from duty braking regime to towing regime, at the running on a line in curve – counter-curve and in slope of 24.53‰.

Contributing factors

- amplification of rotation phenomenon of the locomotive by its superposing over the rotation effect given by the system of the horizontal guiding forces of the rails on the two bogies, at the entrance in curve of the first axle from the first bogie in the running direction;
- the sinuous path in the area of the accident composed of two curves of opposite direction, without alignment and with different radii, the first bogie of the locomotive being on a curve and the second bogie on the other curve;
- the value of the rail twisting of 13 mm (to 12.5 mm admitted at the railway maintenance) measured at the base of 2.5 m;
- the switch no. 7, on which the locomotive derailment occurred, had the slope of 24.53‰ towards the X end of the railway station CFR Sinaia;

B.7.2. Underlying causes

None.

B.7.3. Root cause

None.

C. SAFETY RECOMMENDATIONS

None.

This report will be sent to the Romanian Railway Authority, to the Romanian Railway Safety Authority, to the manager of the public railway infrastructure CNCF “CFR” SA and to the freight railway undertaking S.C. TRANSFEROVIAR GRUP SA Bucharest.

Members of the investigation commission:

- | | |
|------------------|---|
| ▪ STOIAN Eduard | - main investigator |
| ▪ DRĂGHICI Marin | - investigator |
| ▪ PAUL Sever | - investigator |
| ▪ TOADER Doru | - investigator |
| ▪ FLORIAN Lucian | - head of Regional Inspectorate SC- CF Bucharest Regional Branch |
| ▪ ANDREI Dumitru | - head of operation service TFG |