MINISTERUL TRANSPORTURILOR
AUTORITATEA FEROVIARĂ ROMÂNĂ - AFER
ORGANISMUL DE INVESTIGARE FEROVIAR ROMÂN

INVESTIGATING REPORT

of the railway accident
occurred on the 24th of September 2014, in the railway station Halmeu, in the running of the freight train no. 3651/48651, through the derailment of the second bogie in the running direction, from the wagon no. 52623642 (last from the train)

Final edition
December 2014

SUMMARY

A. PREAMBLE

A.1. Introduction

The Romanian Railway Investigating Body, hereinafter called OIFR, performs investigations according to the provisions of the *Law no. 55/*2006 for railway safety, hereinafter called *Railway Safety Law* and also of the *Regulation for the investigation of accidents and incidents, the development and improvement of railway safety on the railway and the metro network in Romania*, approved through the Government Decision no. 117/2010, hereinafter called *Investigation Regulation*.

The investigation action of OIFR aim's to improve the railway safety and preventing the railway incidents or accidents.

The investigation is performed independently of any inquiry and does not aim to establish the guilt or the responsibility.

A.2. Investigation process

According to the art 19, paragraph 2 from the *Railway Safety Law*, corroborated with the art. 48 from the *Investigation Regulation*, OIFR, for the railway accidents and incidents, has to start an investigation and make investigation commissions for gathering and analyzing the technical information, establishment of the occurrence conditions, including the causes and, if case, issuing safety recommendations for the prevention of some similar accidents and for the improvement of the railway safety.

Taking into account the informative note of the General Traffic Safety Inspectorate from CNCF "CFR" S.A., on the 24th of September 2014, concerning the accident occurred on the 24th of September 2014, in the railway station Halmeu, through the derailment of the second bogie, in the running direction, from the wagon no. 52623642, last from the freight train no. 3651/48651 and taking into account that the railway event is defined as accident according to the provisions of the art. 7(1), point b. from the *Investigation Regulation*, OIFR director decided to start an investigation and to appoint an investigation commission.

Through the Decision no. 149, from the 25th of September 2014 OIFR appointed an investigation commission, as follows:

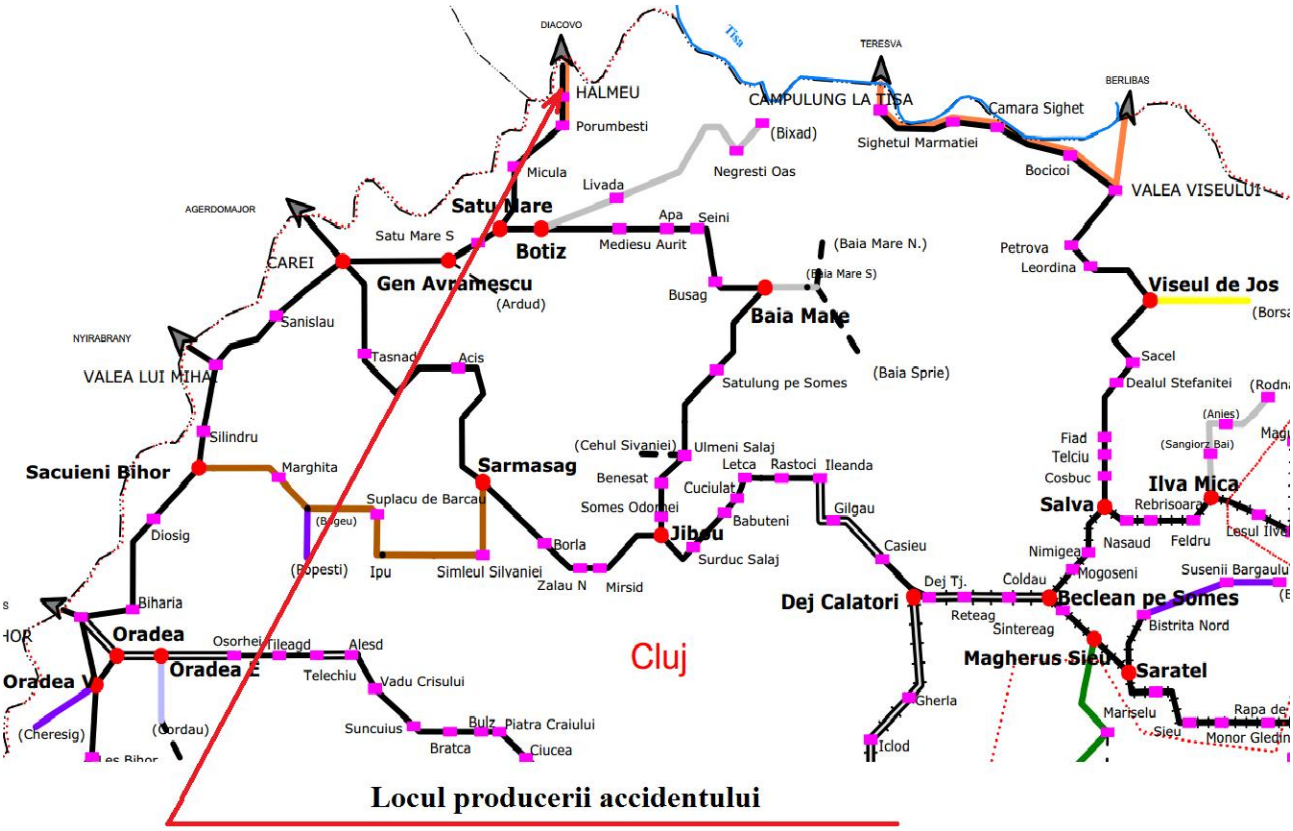
- Vladimir MACICASAN — OIFR's investigator — - main investigator;
- Marian ZAMFIRACHE — OIFR's investigator — - member;
- Traian SZEKELY — regional inspector CREIR Cluj — - member.
- Emil BUCSA — regional inspector CREIR Cluj — - member.
- Cornel POPA — regional inspector CREIR Cluj — - member.

B. INVESTIGATION REPORT BRIEF PRESENTATION

The freight train no. 3651/48651 was composed, as border train, on the 24th of September 2014, in the border station Diacovo (belonging to the State Administration for Railway Transport from Ukraine - UZ) and dispatched to the border station Halmeu (belonging to CNCF "CFR" SA) at 13,05 o'clock.

According to the unified register of free tracks and orders from the railway station Halmeu, on the distance Diacovo – Halmeu, the train no. 3651/48651 run in normal safety traffic conditions.

At 13.50 o'clock, after the train passed completely the entry signal from the railway station Halmeu, occurred the derailment of the second bogie, in the running direction, from the wagon no. 52623642, last from the train.



Accident occurrence place

The accident did not generate injuries or victims.

The direct cause

Direct cause

The direct cause of the accident occurrence is the climbing of the exterior rail curve by the wheel no. 5 of the wagon no. 52623642 at a distance of 7,6 m before the switch crossing nose (for separating gauge) no. 2, following the increasing of the ratio between the creep force and the load which acted on the leading wheel (wheel no. 5), exceeding the derailment stability limit. The increasing of the ratio between the creep force and the load which acted on the leading wheel was generated by:

- deflections over the admitted limits of the specific regulations found at the cross level of the line, deflections which led to big twist of the line and, implicit, at the strong load transfer of the leading wheel (wheel no. 5);
- the thickness of the flange of the wheel no. 5 was under the minimum limit admitted by the Rules of Reciprocal Use of Wagons in International Traffic (PGV), fact which led to the

increasing of the leading angle of the wheel no. 5 in relation with the rail and, implicit, to the increasing of the creep force.

Underlying cause

1. The keeping of wagon no. 52623642 in the train no. 3651/48651 and its ordering in the station Diacovo (UZ) in the conditions in which the thickness of the wheel no. 5 from this wagon was under the limit imposed by the Rules of Reciprocal Use of Wagons in International Traffic (PGV).
2. The keeping in the track of non-corresponding sleepers, in the curve area afferent to switch crossing nose (for separating gauge) no. 2, sleepers which were found as non-corresponding at the census from 2013.

Root cause

None

Taken measures

During the investigation, to decrease appearing risks of accidents with similar causes, the Branch of CNCF "CFR" SA, took following corrective measures:

a) Resending of the mounting plan of the switches crossing noses (for separating gauge) for the rail maintenance subunits ;
b) the performing of additional measures of the gauge and cross level of the line in the area of the the switches crossing noses (for separating gauge) and the adjacent curves;
c) the supply of the Halmeu Line District with wooden sleepers for the wide line.

Safety recommendations

Taking in account those specified in Chapter *C.8. Additional observations*, the investigation commission considers necessary to implement the following safety recommendations:

- start by the public railway infrastructure manager CNCF "CFR" SA of the procedures for finalization of a new Romanian - Ukrainian border agreement, agreement which will be negotiated and signed by Romania and by the representatives of the Romanian Railway Safety Authority - ASFR and the Romanian Railway Investigating Body - OIFR. In the new border agreement will be introduced clear provisions, to establish that the railway staff involved in an accident/incident occurred between border railway stations or in border stations to allow the access at the rolling stock involved and to respond at the questions formulated by the authorized representatives of the State in which occurred the accident / incident.

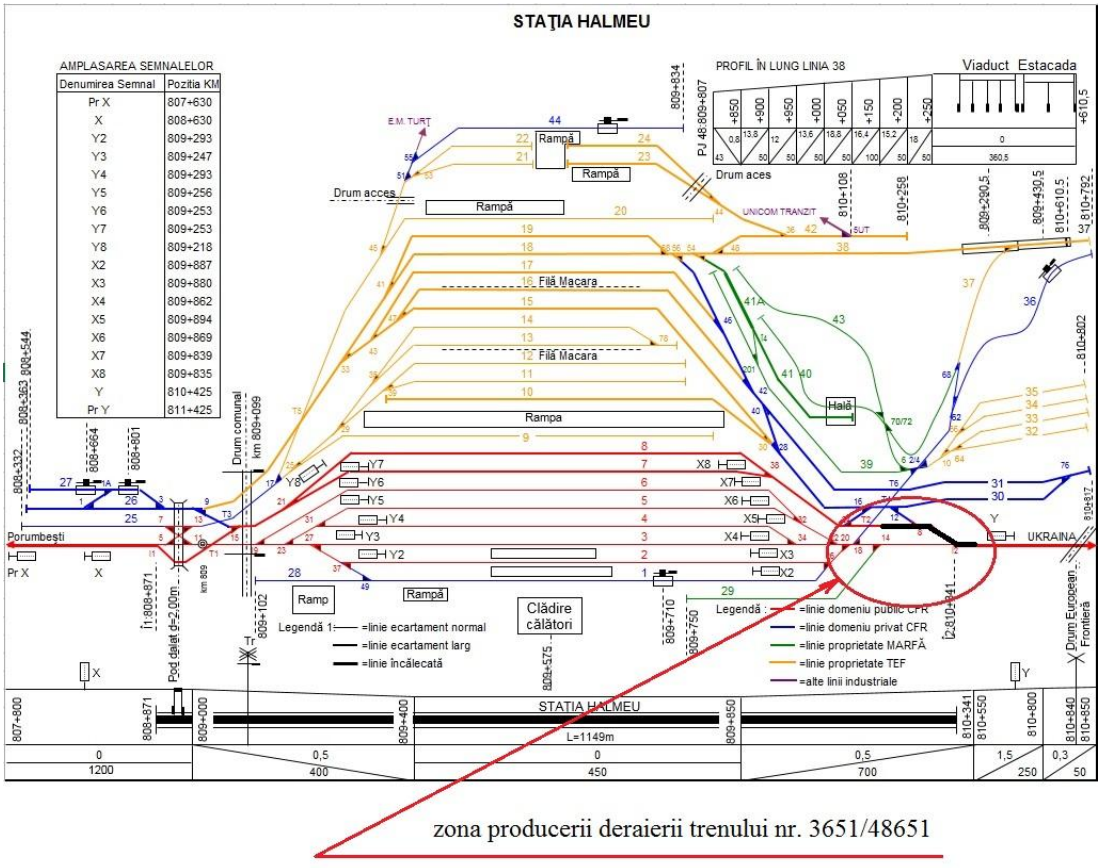
C. INVESTIGATING REPORT

C.1. Accident presentation

On the 24th of September 2014, at 13,05 o'clock, the freight train no. 3651/48651 consist from 17 CSI wagons, 68 loaded axles, 1258 tones, 280 m and hauled with the locomotive DA 1920 (UZ) was dispatched from the border station Diacovo (Ukraine) according to SLBR (Semiautomatic line block with relays) to the railway station Halmeu.

After the stop at the Ukrainian state border (to perform the custom control), the train no. 3651/48651 passed the Romanian state border at 13,40 o'clock. The disposing movement inspector from the railway station Halmeu assured the entry route and put the entry signal put to clear at line 8L (line with large gauge).

After the train no. 3651/48651 passed completely the entry signal, at 13.50 o'clock, occurred the derailment of the second bogie, in the running direction, from the wagon no. 52623642, last from the train.



Train no. 3651/48651 derailment occurrence place

Following the railway accident occurrence, the railway traffic between the border stations Diacovo and Halmeu was closed, thus:

- on the large gauge line from the 24th of September 2014, 15,30 o'clock until 25th of September 2014, 15,35 o'clock;
- on the standard from the 24th of September 2014, 15,30 o'clock until 25th of September 2014, 20,20 o'clock.

The accident did not generate casualties or dead.

After the notification of this railway accident, notification performed according to the specific regulation provisions, at the site went specialists of OIFR, of the Romanian Railway Safety Authority, of the railway infrastructure administrator CNCF "CFR" SA and of the State Administration of the Railway Transport from Ukraine.

Accordingly to the classification foreseen in the *Investigation Regulation*, the derailment of the wagon no. 52623642 from the train no. 3651/48651 on the 24th of September 2014 is classified as **railway accident** and is framed in **Art. 7(1), point b**.

C.2. Accident circumstances

C.2.1. Involved parties

The traffic section where the railway accident took place and the railway station Halmeu are administrated by CNCF "CFR" SA and are maintained by its employees.

The infrastructure and superstructure of the track are administrated by CNCF "CFR" SA and are maintained by the employees of Halmeu 4 District from the L6 Section Satu Mare, Cluj Railway County of CNCF "CFR" SA.

The signaling, centralizing and blocking installations (SCB) from the railway station Halmeu are administrated by CNCF "CFR" SA and are maintained by the employees of CT 2 Section Satu Mare from the , Cluj Railway County.

The railway communication installations from the railway station Halmeu are administrated by CNCF "CFR" SA and are maintained by the employees of Telecomunicatii Feroviare SA.

The railway communication installations from the locomotive are owned by the State Administration for Railway Transport from Ukraine (UZ).

The investigation commission questioned the involved employees in taking over of the train from the technical point of view in the border station, the employees involved in the traffic management from the railway station Halmeu and also the employees involved in the lines maintenance from the railway station Halmeu.

We specify that the employees which deserved the freight train no. 3651/48651 are belonging to the State Administration for Railway Transport from Ukraine (UZ) and they refused to give any statements and sign any kind of documents related to this accident.

C.2.2.Composition and the equipment of the train

The freight train no. 3651/48651 consist of 17 wagons, 68 loaded axles, 1260 tones, 280 m and hauled with the locomotive DA 1920 (UZ), deserved by employees belonging to the State Administration for Railway Transport from Ukraine (UZ).

The train run with a maximum traffic speed of 12 km/h from the railway station Diacovo to the railway station Halmeu, the maximum admitted traffic speed in the derailment area being of 15 km/h.

The locomotive is equipped with a transmitting and receiving radio station and an indicator speed recorder.

C.2.3. Presentation of the railway equipment involved in the accident

C.2.3.1. Lines

Lines

The involved railway infrastructure, respective the railway line is administrated and maintained by the employees of CNCF "CFR" SA / L6 Section Satu Mare, Halmeu L4 District.

The track superstructure in the accident occurrence area is made of rails type 49, on wooden sleepers, curve with a radius of 190 m (curve at the switch crossing nose between the normal line and the broad gauge line) and a radius of 300 m of the switch crossing nose for mixed lines, complete and active K fastening, complete broken stone prism of approximatively 30%, the running speed is of 15 km/h.

Installations

The traffic from the railway station Diacovo (Ukraine) to the railway station Halmeu is made according to SLBR (Semiautomatic line block with relays).

Rolling Stock

Technical characteristics of the wagon no. 52623642:

- private wagon registered at the Russian railways (RZD), owning company EVROSIB – Russia;
- wagon of type covered;
- last periodical inspection (PI) performed on the 19th of August 2013 at the identified company through the code "619", with a validity of 2 years;
- bogie type Diamond;
- axles for wide gauge 1520 mm;
- axle boxes: on roller bearings;
- wheel base: 13.150 mm;
- bogie pitch: 1.800 mm;
- tare: 24.200 kg;
- volume: 138 m^3;
- wagon's total length: 19.150 mm;
- brake type Matrosov with slack adjuster;
- the wagon is equipped with flat centre castings, without wear plate, as are equipped the wagons with semi-spherical centre castings.

C.2.4 Communication means

The communication for the traffic conditions are made between the movements inspectors between the two border stations, respective Halmeu (CFR) and Diacovo (UZ) through direct telephonic line.

C.2.5. Start of the railway emergency plan

After the railway accident occurrence was no need to start the railway emergency plan.

C.3. Accident consequences

C.3.1. Fatalities and injuries

None

C.3.2. Material damages

- at the rolling stock:
- the wagon no. 52623642 derailed by the rear bogie in the running direction (wheels 5, 6, 7 and 8);
- after greasing the centre castings the wagon was rerailed on the line with the help of the hydraulic jacks from the specialized intervention train without to be found other damages at this or its load;
- at the lines: none, according to the document no. 42/E/375/31st of October 2014 of the Lines Division Cluj, annexed to the file;
- at the installations: none;
- at the environment: none;
- at the intervention means: none, it was intervene with own means.

C.3.3. Consequences of the accident in the traffic

- closed lines:

– on the broad gauge line from the 24th of September 2014, 15,30 o'clock until 25th of September 2014, 15,35 o'clock;
– on the standard line from the 24th of September 2014, 15,30 o'clock until 25th of September 2014, 20,20 o'clock.

- Delayed trains: none.
- Cancelled trains: none.
- Additional trains: none.

C.4. External circumstances

On the 24th of September 2014, at the time of the railway accident occurrence, the visibility in the area was perfect, clear sky, without wind, the temperature in the air was of +20°C.
The visibility of the light signals was in accordance with the provisions of the specific regulations in force.

C.5 Investigation course

C.5.1 Summary of the involved staff testimonies

From the testimonies of the **disposing movement inspector** which was on duty on 24th of September 2014, in the railway station Halmeu, following resulted:

- at around 13,00 o'clock he granted consent in block on SLBR to the railway station Diacovo for the train no. 3651/48651;
- the train no. 3651/48651 departure from 13,05 o'clock from the railway station Diacovo and stop at the UZ border for the custom control;
- at around 13,40 o'clock the train no. 3651/48651 passed the Romanian state border;
- he assured the route and put the entry signal on free at line 8L (line with broad gauge);
- after it passed completely the entry signal, the train stopped, being informed by the signalman from switches post no. 2;
- he sent the signalman from the switches post no. 2 on the site, to see the train stop cause;
- at he's returning at the post, the signalman notified him that the last bogie from the last wagon of the train is derailed;
- he notified the station master about the happenings.

From the testimonies of the **expeditor movement inspector** which was on duty on 24th of September 2014, in the railway station Halmeu, following resulted:

- at around 13,40 o'clock the train no. 3651/48651 passed the Romanian state border;
- after it passed completely the entry signal, the train stopped;
- the signalman from the switches post no. 2 notified by phone that the train stop;
- we went on the site and found out that the last wagon from the train (last bogie) is derailed.

From the testimonies of the **signalman** which was on duty on 24th of September 2014, at the switches point no. 2, in the railway station Halmeu, following resulted:

- after assuring the route in block, at around 13,40 he noticed the sudden stop of the train no. 3651/48651;
- he called the disposing movement inspector and notified him about the sudden stop of the train;
- he went on the site and found out that the last wagon from the train (rear bogie) was derailed;
- he reported the findings, by phone, to the disposing movement inspector.

From the testimonies of the **wagon's examiner** (belonging to the freight undertaking SNTFM "CFR Marfa" SA), which was on duty on 24th of September 2014, in the railway station Halmeu, following resulted:

- at around 13,20 o'clock he was notified by phone, by the disposing movement inspector about the fact that the train no. 3651/48651 asked free track;
- at 13,30 he was notified by phone, by the disposing movement inspector about the fact that the train no. 3651/48651 is entering in the railway station at line 8;
- he went on the preseted place to visual inspect the train at the entry in the railway station;
- waiting the train passing for the visual inspection he noticed that the train stop suddenly on the entry line to line 8L, at a distance of about 50 m from the place where he was;
- together with the signalman from the switches post no. 2 went to the locomotive of the train no. 3651/48651 where the driver showed them with the hand the rear of the train;
- getting at the rear of the train site and found out that the last wagon from the train (rear bogie) was derailed;
- he notified by phone the Head of the Wagon's Maintenance Workshop Halmeu, at 13,48 o'clock.

From the testimonies of the **Section Head** of L6 Section Satu Mare, following resulted:

- on the 24th of September 2014, at around 14,00 o'clock was notified by phone about the railway accident occurrence;
- he went to the derailment place where were the measurements performed;
- the last examination with measurements of the crossing switch nose (for separating gauge) no. 2 was performed on 28th of May 2014;
- with the occasion of those measurements was found out that the crossing fit in tolerances of the gauge, and on the curve before the crossing switch nose (for separating gauge) no. 2 existed two measurements at the upper limit of the tolerances foreseen by the Instruction 315 (USSR) at the gauge, and the level values were in tolerances;
- it was proceed at the replacement of the wooden sleepers on the derailment area, at the broad gauge line and was performed the packing of sleepers of the replaced sleepers.

From the testimonies of the **Section Head Deputy** of L6 Section Satu Mare, following resulted:

- on the 24th of September 2014, at around 14,05 o'clock was notified by phone by the Section Head about the railway accident occurrence;
- the last inspection with measurements of the crossing switch nose (for separating gauge) no. 2 was performed on 28th of July 2014;
- with the occasion of those measurements was found out that in the area of the crossing switch nose the values at the gauge and cross level fit in the tolerances admitted by the Instruction 315 (USSR), and on the curve before the crossing switch nose (for separating

gauge) no. 2 existed two measurements at the upper limit of the tolerances foreseen by the Instruction 315 (USSR) at the gauge, and the cross level values were in tolerances;
- it was proceed at the replacement of the concrete sleepers T13 on the derailment area at the line with standard gauge.

From the testimonies of the **Lines District Head** from District 4 Halmeu, following resulted:
- at around 13,55 o'clock he was notified by the Master of the railway station Halmeu about the railway accident occurrence;
- he went to the derailment place where he arrived at 14,00 o'clock;
- the last inspection with measurements of the crossing switch nose (for separating gauge) no. 2was performed on 15th of September 2014 with the occasion of the bi-monthly inspection;
- with the occasion of those measurements was found out that in the area of the crossing switch nose the values at the gauge and cross level fit in the tolerances admitted by the Instruction 315 (USSR), and on the curve before the crossing switch nose (for separating gauge) no. 2 existed two measurements at the upper limit of the tolerances foreseen by the Instruction 315 (USSR);
- he participated at the replacement of the wooden sleepers on the broad gauge line and of the concrete sleepers T13 at the standard line.

C.5.2. Safety management system

At the moment of the accident, CNCF "CFR" S.A., as manager of the railway infrastructure, had implemented its own railway safety management system, according to the provisions of the Minister of Transports' Order no. 101/2008 on the granting of the safety authorization to Romanian railway infrastructure administrator/manager, getting**:**

- Safety Authorization – Part A, identification number ASA 09002 valid until 21st of December 2019 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of the safety management system of the railway infrastructure manager;
- Safety Authorization – Part B, identification number ASB 11006 valid until 21st of December 2019 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of the dispositions taken by railway infrastructure manager in order to comply with the specific requirements necessary to ensure the railway infrastructure safety, in the designing, maintenance and operation, including if case, maintenance and operation of the system for the traffic control and signaling.

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

In the investigation of the railway accident one took into account the next norms and regulations:

- Signaling Regulation no. 004/2006;
- Regulations for the train running and railway vehicle shunting no. 005/2005;
- Rules of Reciprocal Use of Wagons in International Traffic (PGV), Ed. 2012;
- Instruction of important norms and tolerances at lines, branch lines and bridges for the line with USSR gauge from the Romanian railways, Ed. 1950;
- Instruction of electro-mechanical centralization type FT completed with installations for the lines electric control and also for the handling of the Semiautomatic line block with relays between the railway station Halmeu RSR and Diakovo USSR;
- Romanian – Ukrainian Border Railway Convention from the year 1993.

In the investigation of the railway accident one took into account the next sources ad references:

- photos taken soon after the railway accident by the members of the investigation commission;
- questionnaires of the employees involved in the railway accident;
- minutes and measurements performed soon after the railway accident occurrence by the commission members;
- examination and interpretation of the technical condition of the elements involved in the accident;
- Protocol no. 467/09th of October 2014 made in the railway station Halmeu by the Romanian – Ukrainian common commission after the verifications performed at the derailed wagon and the line in the derailment occurrence area..

C.5.4 Operation of the technical equipment, infrastructure and rolling stock

C.5.4.1 Data found out on the line

Technical condition of the line before the accident occurrence

The nominal gauge of the line on which the train run is of 1524 mm (line with wide gauge type USSR).
The track superstructure on the accident occurrence area is made of rails type 49, on wooden sleepers, curve with radius of 190 m curve at the switch crossing nose (between the normal line and the broad gauge line) and a radius of 300 m of the switch crossing nose for mixed lines. The curve is without over heightening and with an over widening of 16 mm.
The line fastening is of type K, this being complete and active. The broken stone prism is complete but clogged of approximatively 30%.
The traffic speed in the accident occurrence area is 15 km/h, set on the mounting and putting on track of the switch crossing nose (between the normal line and the broad gauge line) from the railway station Halmeu.
The last works performed in the derailment occurrence area consisted of cleaning of the broken stone and rectification of the level through packing of sleepers, those being performed on the 26th of December 2012.
The last track inspection in the derailment area was performed on the 15th of September 2014, with this occasion were performed cross level and gauge measurement, being found transversal deformations until 10 mm.
At the same date, 15th of September 2014 was found the keeping on the track, in the curve area afferent to switch crossing nose the between the normal line and the broad gauge line no. 2 of a number of 4 non-corresponding sleepers reviewed in the autumn of 2013, fact which is against the provisions of Art. 45, Chapter II from the Instruction of important norms and tolerances at lines, branch lines and bridges for the line with USSR gauge from the Romanian railways. We mention the fact that, according to the planning made by the Lines District Halmeu, those sleepers had to be replaced in august 2014.

Findings from the line after the accident occurrence

After the railway accident occurred the breaking of the sleepers on the normal line and also on the broad gauge line, resulting also the deformation of the track on both lines (standard and broad) after the crossing switch nose.
The first climbing trace was found on the exterior curve rail with a right deflection at about 7,6 m before the switch crossing nose no. 2 between the line with broad gauge and the line with standard (at km 817+941). The wagon run derailed on a distance of about 53,7 m, stopping at km 817+887.

Photo no.1 The first derailment trace

After the derailment was measured the line gauge variation (E) toward the nominal gauge (1524 mm) and the cross level in transversal profile (N) of a rail to the other with the gauge measuring for the wide line from 2,5 m to 2,5 m and were found the following values:

Measuring point name	-5	-4	-3	-2	-1	0	1	2	3	4
Gauge variation (mm)	+7	+5	+4	+10	+17	+22	+22	+15	+9	+5
Transversal level variation (mm)	5	0	**-2**	**-5**	**-7**	**-10**	**-5**	0	5	5

Note: point "0" represent the place where the derailment occurred;
The train running direction was from point "-5" to point "4".
The difference of level in the measuring points -1 and 0 are not fitting in the limits foreseen by Art. 4, Chapter I from the *Instruction of important norms and tolerances at lines, branch lines and bridges for the line with USSR gauge from the Romanian railways*, and in the points -3, -2, -1, 0 and 1 the exterior curve rail is lower than the interior rail, against the provisions of Art. 6, chapter I from the same instruction.
Also, at a distance smaller than 12 m were found level differences on different rails of the same line, differences of which sum was bigger than 5 mm, fact which is against the provisions of Art. 4, Chapter I from the same instruction.
The values of the line gauge variation toward the nominal gauge fit in limits foreseen at Art. 1 and Art. 2, Chapter I from *Instruction of important norms and tolerances at lines, branch lines and bridges for the line with USSR gauge from the Romanian railways.*

Findings from the line found out by the Romanian – Ukrainian common commission

According to the provisions of the Romania – Ukrainian Border Railway Convention from 1993, OIFR convene a common commission with the representatives from the State Administration for Railway Transport from Ukraine (UZ) from the 09th of October 2014, in the railway station Halmeu, for the inspection of the derailed wagon and of the line in the derailment occurrence area.

After the verifications performed at the line was found **a reverse tilt of the two rails of the curve (exterior curve rail being found with 14 mm lower that the interior curve rail in the derailment occurrence area)**. We specify that this value was measured after the performing of a provisional repair at the line.

C.5.4.2. Data found out on the railway installations

After the inspections performed, were no problems found at the blocking, centralizing and signaling installations (SCB) from the railway station Halmeu.

C.5.4.3. Data found out on the locomotive

The train was hauled with the diesel locomotive DA 1920 belonging to the Ukrainian railways administration (UZ).
The locomotive staff belongs to the Ukrainian railways administration (UZ) and didn't allowed the removing of the speed recorder band, allowing just its photography (Photo no. 2).
After analyzing the photo taken at the speed recorder was found that the train running speed at the moment of the derailment occurrence moment was of about 12 km/h.

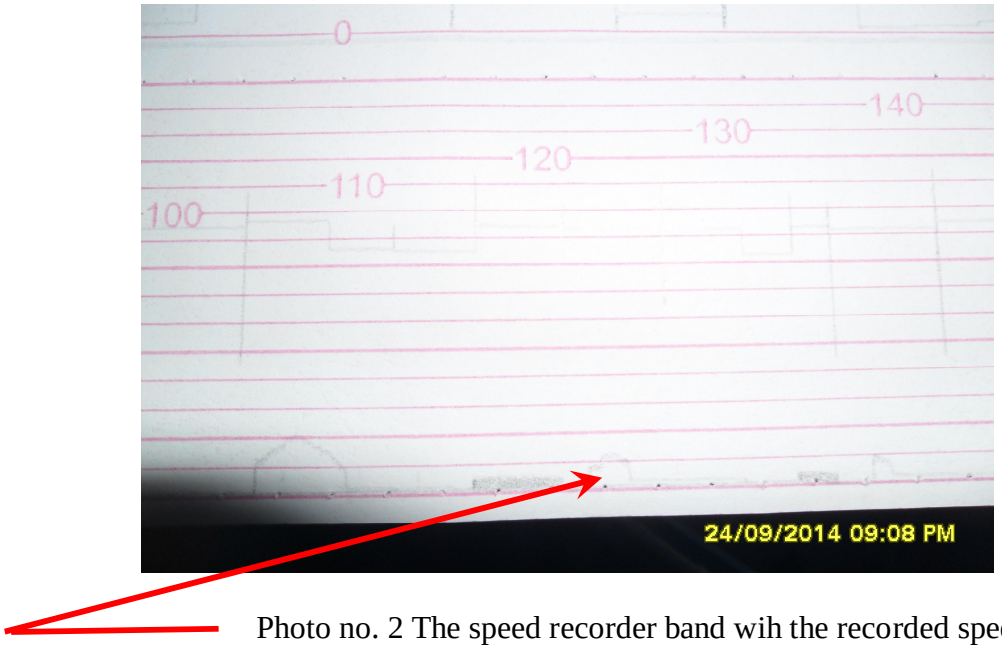


Photo no. 2 The speed recorder band wih the recorded speed at the derailment place

C.5.4.4. Data found out on the wagon no. 52623642

Findings at the wagon after the accident occurrence

With the occasion of lifting and rerailing on the line of the wagon, works performed with hydraulic jacks from the equipment of the specialized intervention train, were found rust traces and pronounced wear due the lack of lubricants between the upper and lower centre castings of the wagon, as can be seen in Photo no. 3.

Photo no. 3 The upper and lower centre castings of the wagon

On 25th of September 2014, after the rerailing of the wagon on the line and its unloading were performed measurements of the characteristically elements of the derailed bogie wheels (distance between the interior faces of the wheels rims, the width of the part which held place for the tyre, wheels diameter, height and thickness of the wheels flange) and also of the clearings between the bogies guides and the wagon's body.

After those measurements was found that the distance between the interior faces of the wheels rims, the width of the part which held place for the tyre, wheels diameter, height and thickness of the wheels flange and also of the clearings between the bogies guides and the wagon's body were in the admitted limits foreseen by the Rules of Reciprocal Use of Wagons in International Traffic (PGV) – Ed. 2012.

Concurrently, it was found that the thickness of the flange of the wheel no. 5 (leading Wheel from the derailed bogie), measured at 18 mm from its peak was of 22 mm, value which is inferior to the admitted limit (24 mm), foreseen at point 2.2.2.4. from Annex 1 of the Rules of Reciprocal Use of Wagons in International Traffic (PGV) – Ed. 2012.

We mention that, because the representatives of the freight undertaking SNTFM "CFR Marfa" SA didn't had a device which could allow the direct setting of the thickness of the flange of the wheel at 18 mm from their peak, the measurement of this dimension was performed with a callipers.

Findings from wagon found out by the Romanian – Ukrainian common commission

After the verifications performed in the Romanian – Ukrainian common commission at the derailed bogie of the wagon was found out that the thickness of the flange of the wheel no. 5 (leading Wheel from the derailed bogie), measured at 18 mm from its peak was of 23 mm, value which is inferior to the admitted limit (24 mm), foreseen at point 2.2.2.4. from Annex 1 of the Rules of Reciprocal Use of Wagons in International Traffic (PGV) – Ed. 2012.

We mention that this time the measurement of the thickness of the flange of the wheels from the derailed bogie was performed whit a special device which permitted the direct measurement of the flange thickness, put at disposal by the Ukrainian representatives.
At the Romanian side request to indicate the time period at which is set, through own regulations, the lubrication of the centre castings of the freight wagons, the Ukrainian side declared that this operation is performed only with the occasion of the Periodical Inspection (PI) and at the changing of the bogies from broad gauge to standard.

C.5.5. Interface man-machine-organization

The Romanian railway staff involved in this railway accident had the valid medical and psychological approvals necessary for the functions their performed.

C.5.6. Anterior events with similar character

Is not the case.

C.6. Analysis and conclusions

C.6.1. Conclusions on the technical condition of the track superstructure

Taking into account the findings from the track superstructure in the derailment occurrence area, findings described at chapter *C.5.4.1 Data found out on the lines*, one can stated that line presented deflections of the cross level over the admitted level by specific regulations, fact which direct led to the derailment of the wagon no. 52623642.

The commission considers that the deflections found at the track cross level are due the keeping on track, in the area afferent to the crossing switch nose (for separating gauge) no. 2 of the none-corresponding sleepers, sleepers which had been reviewed in the autumn of 2013.

C.6.2. Conclusions on the technical condition of the railway installations

The blocking, centralizing and signaling installations (SCB) from the railway station Halmeu were in good condition and could not influenced the accident occurrence.

C.6.3. Conclusions on the technical condition of the rolling stock

Taking into account the findings from the derailed wagon, findings described at chapter *C.5.4.3 Data found out on the wagon no. 52623642,* one can stated that the flange of the leading wheel from the second bogie in the running direction of the train (wheel no. 5) had the thickness under the imposed limit by the Rules of Reciprocal Use of Wagons in International Traffic (PGV), fact which led direct to the derailment of this bogie.

The distance run by the wagons from the train no. 3651/48651 from 24th of September 2014, from the formation station Diacovo (UZ) and until the railway accident occurrence place is about 2,3 km, distance on which, during the wagons running could not occurred wear which could led to the decreasing of the flange thickness of a wagon wheel with about 2 mm.

Taking in account those before, we consider that the leading wheel no. 5 from the second bogie of the wagon no. 52623642 had the failure from above before the performing of the technical inspection at forming in the railway station Diacovo (UZ), inspection foreseen at Art. 3.2 from the Rules of Reciprocal Use of Wagons in International Traffic (PGV).

Because the technical agent (employee belonging to UZ) which performed, on the 24th of September 2014, the technical inspection at forming in the railway station Diacovo (UZ) of the wagons from the train no. 3651/48651 could not be questioned, the investigation commission could not draw conclusions on how were performed the operations foreseen in this technical inspection.

However, the keeping of the wagon no. 52623642 in the train no. 3651/48651 and its guiding in the conditions in which the wheel no. 5 from this wagon presented the upper failure, could lead us to the idea that this failure could not be detected at the technical inspection at forming due an human error arise in the technological process of technical preparation of the wagons.

C.6.4. Analyze and conclusions on how the accident occurred

From the findings analyze performed at the accident place, of the technical condition of lines and involved rolling stock, and also of the employee's questionnaires, it can be conclude that:

- the thickness of the flange of the wheel no. 5 being under the limit admitted by the Rules of Reciprocal Use of Wagons in International Traffic (PGV) led to the increasing of the gauge clearance of the leading axle (5-6) from the bogie no. 2 of the wagon, and then at the increasing of the attack angle of the wheel in relation with the rail and the creep force;
- in those conditions, in the moment of the entry in the curve of the bogie, the guiding exterior surface of the flange of the wheel no. 5 profile entered in tangent contact with the right lateral side of the rail from the curve exterior, forcing thereby the wheel no. 6 to run on the rail from the interior curve on the section of the running profile with maximum conicity of tread;
- in this situation and in the conditions of the existence of an increased the flank angle due the wear of the flange of the wheel no. 5, the contact between the exterior flange of the

wheel and the interior lip of the head of the exterior rail occurred very closed to the peak of the flange of the wheel, situation in which the climbing danger of the flange of the wheel no. 5 on the active running surface of the exterior rail increased very much;

- after the climbing of the flange of the wheel no. 5 on the rail, the contact between that and the rail occurred in the extreme point of the flange peak, point in which the derailment risk of this wheel and leaving of the running surface of the curve interior rail by wheel no. 6 become maximum, followed by its falling between the track rails;
- the deflections over the admitted limits by the specific regulations found at the transversal level of the line led to big twist of the line, fact which led to the strong load discharge of the leading wheel (no. 5);
- after the climbing of the exterior rail by the wheel no. 5 from the leading axle, that run a small distance at the head of the exterior rail and then left the head running surface, falling in the track exterior and hitting strong in the fastening elements of the rail on the sleepers;
- after the falling of the wheel no. 5 in the track exterior, the derailed leading axle started to run tangent at the track curve and then engaged in derailment also the second axle of the bogie no. 2;
- after the climbing of the exterior track by the wheel no. 5, the train run with the wagon no. 52623642 derailed on a distance of 53,7 m, stopping with this wagon at km 817+887.

C.7. ACCIDENT CAUSES

C.7.1. The direct cause

The direct cause of the accident occurrence is the climbing of the exterior rail curve by the wheel no. 5 of the wagon no. 52623642 at a distance of 7,6 m before the switch crossing nose (for separating gauge) no. 2, following the increasing of the ratio between the creep force and the load which acted on the leading wheel (wheel no. 5), exceeding the derailment stability limit. The increasing of the ratio between the creep force and the load which acted on the leading wheel was generated by:

- deflections over the admitted limits of the specific regulations found at the cross level of the line, deflections which led to big twist of the line and, implicit, at the strong load transfer of the leading wheel (wheel no. 5);
- the thickness of the flange of the wheel no. 5 was under the minimum limit admitted by the Rules of Reciprocal Use of Wagons in International Traffic (PGV), fact which led to the increasing of the leading angle of the wheel no. 5 in relation with the rail and, implicit, to the increasing of the creep force.

C.7.2. Underlying cause

1. The keeping of wagon no. 52623642 in the train no. 3651/48651 and its ordering in the station Diacovo (UZ) in the conditions in which the thickness of the wheel no. 5 from this wagon was under the limit imposed by the Rules of Reciprocal Use of Wagons in International Traffic (PGV).
2. The keeping in the track of non-corresponding sleepers, in the curve area afferent to switch crossing nose (for separating gauge) no. 2, sleepers which were found as non-corresponding at the census from 2013.

C.7.3. Root cause

None

C.8. Additional observations

The Romanian - Ukrainian Border Agreement, in craft from 1993, is signed between the National Society of the Romanian Railways (SNCFR) and the State Administration of the Railway Transports from Ukraine (UZ).

The above mentioned agreement is determined how the two sides proceed if accidents between border stations or in the border stations, but it is not established that the railway staff involved in such an accident / incident must allow access to the rolling stock involved and to answer at the questions from the authorized representatives of the State in which the railway accident / incident occurred.

In 1998, the National Society of the Romanian Railways (SNCFR) was reorganized, being established 5 new companies (the public railway infrastructure manager CNCF "CFR" SA, the freight undertaking SNTFM "CFR Marfa" SA, the passenger operator SNTF "CFR Calatori" SA, Railway Assets Management Society "SAAF" SA, Railway Management Services Society "SMF" SA).

Also, in 1998 was established the Romanian Railway Authority – AFER, as specialized technical body of the Ministry of Transport in the railway and subway. The Romanian Railway Authority - AFER had among its duties the investigation and research of railway accidents and incidents.

In 2006, at the reorganization of the Romanian Railway Authority - AFER, was established the Romanian Railway Investigating Body – OIFR, as an independent functional body, whose main task is the railway accidents and incidents investigation.

Considering those above, the investigation commission considers that is necessary the beginning of the procedures for concluding a new border agreement, agreement which will be signed for the Romanian side and by the representatives of the Romanian Railway Safety Authority - ASFR and the Investigating Body Romanian Railway - OIFR.

Also, the investigation commission considers it necessary that in the border agreement has to be established clearly that the railway staff involved in a railway accident / incident occurred between border stations or in a border station must allow access to the rolling stock involved and to answer at the questions from the authorized representatives of the State in which occurred the railway accident / incident.

D. TAKEN MEASURES

Taken measures

During the investigation, to decrease appearing risks of accidents with similar causes, the Branch of CNCF “CFR” SA, took following corrective measures:

a) Resending of the mounting plan of the switches crossing noses (for separating gauge) for the rail maintenance subunits ;
b) the performing of additional measures of the gauge and cross level of the line in the area of the the switches crossing noses (for separating gauge) and the adjacent curves;
c) the supply of the Halmeu Line District with wooden sleepers for the wide line.

E. SAFETY RECOMMENDATIONS

Taking in account those specified in Chapter *C.8. Additional observations*, the investigation commission considers necessary to implement the following safety recommendations:

- start by the public railway infrastructure manager CNCF "CFR" SA of the procedures for finalization of a new Romanian - Ukrainian border agreement, agreement which will be negotiated and signed by Romania and by the representatives of the Romanian Railway Safety Authority - ASFR and the Romanian Railway Investigating Body - OIFR. In the new border agreement will be introduced clear provisions, to establish that the railway staff involved in an accident/incident occurred between border railway stations or in border stations to allow the access at the rolling stock involved and to respond at the questions formulated by the authorized representatives of the State in which occurred the accident / incident.

This Investigating Report will be transmitted to Romanian Railway Safety Authority, to the public railway infrastructure manager CNCF "CFR" SA, the freight undertaking SNTFM "CFR Marfa" SA and to the State Administration of Railway Transport from Ukraine.

Cluj – Napoca, …….*December 2014*

Members of the investigation commission:

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▪ Marian ZAMFIRACHE	OIFR's investigator	- member;
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