MINISTRY OF TRANSPORTS AND INFRASTRUCTURE
ROMANIAN RAILWAY AUTHORITY - AFER

ROMANIAN RAILWAY INVESTIGATING BODY

INVESTIGATING REPORT

on the railway accident
occurred on the 18th of April 2011 in the railway station CFR Jianca

Final edition
The 15th of December 2011

NOTICE

With reference to the railway accident occurred on the 18th of April 2011, at 11:27 p.m., on the range of activity of C.F. Craiova Regional Branch, the running section Rosiori Nord – Craiova (double line electrified), in the railway station CFR Jianca, in the area of the switch no. 7 in the composition of the diagonal 5-7 from the X end of the railway station, consisting of the derailment of the bogie no. 1 of the locomotive EA 45-0374-4 towing the passenger train no. 360-1, belonging to the passenger transport railway undertaking SNTFC "CFR Calatori" SA Bucharest, 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 15th of December 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
Nicu PĂLĂNGEANU

This approval is part of the Report for the investigation of the accident occurred on the 18th of April 2011, at 11:27 p.m., on the range of activity of C.F. Craiova Regional Branch, the running section Rosiori Nord – Craiova (double line electrified), in the railway station CFR Jianca, in the area of the switch no. 7 in the composition of the diagonal 5-7 from the X end of the railway station, consisting of the derailment of the bogie no. 1 of the locomotive EA 45-0374-4 towing the passenger train no. 360-1.

CONTENT

I. PREAMBLE

I.1. Introduction

With reference to the railway accident occurred on the 18th of April 2011, at 11:27 p.m., on the range of activity of C.F. Craiova Regional Branch, the running section Rosiori Nord – Craiova (double line electrified), in the railway station CFR Jianca, in the area of the switch no. 7 in the composition of the diagonal 5-7 from the X end of the railway station, consisting of the derailment of the bogie no. 1 of the locomotive EA 45-0374-4 towing the passenger train no. 360-1, belonging to the passenger transport railway undertaking SNTFC "CFR Calatori" SA Bucharest, 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.

Romanian Railway Investigating Body 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

Immediately after the occurrence of the railway accident, Romanian Railway Investigating Body was notified verbally and in written by the Traffic Safety Regional Inspectorate of Craiova Regional Branch about the occurrence on the range of activity of Craiova Regional Branch, on the running section Rosiori Nord – Craiova (double line electrified), in the railway station CFR Jianca, of the derailment of the first bogie of the locomotive EA 45-0374-4 towing the passengers train no. 360-1 (belonging to the railway undertaking SNTFC "CFR Calatori'' S.A. Bucharest), in the area of the switch no. 7 in the composition of the diagonal 5-7 from the X end of the railway station.

Taking into consideration that the occurrence is defined as accident according to the art. 3 point l 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. 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, the OIFR director decided to start an investiogation. So, through the decision no. 55 -3 from the 1st of November 2011 of the OIFR director, the investigation commission was appointed consisting of:

- Pălăngeanu Nicu – Chief Investigator - main investigator
- Stoian Eduard – head of service Investigation of the Structural Subsystems Defects Interoperability Constituents - member
- Popescu Nicolae - investigator Railway Accident Investigation and Divergences Settlement Department - member
- Timiş Bogdan - central inspector - SNTFC "CFR Calatori'' SA - member
- Scăunaşu Fredi– head of Regional Inspectorate SC - C.F Craiova Regional Branch - member

A. BRIEF PRESENTATION OF THE ACCIDENT

A.1. Brief presentation

On the 18th of April 2011, the passengers train no. 360-1 belonging to the passengers transport railway undertaking SNTFC "CFR Calatori" SA was running on the section Bucharest – Stamora Moravita – Belgrad and was composed of 7 coaches, 28 axles, 337 tones, length 202 meters.
At 11:27 p.m., on the range of activity of CF Craiova Regional Branch, the running section Rosiori Nord – Craiova (double line electrified), in the railway station CFR Jianca, passing over the switch no. 7 in the composition of the diagonal no. 5-7 from the X end of the railway station, occurred the derailment of the first bogie of the locomotive EA 45-0374-4 towing the passengers train no. 360-1 belonging to the passengers transport railway undertaking S.N.T.F.C. "CFR Calatori" S.A.

The locomotive EA 45-0374-4 was served by locomotive-railcar driver belonging to the passengers transport railway undertaking SNTFC "CFR Calatori" SA.
There were no deaths or injuries.

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

A.2.1. The direct cause of the occurrence of this accident was the loss of guiding capacity of the appeal axle on the curve of the switch no. 7 due to the load discharge on the left wheel caused by the difference between the diameters of the wheels of the same axle, followed by the escalation of the rail on the left of the running path.

Contributing factors

- the difference of 2.29 mm between the diameters of the wheels (left-right) from the axle no.1;
- the exceeding of the maximum admitted limit of the rate q_R provided in the sheet UIC-510-2 at the wheel on the right of the axle no. 1 (appeal)
- the existence of the treads on the rim flank and on the rolling surface as consequence of the turning process

A.2.2. Underlying causes
None.

A.2.3. Root cause
Lack of procedures on how to check the positioning of rollers measuring the diameters of the rolling circles after turning with the lathe type Hegenscheidt 102.

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

Completing the technical specification - *Reshaping the bandages at the axles of railway vehicles on the underground lathe type Hegenscheidt 102* – with:

1. chapter regarding the rolls maintenance, the check of the diameters and of the positioning of rollers measuring the diameters of the rolling circles after turning;
2. completion of the measurements sheet prepared after reshaping the bandages with the average value of the measured roughness.

This investigating report will be sent to Romanian Railway Safety Authority, to the manager of the public railway infrastructure CNCF "CFR" SA and to the passengers transport railway undertaking SNTFC "CFR Calatori" SA.

B. INVESTIGATING REPORT

B.1. Description of the accident

On the 18th of April 2011, at 8:45 p.m., the passengers train no. 360-1 (belonging to the railway undertaking SNTFC "CFR Calatori" SA) was sent from the railway station Bucharest North, going to run on the section Bucharest North – Stamora Moravita – Belgrad.

The passengers train no. 360-1 was composed of 7 coaches (28 axles, 337 tones, 202 meters length) and was towed with the locomotive EA 45-0374-4 belonging to the railway undertaking SNTFC "CFR Calatori" SA, being driven by locomotive driver belonging to the same railway undertaking.

The running of the train from formation to the moment of the accident occurrence was without technical or railway safety problems, before the accident having stops and stations in the railway stations CF Videle, Rosiori Nord and Caracal.

On the range of activity of C.F. Bucharest Regional Branch, the train no. 360-1 was sent from the railway station Bucharest North group A from the line no. 2, it ran over the switch no. 6A (left deviation), on the running wire II to the railway station Bucurestii Noi, it passed over the switch no. 10 in deviation to the left and over the switches no. 4 and 4s in deviation to the left and respectively to the right, running to the railway station Chiajna on the wire no. II. From the railway station Chiajna the train no. 360-1 ran to the railway station Videle on the wire no. I.

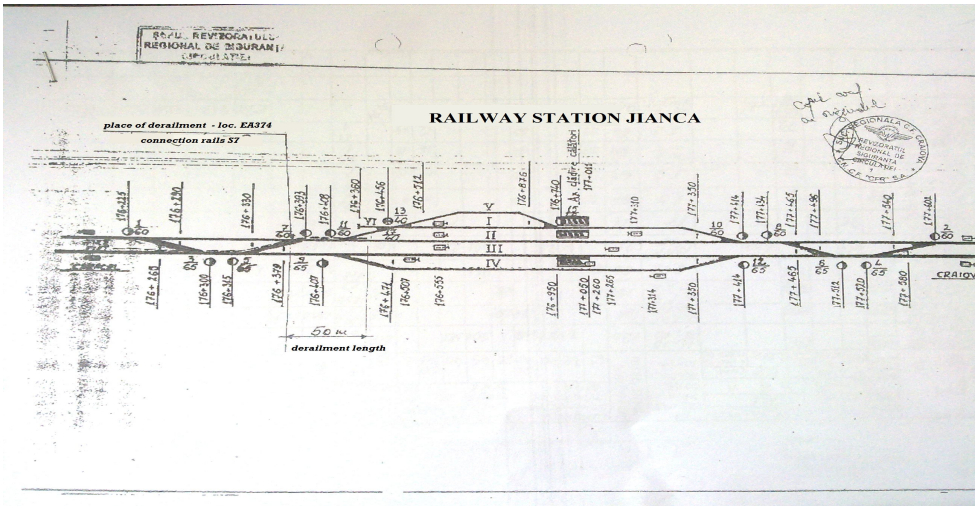
On the range of activity of C.F. Craiova Regional Branch, the train no. 360-1 ran from the railway station CFR Videle to the railway station CFR Rosiori Nord on the wire no. I. In the railway station CFR Rosiori Nord, the train no. 360-1 shunted at the deviated line no. 3, passing in deviation over the switches no. 31/33 and at the exit it passed in deviation over the switches no. 32 and 44, being sent in the direction Caracal on the wire no. I. Further, from the railway station CFR Rosiori Nord to the railway station CFR Jianca, the train no. 360-1 ran on the wire no. I.

According to the provision no. 88 from the 18th of April 2011 (at 10:48p.m.) of the operator RC on the running wire Rosiori Nord-Craiova, the train no. 360-1 was going to run on the distance Jianca – Leu – Malu Mare on the wire no. II (BLA trivialized).

At 11:20p.m., the movement inspector on duty in the railway station CFR Jianca received the passing notice of the train no. 360-1 from the movement inspector from the flag station Grozavesti, then he performed passing path on line no. II with normal command in block, with input in deviation and output on direct line on the wire no. II (BLA trivialized) towards the flag station Leu.

To perform the passing path, with input from the wire no. I to the deviated line II and further to the running wire II Jianca – Leu, the switches were handled and/or checked in the installation CED as follows:
- switches no. 5/7 on the position "on deviation";
- switches no. 1/3 on the position "on direct" with access on the diagonal 5/7;
- switch no. 11 on the position "on direct" with access on the line no. II;
- switches no. 6/8 and 2/4 on the position "on direct" with access at the wire no. II BLA Jianca – Leu;

The switches no. 3 and no. 7 were attacked from the heel.



Passing over the switches no. 5/7, the locomotive driver felt a strong shake followed by noises specific to the derailment. That moment he locomotive driver took actions to close the leg and to quick brake. During the time since the entry into action of the automatic brake to the occurrence of its effect by stopping the train, the locomotive EA 45-0374-4 ran with the first bogie derailed for about 50 m.
When the train stopped the locomotive EA 45-0374-4 was on the area of the switch no. 11, being derailed by the 3 axles of the first bogie (in the running direction).

B.2. Circumstances of the accident

B.2.1. Involved parties

The running section where the railway accident occurred is managed by CNCF "CFR" SA- CF Craiova Regional Branch.

The railway infrastructure and superstructure are managed by CNCF "CFR" SA and maintained by the employees of Lines district no. 10 Jianca in Section L2 Rosiori.
The installations signaling, centralization and blocking (SCB) in the railway station CFR Jianca are managed by CNCF "CFR" SA and maintained by the employees of CF Craiova Regional Branch – Section CT 3 Rosiori.

The installation of railway communications in the railway station CFR Jianca is managed by CNCF "CFR" SA and maintained by the employees of SC Telecomunicatii CFR SA.

The installation of power and electric traction (IFTE) is managed by CNCF "CFR" SA and maintained by the employees of SC Electrificare CFR SA.

The installation of railway communications on the locomotive is the property of the railway undertaking SNTFC "CFR Calatori" SA and is maintained by the employees of SCRL Brasov.

The locomotive involved in the derailment is the property of the railway undertaking SNTFC "CFR Calatori" SA.

B.2.2. Forming and equipment of the train

The passengers train no. 360-1 belonging to the passengers transport railway undertaking SNTFC "CFR Calatori" SA was composed of 7 coaches (28 axles, 337 gross tones, of which automatically braked according to the service book 371 tones, in fact automatic 474 tones, hand braked according to the service book 67 tones, in fact hand braked 133 tones and a length of 202 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 in the enclosure of the installation INDUSI was on the position "R", corresponding to the passengers trains.

B.2.3. Railway equipments

Description of the railway path

The railway path in plan

The railway path in plan, in the area of the railway accident occurrence is composed of the diagonal 5-7 between the wire I and the wire II. In the area of the railway accident occurrence in the profile along of the railway path is with slope of 1.3‰, ramp in the running direction of the train.

The diagonal 5-7 has the real length of 11 meters and is equipped with rail type 65/60 (transition coupons) and concrete sleepers T17 with indirect clamping.

The point where occurred the escalation of the rail on the outer wire of the curve of the switch no. 7 by the wheel on the left of the first axle of the locomotive (in the running direction of the train) is located 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 60, wooden sleepers with indirect clamping type K, path with joints. The switch no. 7, in which area occurred the escalation of the rail on the outer wire of the curve of the switch by the wheel on the left of the first axle of the locomotive (in the running direction of the train), is type 60, radius R=300 m, tangent tg=1:9, left deviation, flexible needles, in good condition, appropriate wooden sleepers, elastic clamping type SKL12 complete and active, simple locking with DAM.

The prism of broken stone was complete and did not have clogged areas.

The switch no. 7 has welded the joints on top, the inner joints, the heel joints of the core on direct, without being included in the CFJ.

Description of the safety installations to control railway traffic

The railway station CFR Jianca is provided with installation signaling, centralization and blocking type CR2 DOMINO on section with automatic line block.

Description of the installations of power and electric supply
The contact line, part of the installation of power and electric supply, is made of the stranded suspension and its support system on reinforced concrete pillars. On the wire I between the flag station Grozavesti and the railway station CFR Jianca the stranded suspension is type completely compensated.

B.2.4. Means of communication
The communication between the locomotive driver and the movement inspector and between the locomotive driver and the train party was provided through radio-telephone installations.

B.2.5. Triggering the railway emergency plan
Immediately after the occurrence of the railway accident, triggering the intervention plan to remove damage 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 *HG 117/2010*, so there came representatives of Romanian Railway Authority – AFER, of the manager of the public railway infrastructure CNCF "CFR" SA - C.F Craiova Regional Branch and of the passengers transport railway undertaking SNTFC "CFR Calatori" SA.
To lift the derailed locomotive EA 45-0374-4 and restore it on the lines was asked the specialized intervention train with hydraulic winches (TIS with hydraulic winches) belonging to SC Interventii Feroviare – Craiova District. The intervention train arrived in the railway station CFR Jianca on the 19th of April 2011, at 1:58 a.m. and the locomotive was restored on the rails at 5:15 a.m.
To reopen the railway traffic between the railway station CFR Jianca and the flag station Grozavesti, from the railway station CFR Caracal was directed the locomotive-aid EA 083 at 00:26 and re-shunted the train no. 360-1 at the line no. III in the railway station Jianca at 2.12 a.m.

To tow the train no. 360-1 from the railway station CFR Jianca to the railway station Timisoara Nord was directed from the railway station CFR Craiova the locomotive EA 402, belonging to the railway undertaking SNTFC, which arrived in the railway station CFR Jianca at 00:58 and the train no. 360-1 was sent from the railway station CFR Jianca at 2:37 a.m., with a delay of 193 minutes.

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 45-0374-4, according to the estimate no. 134/1438/2011 of Passengers Bucharest Depot amounted to 135.35 lei;
- at the lines, according to the estimate no. 225/19.05.2011 of section L2 Rosiori - CFR Craiova Regional Branch, amounted to 213 394. 80 lei;
- at the installations – none;
- the intervention TIS with hydraulic winches, according to the estimate no. 3.1/3/199/19.05.2011 of section L6 Craiova - CF Craiova Regional Branch, amounted to 5 492.76 lei;
- the mean of towing of the TIS with hydraulic winches, according to the estimate no. R2/869/18.05.2011 of Banat-Oltenia Branch, Craiova Depot amounted to 4 516. 82 lei;
- passengers train delays, amounted to 1 414.94 lei.

Total amount of the damages 224 954.67 lei

B.3.3. Consequences of the accident in railway traffic

The railway traffic between the railway station Jianca and H.m. Grozavesti wire I was closed on the 19th of April 2011, from 00:12 to 2:28 am.

Train delays: 7 passenger trains with a total of 357 minutes and 7 freight trains with a total of 1366 minutes.

B.4. External circumstances

On the 18th of April 2011, between 11:00 p.m. - 7:00 a.m. the visibility was good and the air temperature was of $+9^0$ 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 investigation commission questioned the locomotive driver who on the date of the accident drove and served the locomotive EA 45-0374-4 towing the train and the movement inspector on duty in the railway station CFR Jianca.

The locomotive driver of the locomotive EA 45-0374-4, which towed the passengers train no. 360-1 stated as follows:

- on the 18th of April 2011 he took over the locomotive EA 374 from the depot Bucharest Passengers, without finding any technical problem, being distributed to tow the train no. 360-1 on the section Bucharest North-Timisoara Nord;
- he left from the railway station Bucharest North with the train 360-1, at 8:45 p.m. and to the railway station Jianca there was no problem in the running of the train or at the locomotive;
- at the entry in the railway station Jianca he was announced through the radio-telephone station by the IDM on duty that he had entry path on the running wire I in deviation and that he was going to run on the wire II on the left to the flag station Leu;
- after attacking the second switch in the path he heard a strong noise and he took actions to stop the train;
- after stopping the train and insure of the locomotive against moving he went down from the locomotive cabin and he found that the locomotive was derailed by the first bogie in the running direction (axles 1, 2 and 3). He announced through the radio-telephone station the IDM in the railway station Jianca and by telephone the Dispatch service of RTFC Craiova and he waited for the investigation commission.

The IDM on duty in the railway station CFR Jianca stated as follows:

- on the 18th of April 2011, at 4:50 p.m., he took over the movement service. At 10:48 p.m. he received the RC order no. 88 which receipt he confirmed with the no. 24, through which the operator RC disposed that the train no. 79763 to run on the distance Jianca – Leu on wire II BLA trivialized. At 10:57 p.m. he passed on the line 2 the train no. 79763;
- at 11:19 p.m. he received from the IDM in the flag station Grozavesti the passing notice of the train no. 360-1, then he performed passing command from the line II with input path in deviation and output path from direct line to the wire II BLA trivialized to the flag station Leu. The passing path of the train no. 360-1 was performed with normal command on the command device;
- after communicating through the radio-telephone station with the driver of the train no. 360-1 on the passing conditions through the railway station Jianca, he supervised on the command device the passing path and after the train 360-1 passed by the input signal he went out to supervise by scrolling the passing of the train;
- being on the platform to scroll the train he noticed that it was stopped in the area of the switches. He came back in the movement office, he contacted by radio-telephone station the driver and this one told him that the locomotive had derailed by the first and the second axle

over the switch no. 11. In the same time the couponing bell was acoustically signaling and the switch no. 11 had no control on the command device. He notified the operator RC and he recorded in the RRLISC the breaking of the seal from the couponing bell button. He notified the head of the railway station, the lineman L and the police agent.

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 delivered the following documents:

- 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.

Also, SNTFC "CFR Calatori" SA as railway undertaking had 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*, being delivered the following documents:

- 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 the following:

Norms and regulations

- *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
- *Technical Regulation of Rail Operation no. 002 approved by the Order of the Minister of Transport, Constructions and Tourism no. 1186 on the 29th of August 2001*;
- *Instructions on the repair of the axles mounted at the railway vehicles no. 931 since 1986*;
- *Railway Technical Norm N.T.F. 81-002/2004. Railway vehicles. Mounted axles. General quality technical conditions*, approved by O.M.T.C.T. no. 1826/07.10.2004;
- *Order of the Traction General 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 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 requested by the members of the investigation commission, submitted as pieces at the investigation file;
- photos taken immediately after the occurrence of the accident by the members of the investigation commission;
- photos taken at the involved locomotive EA 45-0374-4, taken at the place of the accident;
- 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;
- results of the measurements performed immediately after the occurrence of the railway accident at the locomotive;
- examination and interpretation of the technical condition of the elements involved in the accident, infrastructure and locomotive;
- questioning of the employees involved in 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 on the switch no. 7 from the railway station CFR Jianca was performed on the 1st of April 2011 and consisted of the checking of the hidden parts of the switch on the sleepers in the path.

The last inspection of the switch no. 7 when were performed checks of the gauge and of the cross level with the rail measuring pattern were performed on the 14th of April 2011.

The measured values at that moment were not exceeding 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 locomotive

- excepting the joints from the core heel, on deviation all the inner joints in the composition of the switch no. 7 were welded;
- on the sleeper no. 38 in the composition of the switch no. 7 (counted from the top of the needles and being in the composition of the connection rails) was identified a sign of escalation of the wheel on the left in the running direction of the appeal axle;
- on the sleeper no. 32 (counted from the top of the needles of the switch no. 7), placed in the area of the connection rails on the direction in deviation of the switch no. 7, was identified a sign of fall outside the path on the left;
- on the rolling surface of the rail head corresponding to the outer wire of the curve of the switch no. 7 (the rail on the left in the running direction of the train) from the sing of escalation towards the top of the switch no. 7 was identified the sign left by the wheel bandage rim on a length of 3780 mm, then there was found the sign of fall of the wheel outside the rail (on the sleeper no. 32 counted from the top of the needles and placed within the connection rails);
- from the derailment point towards the top of the switch no. 7 and up to the switch no. 11 (placed after the panel in front of the switch no. 7) were found signs of hitting of the metallic parts of the switches no. 7 and no. 11 and of the metallic elements of the panel between the two switches;
- on the area of the diagonal 5-7, the sleepers were in good condition, the clamping was found complete and active, the prism of broken stone was unclogged;
- at the joints in the composition of the switches no. 5 and no. 7 and in the composition of the panel between these switches were not found side or vertical thresholds.

Measurements performed at the line

From the place of the first sign found on the side surface between the path 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 equidistance of 2.5 m.
The measured values were within the provisions of the *Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989* corresponding to the running speed in deviation of 30 km/h over the diagonal 5/7.

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

Preliminary findings performed in the railway station CF Jianca at the locomotive EA 45-0374-4

- the locomotive EA 45-0374-4 was stopped and derailed by the axles 1, 2 and 3 on the area of the switch no. 11;
- there were not found signs of axial displacement or scrap at the junction bandage-rim;
- there were not found plane places at the bandages;
- the automatic brake: good;
- the direct brake: good;
- the hand brake: good;
- the air compressors: normally working;
- the air manometers condition: good and metrological checked;
- the position of the driver valve: braking;
- the tightness of brake system: good;
- the installation DSV: sealed and in operation.

Findings performed at the locomotive EA 45-0374-4 at SC IRLU SA Bucharest – Craiova Repairs Section, after the occurrence of the derailment

- there were performed measurements of the locomotive wheels bandages rims rates, inclusively the rate "D", in 3 points, the measured values being within the instructional values provided, according to the *Technical Regulation of Rail Operation no. 002/201* and the Instruction no. 931/1986;
- there were not found plane places at none of the locomotive bandages;
- there were not found signs of axial displacement or scrap at the joint bandage-rim;
- there were not found construction or functional defects of the cross coupling, the length of the connection being of 998 mm (there was not found the plate that indicates the value previously measured), the provided value being of 1000 mm ±10 mm;
- after the measurement of the loads on the axle and of the mechanic strokes (measurements performed after the derailment), were found exceeding of provided values as follows:
  - at the axle no. 2 the difference between the load on the left axle and the right wheel was of 7.9%, the limit of 2% being exceeded with 5.92%;
  - the stroke between the side rubber pads and the frame of the bogie P1 on the right 29.5 mm, the distance between the rolling box and the bogie frame at the axle no. 5 the wheel on the right 27 mm, the axle no. 4 the wheel on the right 31mm and the axle no. 3 the wheel on the right 44.5 mm.
- after the measurement of the circles diameters of the rolling wheels were found exceeding of the provided values (for the driving axles 1 mm), as follows:
  - the difference of 2.29 mm between the wheels diameters (left-right) from the axle no. 1.
  - the difference of 3.08 mm between the wheels diameters (left-right) from the axle no. 2.
  - the difference of 2.33 mm between the wheels diameters (left-right) from the axle no. 3.
  - the difference of 2.40 mm between the wheels diameters (left-right) from the axle no. 4.

- the difference of 2.62 mm between the wheels diameters (left-right) from the axle no. 5.
- the difference of 3.22 mm between the wheels diameters (left-right) from the axle no. 6.

- the measurements were performed on the lathe of bandages belonging to Section IRLU Craiova, authorized by AFER;
- the lack of the oil in the tank of the installation greasing the bandage rim (installation type Secheron) ;
- there were performed measurements at the feathers and additions of the elastic elements (metalastics), these being within the provided instructional values;
- there was found the exceeding of the maximum admitted limit of the rate q_R provided in the sheet UIC-510-2 at the wheel on the right of the axle no. 1 (the appeal wheel);
- the value of the average roughness of the bandage rim surface of the wheel on the left, the axle no. 1 (the wheel which escalated) measured after the running of 209 km in the depot SNTFM "CFR Marfa" Craiova was of 7.24 μm, Railway Technical Norm no. 81-002/2004 providing an average roughness lower than or equal to 12.5 μm.

Findings performed on the 5th of May 2011 at the locomotive EA 45-0374-4 at Bucharest Passengers Repairs Section belonging to SC "CFR SCRL" Brasov

There were performed 3 measurements of the diameters of the rolling circles at the wheels of the axle no. 1, being found differences between the wheels diameters (left-right) as follows:

- at the first measurement of 2.02 mm;
- at the second measurement of 0.8 mm;
- at the third measurement of 1.05 mm,

under the circumstances where the provided values for the mounted axles is of maximum 1 mm.
The lathe measuring the diameters of the rolling circles of the wheels in the Railcars shed - Bucharest Passengers does not have AFER authorization.

Findings performed on the 28th of April 2011 at the railway infrastructure in the X end of the railway station CFR Jianca

After the mechanic stuffing works with heavy rail machines performed after the occurrence on the 19th of April 2011, there were performed the following measurement types:
- the topographical of the switches area where in included the diagonal no. 5/7 and measurements to establish the profile along;
- the check of the geometry of the diagonal no. 5/7;
- check the gutters on the deviated direction of the switch no. 7;

B.6. Analysis and conclusions

On the 18th of April 2011 the train no. 360-1 had passing command from the running wire I Grozavesti-Jianca to the direct line II from the railway station C.F. Jianca with input in deviation and output in the running wire II Jianca-Leu. Under the circumstances of a failure of the isolated section 4-12 from the Y end of the railway station Jianca, during the interval 17th – 18th of April 2011, previous to the occurrence of the accident, on the same path on which ran also the train no. 360-1, respectively over the diagonal 5-7 (in deviation), ran a number of 29 trains, without being found irregularities.

From the directing railway station, respectively the railway station CFR Bucharest Nord, to the entry in the railway station CFR Jianca, the locomotive of the passengers train no. 361-1 ran in deviation over a number of 7 diagonals.

For the access at the deviated lines from the railway station with the maximum speed of 30 km/h, the locomotive driver took in time braking actions, so that at 11:24:03 p.m. the train passed by the

signal announcing the railway station CFR Jianca (PrX) with the speed of 73 km/h, at 11:25:22 p.m. it passed by the input signal X with the speed of 47 km/h and in a distance of 502.81 meters the train speed decreased from 47 km/h to 30 km/h, then it ran a distance of 228.29 meters with speeds within 13-30 km/h. In a distance of 4.48 m, the running speed of the train decreased from 13 km/h to 0 km/h and the train stopped at 11:26:48 p.m.

In the area of the railway accident occurrence in the profile along of the railway path is with slope of 1.3‰, ramp in the running direction of the train.

The diagonal 5-7 has the real length of 11 meters and is equipped with rail type 65/60 (transition coupons) and concrete sleepers T17 with indirect clamping.

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

From the place of the first sign found on the side surface between the path 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 equidistance of 2.5 m.

The measured values were within the provisions of the *Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314/1989* corresponding to the running speed in deviation of 30 km/h over the diagonal 5/7.

On the 19th of April 2011 (after the performance of the mechanic stuffing works with heavy rail machines) were performed the following measurement types:

- the topographical of the switches area where in included the diagonal no. 5/7 and measurements to establish the profile along;
- the check of the geometry of the diagonal no. 5/7;
- check the gutters on the deviated direction of the switch no. 7;

On the 18th of April 2011**,** at the locomotive EA 45-0374-4 at SC IRLU SA Bucharest – Craiova Repairs Section after the occurrence of the derailment were performed measurements of the rates A, B, C, D, E, q_R, measurements of the roughness and also the measurement of the loads on the axles and of the mechanic strokes.

- there were not found plane places at none of the locomotive bandages;
- there were not found signs of axial displacement or scrap at the joint bandage-rim;
- there were not found construction or functional defects of the cross coupling, the length of the connection being of 998 mm (there was not found the plate that indicates the value previously measured), the provided value being of 1000 mm ±10 mm;;
- after the measurement of the loads on the axle and of the mechanic strokes, after the derailment, were found exceeding of provided values at the axle no. 2, the difference between the load on the left wheel and the right wheel being of 7.9%;
- the stroke between the side rubber pads and the frame of the bogie P1 on the right 29.5 mm, the distance between the rolling box and the bogie frame at the axle no. 5 the wheel on the right 27 mm, the axle no. 4 the wheel on the right 31mm and the axle no. 3 the wheel on the right 44.5 mm.
- after the measurement of the circles diameters of the rolling wheels were found exceeding of the provided values (for the driving axles 1 mm), as follows:
  - the difference of 2.29 mm between the wheels diameters (left-right) from the axle no. 1.
  - the difference of 3.08 mm between the wheels diameters (left-right) from the axle no. 2.

- the difference of 2.33 mm between the wheels diameters (left-right) from the axle no. 3.
- the difference of 2.40 mm between the wheels diameters (left-right) from the axle no. 4.
- the difference of 2.62 mm between the wheels diameters (left-right) from the axle no. 5.
- the difference of 3.22 mm between the wheels diameters (left-right) from the axle no. 6.

- there was found the exceeding of the maximum admitted limit of the rate q_R provided in the sheet UIC-510-2 at the wheel on the right of the axle no. 1 (the appeal wheel);
- the value of the average roughness of the bandage rim surface of the wheel on the left, the axle no. 1 (the wheel which escalated) measured after the running of 209 km in the depot SNTFM "CFR Marfa" Craiova was of 7.24 μm, Railway Technical Norm no. 81-002/2004 providing an average roughness lower than or equal to 12.5 μm.
- there were performed measurements at the feathers and additions of the elastic elements (metalastics), these being within the provided instructional values;
- the measurements were performed on the lathe of bandages belonging to Section IRLU Craiova, authorized by AFER;

On the 5th of May 2011 on the lathe measuring the diameters of the rolling circles of the wheels in the Railcars shed - Bucharest Passengers, there were performed 3 measurements of the diameters of the rolling circles at the wheels of the axle no. 1, being found differences between the wheels diameters (left-right) as follows:

- at the first measurement of 2.02 mm;
- at the second measurement of 0.8 mm;
- at the third measurement of 1.05 mm,

under the circumstances where the provided values for the mounted axles is of maximum 1 mm

- on the 18th of April 2011 in the Repairs Section Bucharest Passengers belonging to S.C "CFR SCRL Brasov" were performed turnings of the wheels bandages and also the balancing of the loads on the axle at the locomotive EA 374.

Conclusions

After the analysis of the measurements performed there were found exceeding of the following parameters:

- the difference between the diameters of the wheels on the left/on the right:
  - the difference of 2.29 mm between the wheels diameters (left-right) from the axle no. 1.
  - the difference of 3.08 mm between the wheels diameters (left-right) from the axle no. 2.
  - the difference of 2.33 mm between the wheels diameters (left-right) from the axle no. 3.
  - the difference of 2.40 mm between the wheels diameters (left-right) from the axle no. 4.
  - the difference of 2.62 mm between the wheels diameters (left-right) from the axle no. 5.
  - the difference of 3.22 mm between the wheels diameters (left-right) from the axle no. 6.
- the maximum admitted limit of the rate q_R provided in the sheet UIC-510-2 at the wheel on the right of the axle no. 1 (the appeal wheel).

Also there was found the existence of treads on the rim flank and on the rolling surface of the bandage, resulting from the process of lathing.

B.7. Causes of the accident

B.7.1. The direct cause of the occurrence of this accident was the loss of guiding capacity of the appeal axle on the curve of the switch no. 7 due to the load discharge on the left wheel caused by the difference between the diameters of the wheels of the same axle, followed by the escalation of the rail on the left of the running path.

Contributing factors

- the difference of 2.29 mm between the diameters of the wheels (left-right) from the axle no.1;
- the exceeding of the maximum admitted limit of the rate q_R provided in the sheet UIC-510-2

at the wheel on the right of the axle no. 1 (appeal)
- the existence of the treads on the rim flank and on the rolling surface as consequence of the turning process

B.7.2. Underlying causes

None.

B.7.3. Root cause

Lack of procedures on how to check the positioning of rollers measuring the diameters of the rolling circles after turning with the lathe type Hegenscheidt 102.

D. SAFETY RECOMMENDATIONS

Completing the technical specification - *Reshaping the bandages at the axles of railway vehicles on the underground lathe type Hegenscheidt 102* – with:

1. chapter regarding the rolls maintenance, the check of the diameters and of the positioning of rollers measuring the diameters of the rolling circles after turning;
2. completion of the measurements sheet prepared after reshaping the bandages with the average value of the measured roughness.

This investigating report will be sent to Romanian Railway Safety Authority, to the manager of the public railway infrastructure CNCF "CFR" SA and to the passengers transport railway undertaking SNTFC "CFR Calatori" SA Bucharest.

Members of the investigation commission:

- Pălăngeanu Nicu – Chief Investigator - main investigator
- Stoian Eduard – head of service Investigation of the Structural Subsystems Defects Interoperability Constituents - member
- Popescu Nicolae - investigator Railway Accident Investigation and Divergences Settlement Department - member
- Timiş Bogdan - central inspector - SNTFC "CFR Calatori'' SA - member
- Scăunaşu Fredi– head of Regional Inspectorate SC - C.F Craiova Regional Branch - member

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