

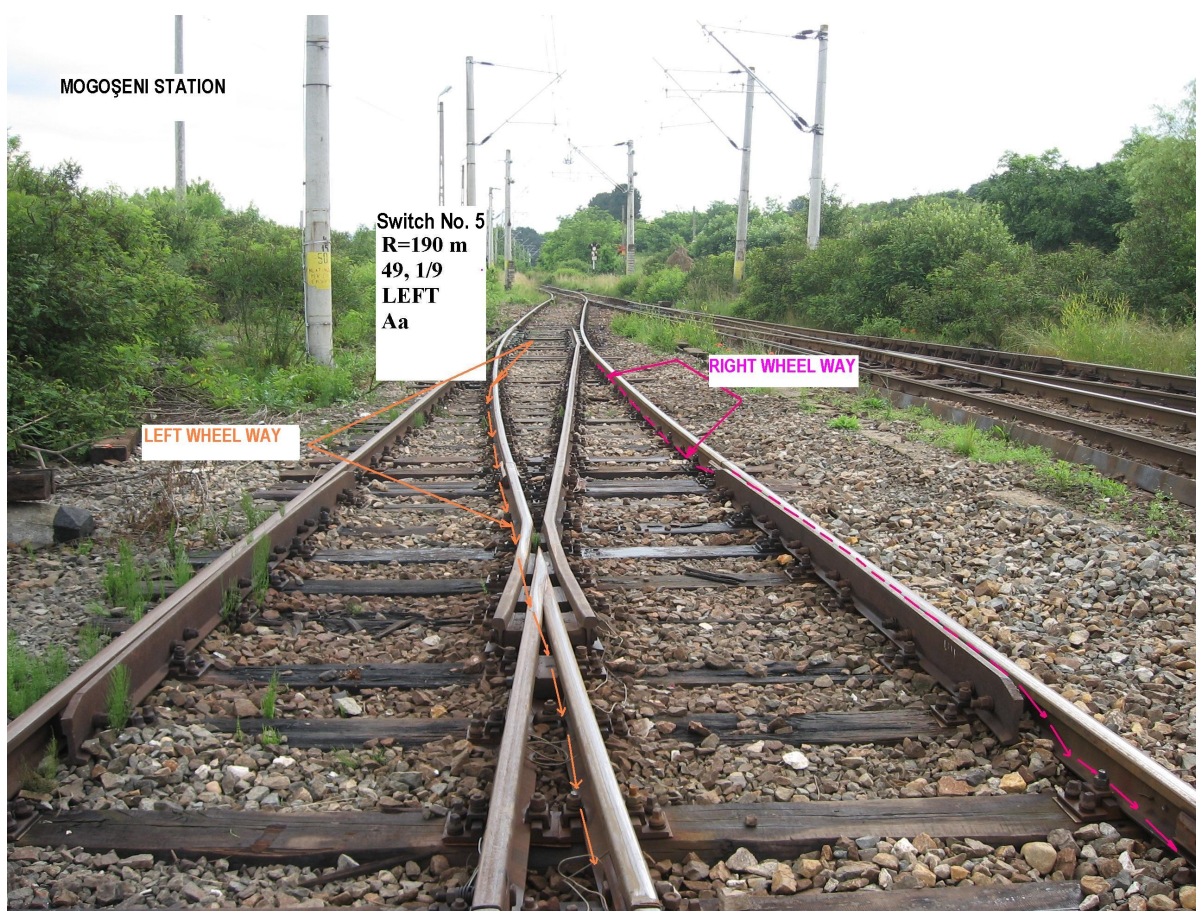


MINISTRY OF TRANSPORT AND INFRASTRUCTURE  
ROMÂNIAŢN RAILWAY AUTHORITY – AFER  
ROMÂNIAN RAILWAY INVESTIGATING BODY



## INVESTIGATING REPORT

On the derailment of the locomotive EA 826  
of the passenger train no. 4483 belonging to  
SNTFC “CFR Passengers” SA in Mogoseni station  
on the 26<sup>th</sup> of May 2008



*Final edition*

12 January 2009

## 1. Summary

### 1.1 Brief presentation of the event

- 1.1.1 On the 26<sup>th</sup> of May 2008, the passenger train no. 4483, belonging to the railway undertaking SNTFC "CFR Calatori" SA, was dispatched from the Nimigea station to the Mogoseni station, at 15:06 hour according to the automatic block line, without remarks. At the entry into the halt Mogoseni, on the deflecting line 1, with the speed 24 km/h, happened the derailment of the first axle in the direction of traffic (axle no. 6), belonging to the locomotive EA 826, that hauled 3 coaches with 12 axles and 144 tones. The derailment happened in the connection rails area, on the deflecting section, of the switch no. 5 from Mogoseni station.
- 1.1.2 According to the provisions of the art. 3 of the Law no. 55/2006 concerning the railway safety, the event, that is the derailment of the passenger train locomotive no. 4483, is a railway accident.
- 1.1.3 One found out some problems in the railway activity concerning the railway infrastructure situation and wrong work systems that can be favored factors, respectively direct causes, primary and underlying causes of the railway accident.
- 1.1.4 One could establish cause connections between these favored factors, underlying causes and the direct cause that lead to the railway accident.
- 1.1.5 In order to establish the connections between the direct cause and the favored factors, respectively secondary causes, was need to question the involved railway staff, as well as to study some documents drawn up at the moment of some works and inspections performed on the track in the derailment place.

### 1.2 Direct cause of the railway accident is:

The presence in the switch no. 5, in the connection rails area, in the curve with the radius  $R=190m$ , of **5 unsuitable sleepers**, in succession, that could not ensure the fastening of rail on the sleepers by coach screws, led to a gauge widening over the derailment safety limits and to the left wheel running inside the track.

### 1.3 Underlying causes

- 1.3.1 The missing from the team inspection notebook of the bimonthly measurements, according to the provisions of the sheet no. 3, art. 2 from the Instruction no. 305/1997 concerning the establishment of the terms and of the order for the track inspection.

- 1.3.2 The non-performance of all switches inspections that the district head has to do, according to the provisions of the art. 26 from the Instruction no. 323/1965 of the district permanent way inspector, district head for the track maintenance.
- 1.3.3 The presence of some wrong data concerning the geometrical characteristics of the switches in the inspections notebooks, that can lead to the use in operation of some unsuitable tolerance intervals that maintained in track can lead to the sleepers and fastenings wear.
- 1.3.4 The absence of the switches measurements analysis.
- 1.3.5 The non-performance of the complete technological processes during the inspections of the switches hidden parts.
- 1.3.6 The non-removal of the gauge and level failures found out during the inspections of the switches hidden parts.
- 1.3.7 One did not supply the materials stipulated to be replaced in the approved maintenance plan of the tracks and switches.
- 1.3.8 One did not perform a realistic analysis at the end of the year 2007, concerning the replacement of the switches for 2007. One supplied smaller quantities against those needed, that are not in accordance with the size of the requested sleepers. So in 2007, from an approved necessary of 541 special sleepers, one supplied 308 pieces, from which 64 were supplied over the requested sizes. This led to a supply of 244 sleepers requested on sizes. The real percentage of the sleepers supplied on sizes is 45% not 57% as is written in the achievements global situation for 2007.
- 1.3.9 The head team job from district 2 Beclean, Mogoseni team is vacant and the railway safety responsibilities/competences, according to the Instruction 305/1997 concerning the establishment of the deadlines and order for the track inspection, was not designed/re-assigned by the track section management.
- 1.3.10 The exceeding of instruction deadline for the unsuitable special sleepers replacement of the switches.

**1.4 Primary causes** that led to the railway accident are connected to the framework for the regulation and implement of the railway safety management system concerning the maintenance and repair of the switches that have the next failures:

- 1.4.1 The missing of a connection between the inventoried necessary and the supply with some pegs, whose unsuitable presence on the track is not accepted by the regulations ( sleepers on switches, sleepers on bridges, and so on )

- 1.4.2 The missing of a periodicity of some maintenance and repair works at the tracks and switches.
- 1.4.3 The lost of the technical abilities of the staff involved in switches maintenance and repair, by supplying switches from time to time and the rehabilitation from the knowledge and practical abilities point of view.

## **1.5 Recommendations**

- 1.5.1 The re-viewing of the sleepers inventory in order to draw up a plan for the replacement of the unsuitable sleepers and the establishment of the necessary running conditions.
- 1.5.2 The performance of an analysis concerning the progress of the sleepers wear on the switches within 5 years at least, in connection with the supply progress and track sleepers replacement for switches of the running lines, main lines and arrival – departure lines.
- 1.5.3 The performance of an analysis concerning the running speed slackening progress, on the switches, establishing the percentage of all causes.
- 1.5.4 The performance of an analysis concerning the means for keeping and improving the technical and practical abilities of the staff involved in the management, maintenance and repair of the switches, by internal trainings like staff training or in special institutes.
- 1.5.5 The analysis of the opportunity to perform a study on the Romanian railway network situation, concerning the track maintenance activity.

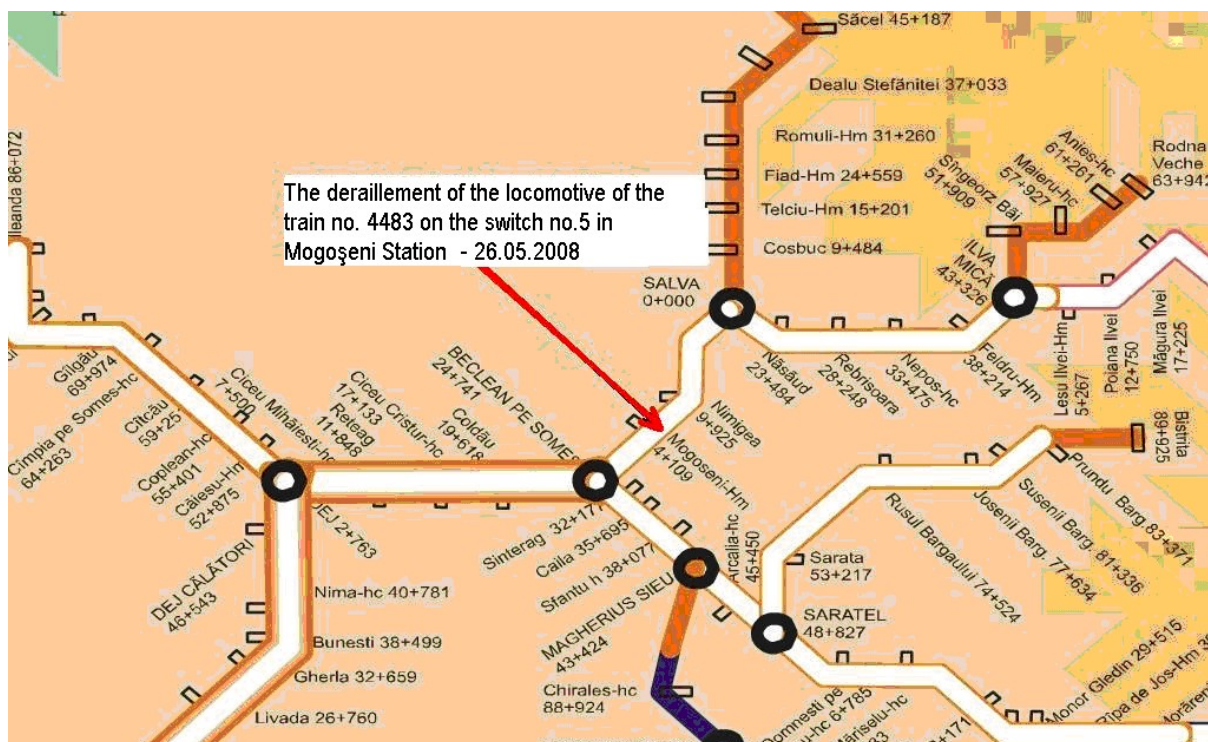
## **2. Immediate facts of the occurrence**

### **2.1. The occurrence**

2.1.1 According the finding out of the railway infrastructure situation, track materials situation, involved staff testimonies, the documents for the evidence of the track measurements and the analysis of the records of the speed recorder, the railway event was reconstituted.

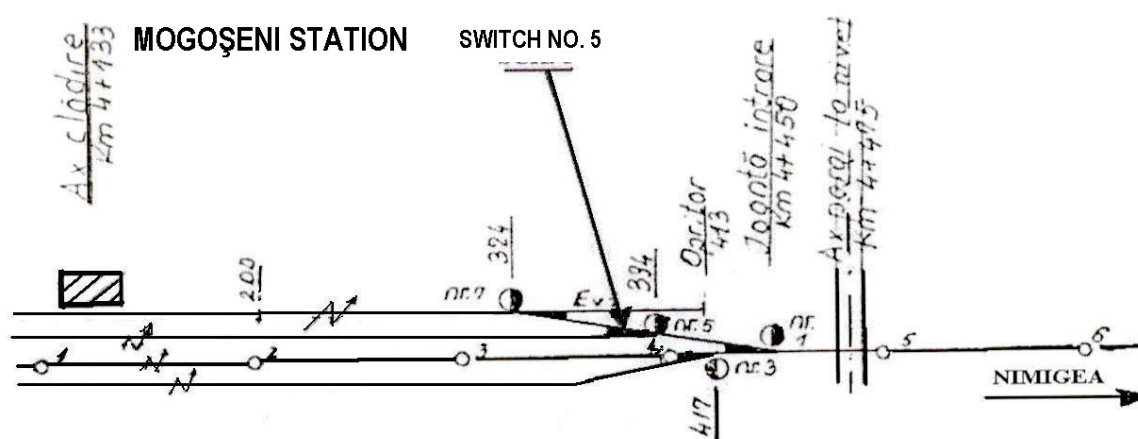
The Mogoseni station belongs to the subsidiary of the Railway County Cluj, in the center of the Romanian railway network at 92 km east from the railway station Cluj Napoca.





Picture 1 - Geographical position of the accident

2.1.2 On the 26<sup>th</sup> of May 2008, the passenger train 4483, consisting in 3 wagons matriculated by SNTFC “CFR Calatori” SA, having 12 axles and 144 tones with 100m length , hauled by the locomotive EA 826 from Cluj Depot, without driver’s assistant, was dispatched from the Nimigea station to the Mogoseni station at 15:06 hour, according the automatic block line. At the arrival in the Mogoseni station, on the deflecting line 1, at 15:18 hour, at a speed of 24km/h happened the derailment of the first axle in the traffic direction ( axle 6 ) belonging to the locomotive EA 826, in the rails connection area, on the deflecting section of the switch no. 5 from the station( picture 2 ).



**Picture 2:** Scheme of the Mogoseni station, in the accident area

2.1.3. At 4 m after the joint of the curved stock rail ( heel of blade ) of the switch no. 5, on the connection rail between the curved stock rail heel and the running rail with the check rail on the deflecting section , in a curve with radius of 190m, left deviation, the left wheel run inside the track,

running then on the ump surface of the base of rail and on the vertical fastening screws. The wheel fall happened between the sleepers 19 and 20 from the joint of the point of the switch tongue no. 5, at 24 km/h speed. (picture 3)



**Picture 3** – First wheel derailment area

2.1.4 After the left wheel fall, the right wheel run 3.5 m on the connection rail from the deflecting section right, then the tire lip climbed the head of the rail and fell outside the track on the deflecting section to the connection rail from the right of the track on the switch direction ( between the sleepers 25 and 26 ) and run on the vertical metallic fastenings and on the sleepers ( picture 4 ).





**Picture 4 - The right wheel print on the connection rail before the derailment on the deflecting section outside**

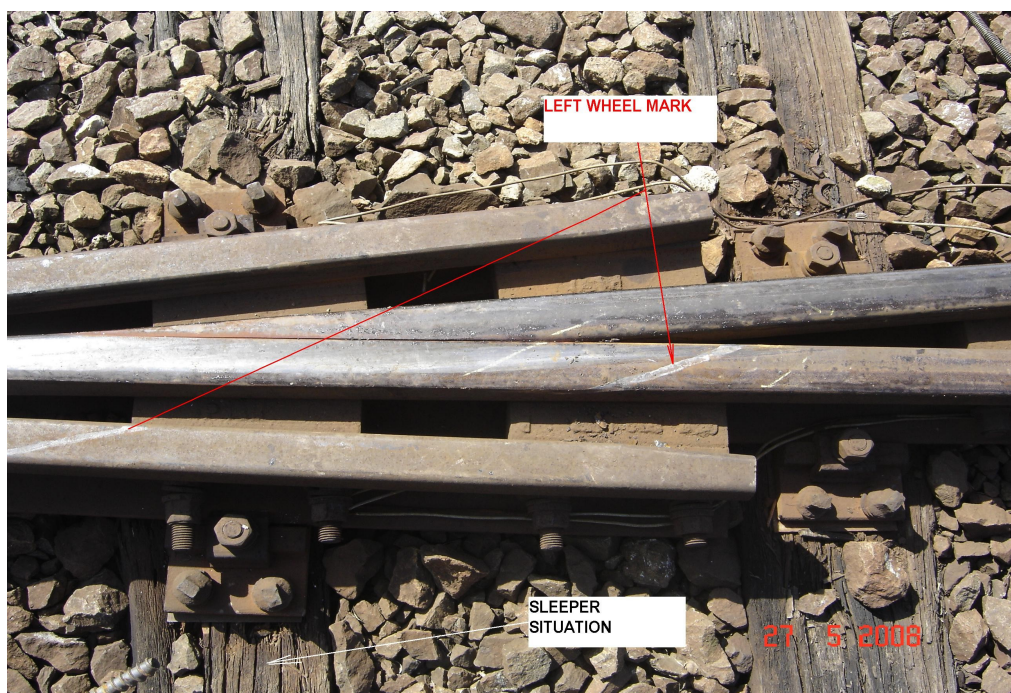
2.1.5 The derailed axle run up to the check rail on the deflecting section from the left of the track, from the common crossing, deteriorated the lingnofolium insulated joints on the deflecting section, then the left wheel hit on the vertical section of the check rail end and run on the flange way/drain between the rail and check rail (picture 5).





**Picture 5. The left wheel hit the check rail**

2.1.6 Because of the forced guiding of the wheel from the left of axle, on the deflecting section, the right wheel climbed the common crossing of the switch 5 and then fell at the crossing heel between the rail outside from the right deflecting section and the rail outside from the left of the switch (picture 6).



**Picture 6. The right wheel print in the switch crossing**



2.1.7 The derailed axle run 26.5 m from the switch heel on the line 1 on the deflecting section of the switch 5, stopping at 7m after the glued insulated joint corresponding to the section of the exit signal Y<sub>1</sub> from the line 1.

2.1.8 According to the provisions of the art. 19 of the Law no. 55/2006 concerning the railway safety was set up the Romanian Railway Investigating Body, permanent, independent body in the Romanian Railway Authority - AFER, that carries on the investigation of the serious railway accidents, its objective being to improve the railway safety and to prevent the accidents. The Romanian Railway Investigating Body can investigate, besides the serious accidents, those accidents and incidents that in a little different condition could lead to serious accidents, inclusively the technical failures of the structural subsystems or of the interoperability constituents of the European high speed or conventional railway systems.

2.1.9 According to the provisions of the art. 3, point I of the Law no. 55/2006 concerning the railway safety the present event, respectively the derailment of the locomotive of the train 4483, EA 826 from the halt Mogoseni, is a railway accident.

2.1.10. Taking into account that on the 26<sup>th</sup> of May 2008 occurred a railway accident according to the Law no. 55/2006 concerning the railway safety, that in a little different condition could lead to a serious accident, the Romanian Railway Investigating Body decided to investigate this railway event, the investigating commission consisting in:

SFARLOS Dumitru – investigator in charge

OLARU Mihai – investigator

ZAMFIRACHE Marian – investigator

2.1.11. The purpose of the investigation is not to establish the guilty or the responsibility and it is performed in the same time with other inspection actions.

2.1.12. The investigation is performed as opened as possible, so all the parties can be hear and have access at the results. The infrastructure manager and the involved railway undertaking, the Romanian Railway Safety Authority, are regularly informed about the investigation and its course, giving, at their request, the possibility to present their opinions and points of view on the investigation and having the possibility, on request, to comment on the report information.

## **2.2. The background to the occurrence**

2.2.1 The staff involved in the event occurrence and progress belonging to CN “CFR” SA – subsidiary of the Railway County Cluj – Track Section L8 Bistrita – District 2 Beclean (control and management staff of the Track Division Cluj, track section head L8 Bistrita, adjoin of the track section head L8 Bistrita, track section examiner from the Track Section Cluj, district head L2 Beclean, track examiners team L Mogoseni ).

2.2.2 The involved locomotive was type **EA 826**, belonging to SNTFC “CFR Calatori” SA - Depot Cluj.

2.2.3 The involved railway infrastructure, respectively the tracks of the Mogoseni station, is in the responsibility of CNCF "CFR" SA – subsidiary of Railway County Cluj.

2.2.4 The tracks of the Mogoseni station are maintained by the staff from the District 2 Beclean, team 5 Mogoseni from the track section L8 Bistrita.

2.2.5 The switches area from 1,3,5,7 in the Mogoseni station are disposed in a grade of 3‰.

2.2.6 The track 1 is a straight line, made of rail type 49, on reinforced concrete sleepers T13, without the first two panels ( of 8,50 m and 15 m ) from the heel of the switch 5 made on normal wood sleepers.

2.2.7 The switch no. 5 is type 49, R=190m, 1:9, left deviation, jointed points (Aa), gauge 1435 mm, assembled on wood sleepers, indirect fastening K.

2.2.8 The running lines and the lines 1-3 of the Mogoseni station are electrified.

## **2.3 Event consequences**

**2.3.1 Victims and injured persons:** Following the railway accident there were no victims and injured persons

### **2.3.2 Material damages:**

- track - none
- locomotive – 1803,10 lei according to the estimate B2/1298/2008
- cars – **none**
- equipments – none
- environment – none
- other damages – 209,6 lei

The damages cost is according to the estimates drawn up by the rolling stock owner and the railway infrastructure responsible.

There were no material damages, deteriorations or replacements in the switches 5 and at those two panels from the heel on the line 1 because these (situated on the track at the moment of the derailment) were completely fault and unsuitable.

There was no estimation concerning the cost with the labor for the replacement of the destroyed railway parts because this was remaining from the maintenance works planed but not performed in the last months.

## **2.4 External circumstances**

2.4.1 On the 26<sup>th</sup> of May 2008, between 15:00 hour and 16:00 hour the visibility was very good, the temperature was about 24<sup>o</sup>C, unclouded sky, no wind.

2.4.2 Lines 1 ( arrivals – departures ) and 2 ( main line ) were free and the lines 0 ( depot) and 3 (arrivals – departures ) were busy.

2.4.3 The signals and the interlocking systems, electric traction and telecommunications functioned well.

### **3. Record of investigations and inquiries**

#### **3.1 Summary of the involved staff testimonies**

**3.1.1 The movements inspector** on duty at the moment of the event occurrence in the Mogoseni station, stated :

- the driver of the train 4483 informed by RTF at about 15:16 hour that happened the derailment of the first axle in the traffic direction;
- notified the traffic controller in order to decide on the traffic;
- notified the manager of the railway station Beclean, to which belongs the Mogoseni station.

**3.1.2 The locomotive driver** of the derailed locomotive EA 826 that hauled the train 4483 stated:

- during the running of the locomotive on the deflecting section 1, in the switches area he heard a strong noise at the roster part and took measures for the fast braking of the locomotive;
- contacted by RTF the movements inspector from the Mogoseni station;
- asked the conductor the application of the handbrakes of the cars.

**3.1.3. The appointed track inspector**, belonging to the district 2 Beclean, who inspected the track in the Mogoseni station stated:

- the last inspection was performed on the 10<sup>th</sup> of May 2008, then he went on a holiday for 15 days;
- he knew that on the switch 5 of the Mogoseni station there were unsuitable sleepers in succession;
- he did not send a written notification about the existence of the unsuitable sleepers;
- the existence of those sleepers was also known by the district head.

**3.1.4 The reserve inspector**, belonging to the district 2 Beclean, that inspected the track in the Mogoseni station area, between the 24<sup>th</sup> and the 25<sup>th</sup> May 2008, before the railway accident, stated:

- he knew that on the switch 5 of the Mogoseni station there were unsuitable sleepers in succession;
- the existence of those sleepers was known by the district head.

**3.1.5 The 2nd track section head Beclean** stated:

- he knew that on the switch 5 of the Mogoseni station there were unsuitable sleepers in succession;
- he made a written requested at the track section management, concerning the supply with sleepers for the replacement of those unsuitable;
- the district 2 Beclean was not provided with sleepers;
- there are no inspection notebook for the switches inspection at the team 5 Mogoseni;
- the measurements from the last fortnightly inspection were not written in the inspection notebook of the team;
- in the inspection notebook of the switches from the district 8 Beclean, at the geometrical data of the switch 5 was written a wrong value, that is 300m for the radius instead the correct value of 190m.



**3.1.6 The assistant of the track section head** from the track section 8 Bistrita stated:

- he did not inspect the switch no. 5 since he was appointed in this job;
- the unsuitable sleepers from the switch were not replaced because the track section was not provided with, in 2008 no sleeper was received.

**3.1.7 The track section head of the track section L8 Bistrita** stated:

- he knew that on the switch 5 of the Mogoseni station there were unsuitable sleepers in succession
- one did not take measures in order to limit or to close the traffic on the switch 5, until the unsuitable sleepers replacement.

**3.1.8 Track section inspector** responsible with the traffic safety stated:

- the last control at the district 2 Beclean was performed on the 17<sup>th</sup> of March 2005 and in 2006 and 2007 was performed no control because he was on sick leave or on holiday in the months planned for control;
- on the day of inspection were found out on the switch 5 unsuitable sleepers and muddy areas;
- he thought that district head, track section head or the assistant of the track section head had to take measures in order to limit or close the traffic on the switch 5, until the replacement of the unsuitable sleepers .

**3.1.9 Track section head** from the track division Cluj stated:

- the last inspection at the track section L8 Bistrita was performed in January 2008;
- for the unsuitable sleepers found out in the switches, were supplied new sleepers, priority on the switches from the main lines in the railway stations;
- he thought that one had to take measures to close the traffic on the switch 5, until the replacement of the unsuitable sleepers.

## **3. 2. Safety management system**

From the safety management system analysis resulted:

3.2.1 The locomotive used to haul the train is equipped with safety, vigilance equipments and equipments for the punctual control of the speed, and these were in operation, according to the finding minutes. The measurements at the tires and locomotive axles are situated in the values accepted by RETF 002/2001

3.2.2 The inside and outside equipments were in good operation, according to the finding minutes.

3.2.3 The switches from the end X of the Mogoseni station had all the subsystems and complete metallic parts and in tolerance, excepting the fastenings on the sleepers of the switch no. 5 where the fastening was not realized on 5 sleepers in succession, according to the finding minutes.

3.2.4 The automatic signaling of the level crossings and automatic line block were in operation, according to the finding minutes.

## **3.3. Norms and regulations**

3.3.1 The deadlines and the order for the track inspection performance are stipulated in the Regulations for the trains running and railway vehicles shunting, no. 005.

3.3.2 The bimonthly measurements of the switch no. 5 are missing, according to the Instruction no. 305/1997, concerning the establishment of the deadlines and order for the track inspections performance, the sheet no. 3 art. 12 c) and the sheet no. 4 art. 3, measurements not being written in the inspection team notebook by the team head or the district head.

3.3.3 The measurements of the switch no.5, performed by track section head and the assistant of the track section head, according to the provisions of the Instruction no. 305/1997, concerning the deadlines and order establishment for the track inspections performance, sheet no. 11 art. 2 b) and the sheet no. 12 art 2 b), are missing, the measurements not being written in the inspection notebook of the district.

3.3.4 The duties and the responsibilities of the district head concerning the inspection of the switches situation are stipulated in the Instruction no. 323/1965 for the district permanent way inspector head for the track maintenance and in the Order 33/34 – 1978 of the Track Division Bucuresti, concerning the inspection of the hidden parts of the switches.

3.3.5 The district head did not perform all the inspections concerning the switches situation, according to the provisions of the Instruction no. 323/1965 for the district permanent way inspector head for the track maintenance, art. 26.

3.3.6 The district head did not observe the technological process, included in the Order 33/34 – 1978 of Track Division Bucuresti concerning the inspection of the hidden parts of the switches, annex 2 that at the preparing works stipulates the rectification of the plan position of the switch, addition and replacement of the unsuitable screws .

3.3.7 The district head did not analysis the switches measurements during the inspections of the hidden parts, according to the Order 33/34 – 1978 of the Track Division Bucuresti concerning the inspection of the switches hidden parts.

3.3.8 The district head did not perform the total technological processes during the inspections of the switches hidden parts, stipulated in the Order 33/34 – 1978 of the Track Division Bucuresti concerning the inspection of the switches hidden parts.

3.3.9 The track section inspector duties are stipulated in the Instruction no. 305 concerning the establishment of the deadlines and order for the track inspection performance.

3.3.10 The track section inspector did not observe the periodicity ( a year ), period at which he inspects a tracks district according to the provisions of the Instruction no. 305, concerning the establishment of the deadlines and order for the track inspection performance, sheet no. 13, art. 2.

3.3.11 Acceptance on track of unsuitable sleepers on the switches is stipulated in the Instruction no. 314/1989 with norms and tolerances for the track construction and maintenance - tracks with standard gauge.

3.3.12. Keeping in track of the unsuitable sleepers in the switch no. 5 is not permitted by the Instruction no. 314/1989 with norms and tolerances for the track construction and maintenance – tracks with standard gauge, chapter II, art. 15, point 11. The instruction provision shows that, after the exceed of

the term of 12 months for the keeping in track of the unsuitable sleepers, the only safety measure should be the closing of the traffic on these switches .

### 3.4 Rolling stock and technical equipments operation

**3.4.1. From the locomotive inspection** in commission, after the accident occurrence resulted:

**3.4.1.1.** The measurements performed in the commission, by the synthesis county inspector, safety traffic department head and safety traffic regional inspector, and written in the measurements sheets, enclosed to the technical finding minute – piece of the investigation file drawn up by the investigation commission, set up at CNCF “CFR” SA level, according to the provisions of the Instruction for the prevention and investigation of the railway accidents and events no. 003/2000:

In the minute is written that the measurements performed at the tires of the locomotive axles are in the values accepted by RETF 002/2001.

**Table 3**

Measured quota	Measured values (mm)											
	Axle 1		Axle 2		Axle 3		Axle 4		Axle 5		Axle 6	
	ST	DR	ST	DR	ST	DR	ST	DR	ST	DR	ST	DR
A	2	2.5	2.5	2.5	2.5	2.5	1.5	1.5	2	2.5	2	3
B	63	63	62	62	58	57.5	62	61.5	59.5	60	62	62
C	31	28	32.5	32	29	29	28.5	29	31	31	28	29
I	30.5	31	31	31	31	31	30	30	30.5	31	30.5	31.5
q <sub>r</sub>	8.5	8	10	13	10	10.5	9	11.5	10	12	8.5	9.5
D(N)	1418		1424		1417.5		1417		1421.5		1417.5	
E(K)	1359		1359.5		1359.5		1359...5		1359..5		1360.5	

Accepted values:

- Dimension A maximum 5 mm according to RETF 002 art. 221(19)a;
- Dimension B minimum 45 mm according to RETF 002 art. 221(7)e;
- Dimension C minimum 22 mm according to RETF 002 art. 221(4)a;
- Dimension I maximum 36 mm according to RETF 002 art. 221(6);
- Dimension q<sub>r</sub> minimum 6,5 mm according to RETF 002 art. 221(9);
- Dimension D minimum 1410 and maximum 1426 according to RETF 002 art. 221(2)a;
- Dimension E minimum 1357 and maximum 1363 according to RETF 002 art. 221(3)a.

The technical finding minute has also enclosed the sheet with the measurements of the loads distribution on the axle, drawn up after the derailment, showing that the running gear ensemble was unbalanced.

**3.4.1.2.** The minute for the tape reading – piece of the investigation file drawn up by the investigation commission, set up at CNCF “CFR” SA level, shows that the locomotive speed at the derailment moment was 24 km/h.

**3.4.1.3.** The measurements of the values of the loads distribution on the axle of the locomotive EA 826 are not relevant because they are performed after the derailment and the unbalancing of the running gear can be its consequence. The last measurement of the loads on the axle and of the mechanical



clearances was performed on the 18<sup>th</sup> of January 2008, the registered values being in the accepted tolerances.

**3.4.1.4.** All the values of the measurements at the tires of the locomotive axles are in tolerances.

**3.4.1.5.** The locomotive speed of 24 km/h established from the tape reading is under the maximum running speed of 30 km/h accepted on the switch no. 5, according to the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance - tracks with standard gauge, art. 15, 3b and AB.6

**3.4.2. From the inspection performed by the commission at the tracks and switches**, after the accident occurrence, resulted:

**3.4.2.1.** The data resulted from the measurements performed by the safety traffic county inspector and by the safety traffic track section inspector and written in a minute – piece of the investigation file drawn up by the investigation commission, set up at CNCF “CFR” SA level, according to the provisions of the Instructions for the railway accidents and events prevention and investigation no. 003/2000:

**3.4.4.1.1.** One states that the measurements were performed with the gauge measure in the characteristic points of the switch and the measurements from the track 1 on which happened the derailment could not be performed because the track distortion and sleepers deterioration.

**Table 1**

Point	1 pj	2 vf	3 c d	4 ca	0 cm	-2 id	-1 ia	
<b>E (mm)</b>	10	23	20	27	-	-3	0	Track distorted after derrailment
<b>N (mm)</b>	5	6	6	11	-	5	-1	

Where: pf – first joint

ca – heel of blade deflecting section

vf – tip of switch

cm – middle curve

cd – heel of blade main track

o – derailment point

id – crossing on main line

ia – crossing on deflecting section

**3.4.2.1.2.** The commission shows in the minute that the derailment happened on the switch no. 5, type 49, left deviation, 1/9, Aa ( jointed points ) and R=300m. The radius size was not shown correct, this being found out afterwards by the OIFR staff as 190 m. Following this finding was changed the commission minute.

3.4.2.1.3. In the minute is stipulated that in the derailment point were 5 sleepers out of order, in succession, and the metallic track fastenings was inactive and did not ensure the fastening and the track bed was chocked about 40% .

3.4.2.1.4. During the wears switches inspections was found out that these were according to he instructions provisions.

**3.4.2.2. The data resulted from the inspections performed there by the investigation commission on the 27<sup>th</sup> of May 2008:**

i. the Mogoseni station tracks are maintained by the district 2 Beclean, team 5 Mogoseni from the track section L8 Bistrita;

ii. the switches area 1,3,5,7 from the Mogoseni station and the track 1 are disposed in a grade of 3‰;

iii. track 1 is a straight line, made of rail type 49, with sleepers from reinforced concrete T13, without the first two panels ( of 8,50m and 15 m ) from the heel of the switch no. 5, made on standard wood sleepers;

iv. the switch no. 5 is type 49, R=190m, 1:9, left deviation , with jointed points, gauge 1435mm, assembled on wood sleepers, fastening K indirect;

v. the running and the shunting on the switch no. 5 was closed, affecting the tracks 0 and 1 ( the end from the switch no. 5);

vi. from the visual remarks, the track bed from in the area of the switch 5 was chocked bout 40 % and 80-90% in the area of the switch 1;

vii. on those two track panels, on the cross-over 1-5 were founfd 17 unsuitable wood sleepers from those 30 that were there;

viii. on the switch no. 5 were found 25 unsuitable sleepers disposed six in a row in the switch area, 11 pieces in the connection rails area and 8 pieces in the common crossing area;

ix. the first two track panels on the track 1 from the heel of switch 5 were removed and all the standard wood sleepers, deteriorated by the derailment, were replaced with 26 sleepers from reinforced concrete T13;

x. starting with the first print of the left wheel that fell from the head of rail inside the track were found out 5 unsuitable sleepers, in succession, that in the sleeper metallic fastening area had put universal irons for the gauge rectification between the plate flanging and the base of the rail. Also, on these sleepers all the coach screws were with wear, curved and reclined in the sleeper to the curve outside (picture 3);

xi. after the last measurements performed at the gauge on the 6<sup>th</sup> of May 2008 as well as on the 21<sup>st</sup> of May 2008 and until the event occurrence moment were not performed rectification works at the gauge on the switch no. 5 in order to put it in the accepted tolerances of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance - standard gauge tracks;

xii. the lingnofolium cover plates of the insulated joint from the crossing tip on the deflecting section of the switch 5 were destroyed by the derailed wheels and replaced with new cover plates (picture 5).

### **3.4.2.3 The data resulted from the inspections performed by the investigation commission at the derailment place on the 19<sup>th</sup> of June 2008:**

- i. the traffic on the switch no. 5 and on the track 1 was opened from the evening of the 27<sup>th</sup> of May 2008 and was normal;
- ii. the wood sleepers from the first two track panels from switch heel were completely replaced with concrete sleepers T13 (26 pieces);
- iii. in the switch were replaced 6 sleepers, from those 25 found out on the 27<sup>th</sup> of March 2008 being unsuitable (picture 7);



Picture 7 – Situation of the sleepers in the crossing

- iv. the fastenings situation was improved in the areas significantly affected by the derailment (connection rails area), other areas ( switch tip, crossing ) not being improved yet;
- v. between the tip joint of the switch and the fourth slide chair from the curved point (right), the fastenings with coach screws are reclined to the right ( curve outside, permitting the track movement under the running (picture 8);





**Picture 8** – The situation of the fastenings on switches

- vi. In the switch and connection rails area, the fastening of the metallic plates on the sleepers was not complete, in many situations missing 50% from the coach screws (picture 9);



**Picture 9** – The situation of the fastenings on the connection rails

- vii. the geometrical characteristics of the switch were inspected by measurement and was confirmed that its radius is 190m, not 300m, the wrong value written in the finding minute no. 21/2008. drawn up on the 26<sup>th</sup> of May 2008 after the derailment and in the notebook for the district switches inspection. The measurements were registered in the questionnaire drawn up by the track district head on the 19<sup>th</sup> of June 2008.

#### 3.4.2.4 Data resulted from the analysis of the documents asked from the railway undertaking:

- i. The records of the district Beclean were checked and resulted that the last measurement at the switch no. 5 was performed on the 6<sup>th</sup> of May 2008, proved with the evidences of the measurement register of the district switches and of the daily sheet, second part of the team no. 5 Mogoseni, performed during the works for the hidden parts inspection – VPA.
- ii. In the switches measurement register, belonging to the district, in the columns for the identification of the geometrical characteristics was written the value 300m for the radius of the switch no. 5 from the Mogoseni station, wrong registering because on the field the switch had a radius of 190m.
- iii. The measurements written in the measurement register and in the daily sheet second part on the 6<sup>th</sup> of May 2008 ( VPA works ) were not analyzed in accordance with the accepted tolerances in operation, according to the provisions of the Instruction no. 314/1989 of norms and tolerances for track construction and maintenance – standard gauge tracks.
- iv. The records concerning the planning of the VPA works from the track section L8 Bistrita were checked and was found out that the switch 5 from the Mogoseni station for the entrance on the track 1 arrivals-departures in 2007 was inspected on the 7<sup>th</sup> of November and in 2008 was planed and checked on the 6<sup>th</sup> of May, according to the provisions of the Instruction no. 314/1989 of norms and tolerances for the track construction an maintenance – standard gauge tracks that stipulates that the switches from the arrival-departures tracks be inspected one time in a year.
- v. According to the registering from the notebook for the district switch inspection, yearly were performed minimum 3 measurements at the level and the gauge of the switch no. 5. At these measurements, starting from 2007, the values exceeding the tolerances at level and gauge are not pointed out by encircling;
- vi. From the analysis of the last three measurements performed between September 2007 and May 2008 results that the values of the gauge measured in tip points of switch tongue (1), heel of blade on deflecting section (2) and middle curve (3) exceed systematically the accepted values so:

**Table 2**

Point	v.a.-1	c.a.ab.-2	c.m.-3	Diference		
Date	Measurement/ tolerance	Measurement/ tolerance	Measurement/ tolerance	1	2	3
06.09.2007	1450	1460	1454	+1	+14	+8
	1442-1449	1438-1446	1438-1446			
07.11.2007	1455	1464	1440	+6	+17	-
	1442-1449	1438-1447	1438-1446			
06.05.2008	1450	1450	1454	+1	+3	+8
	1442-1449	1438-1447	1438-1446			
26.05.2008	1458	1462	-	+9	+15	-
	1442-1449	1438-1447	-			



- Differences for operating tolerances exceeding
  - Interval of the measured values in operation
  - Measured values after derailment
  - Measured values before derailment
- vii. according to the track section jobs record, at the district 2 Beclean, the tracks team head job is vacant in Mogoseni;
- viii. according to the track plan proposals of the RPMG-CI works for 2008, the switch no. 5 is included to be submitted to these works;
- ix. according to the inventories of the sleepers on the switches, performed in 2007 were inventoried 8 unsuitable sleepers and in 2008 were inventoried 5 unsuitable sleepers, although in 2007 no sleeper was replaced and at the moment of the event were found out 25 unsuitable sleepers in the track;
- x. the last minute for the inspection in the commission was drawn up in the Mogoseni station on the 21<sup>st</sup> of May 2008 when was measured the gauge at the point of switch tongue no. 5. The value of -6 (1429mm) written in the minute is not in the accepted tolerance of minimum 1445-3=1442;
- xi. from the comparative analysis of the measurements performed on the switch no. 5 during the VPA works on the 6<sup>th</sup> of May 2008 written in the daily sheet second part and in the notebook for the district switches inspection was found out that at the end of the works the deviations from the level and gauge tolerances were not removed, the unsuitable sleepers were not replaced and consequently the fastening was not improved, resting in the same situation as before the inspection;
- xii. from the presentation of the data concerning the inventory of the track materials from the district 2 Beclean belonging to the track section L8 Bistrita for 2008:
- on the switch no. 5 from the Mogoseni station ( involved in the derailment ) were inventoried 5 unsuitable special sleepers;
  - no piece out of order were inventoried in the switch no. 5;
  - against the last inventory the number of the wood special sleepers decreased with 3 pieces;
  - between those 2 inventories, in the switch no. 5 no special sleeper was replaced;
  - at the moment of the derailment there were 25 unsuitable sleepers in the track;
  - the switch no. 5 from the Mogoseni station was not included in the program for 2008 in order to be replaced with a new switch or with a switch . Also, this switch was not found in the plan for the replacement of the metallic parts;

**Picture no. 10 Scheme of the switch :S49-190-1:9, St, Aa-1435**

**3.4.2.5 Conclusions concerning the track situation before the derailment**

- i. the measurement performed after the derailment ( on the 26<sup>th</sup> of May 2008 by the investigation commission), according to the table no. 1 in the point vf ( point of switch tongue ) is E/N=23/6 ( accepted value 14/5) and shows an exceeding of the tolerances limits at gauge of 9 mm and at cross level of 1 mm. The provisions of the art. 19, points 2 and 6 from the table no. 17 from the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks were not observed;
- ii. the measurement performed after the derailment ( on the 26<sup>th</sup> of May 2008 by the investigation commission ), according to the table no. 1 in the point ca ( heel of blade on deflecting section ) is E/N= 27/11 ( accepted value 11/5) shows an exceeding of the tolerances limits at the gauge with 16 mm and at the cross level with 6 mm. The provisions of the art. 19, points 2 and 6 and the



- values from the table no. 17 of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks were not observed;
- iii. the last three gauge measurements performed before the derailment are written in the notebook for the district switches inspection, according to the table no. 2, in the point ca ( heel of blade on deflecting section ) shows that the tolerance limit of 11 mm is systematically exceeded with values from 3 to 17 mm and these deviations are not pointed out by encircling in the inspection notebook. The provisions of the art. 19, points 2 and 6 and the values from the table no. 17 of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks were not permanently observed within the last 8 months before the derailment;
  - iv. during the last work for the inspection of the hidden parts (VPA), performed on the 6<sup>th</sup> of May 2008, according to the registering from the notebook for the inspection of the track switches and from the daily sheet, second part at the end of the works, from the 7 gauge measurements performed in the characteristic points, only the value measured at the first joint of the switch is in tolerance limit, the other 6 measurements exceeding the accepted tolerances with values from -11 mm to +20 mm. The technological process stipulated in the Order 33/34-1978 of the track section Bucuresti annex 2, that at the preparing works stipulates the rectification of the switch plan position, addition and replacement of the unsuitable screws, was not observed;
  - v. at the derailment moment there were on the switch no. 5 unsuitable sleepers in succession, on the connection rails area, that did not ensure the fastening, and totally, on the switch were 25 unsuitable sleepers from which only 5 sleepers were inventoried. The provisions of the art. 15, point 11 of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks, that require as “in the switches are not accepted unsuitable, curved or bent” sleepers were not observed;
  - vi. the finding minute drawn up after the derailment by the investigation commission did not report on the situation of the switches fastenings and if the fastenings are complete;
  - vii. both on the 27<sup>th</sup> of May 2008 and on the 19<sup>th</sup> of June 2008 was found out the missing of the coach screws that in some area reached 50% (picture 9). The provisions of the art. 15, point 12 of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks, were not observed;
  - viii. on the switch, on the deflecting section, both at the moment of the derailment and after that, are operated two insulated joints type JLN ( lignofolium ). The provisions of the art. 15, point 9 of the Instruction no. 314/1989 of norms and tolerances for the track construction and maintenance – standard gauge tracks, that require as “the insulated joints from the switches on the main lines and on the arrivals-departures lines will be glued insulated joints (JIL)” sleepers were not observed;
  - ix. on all length of the curve of the deflecting section of the switch no. 5, the fastenings of the metallic plates on the sleepers have coach screws, in the most cases, reclined to the right ( curve outside), that shows an unsuitable maintenance;
  - x. all the measurements were performed after the derailment. The problems found out after the measurement point heel of blade can be a consequence of the derailment.

### **3.5 Documents concerning the event management**

#### **3.5.1 Measures taken by the staff for the traffic signaling and control**

- 3.5.1.1 At 15:17 hour the driver notified the movement's inspector about the locomotive derailment.
- 3.5.1.2 Between 15:18 hour and 15:21 hour the movements inspector notified the traffic controller (15:18 hour), railway station manager (15:19 hour), district head L (15:20 hour) and the electro-mechanic SCB (15:21 hour).
- 3.5.1.3 The conductor makes sure the wagons by clamping the handbrake;

- 3.5.1.4 At 15:22 hour the running line Nimigea – Mogoseni was closed according the traffic controller order ( no. 63 );
- 3.5.1.5 At 17:54 hour the running line Nimigea – Mogoseni was opened.

### **3.5.2 Measures adopted in order to protect and safeguard the event place**

- 3.5.2.1 At 17:10 hour the train with the breakdown wagon 48616/51524 arrived at the halt Mogoseni;
- 3.5.2.2 At 17:34 hour was closed the traffic on the switch no. 5 in order to replace the deteriorated sleepers following the derailment.
- 3.5.2.3 Between the 26<sup>th</sup> of May 2008, 17:34 hour and the 27<sup>th</sup> of May 2008 were replaced the wood sleepers with sleepers BA T13 from the two panels of the track 1 at the heel of the switch 5, five wood sleepers on the switch 5, was adjusted the deflecting section of the switch 5 and were replaced the lingofolium cover plates and the out of order metallic track fastenings at the moment of the locomotive axle derailment.

### **3.6 Interface man – vehicle – organization**

- 3.6.1 The working program of the involved staff was 8 hours for the locomotive driver and the train crew ( conductor ), and for the movements staff, respectively the movements inspectors and the traffic controllers, the working program is on shift 12/24.
- 3.6.2 The medical and personal circumstances for the locomotive driver:
- the on duty hauling and movements staff was capable from the medical and psychological point of view;
  - the staff was tested with the vial and was found out that it was not under the influence of alcoholic beverages.

### **3.7 Traffic closes**

The traffic was closed between the Nimigea station and the Mogoseni station and the main line II Mogoseni from 15:21 hour to 17:54 hour on the 26<sup>th</sup> of May 2008.

On the 26<sup>th</sup> of May 2008 the train 4110 had a delay of 13 minutes, the train 4485 had a delay of 138 minutes and the train 4305 had a delay of 23 minutes.

The train no. 4483 Mogoseni – Dej Calatori and train no. 4484 Mogoseni – Ilva Mica was cancelled.

## **4. Analysis and conclusions**

**Direct cause** of the railway accident is:

The presence in the switch no. 5, in the connection rails area, in the curve with the radius  $R=190m$ , of **5 unsuitable sleepers**, in succession, that could not ensure the fastening of rail on the sleepers by coach screws, led to a gauge widening over the derailment safety limits and to the left wheel running inside the track.

#### 4.1 Underlying causes:

- 4.1.1. The missing from the team inspection notebook of the bimonthly measurements, according to the provisions of the sheet no. 3, art. 2 from the Instruction no. 305/1997 concerning the establishment of the terms and of the order for the track inspection.
- 4.1.2. The non-performance of all switches inspections that the district head has to do, according to the provisions of the art. 26 from the Instruction no. 323/1965 of the district permanent way inspector, district head for the track maintenance.
- 4.1.3. The presence of some wrong data concerning the geometrical characteristics of the switches in the inspections notebooks that can lead to the use in operation of some unsuitable tolerance intervals that maintained in track can lead to the sleepers and fastenings wear.
- 4.1.4. The absence of the switches measurements analysis.
- 4.1.5. The non-performance of the complete technological processes during the inspections of the switches hidden parts.
- 4.1.6. The non-removal of the gauge and level failures found out during the inspections of the switches hidden parts.
- 4.1.7. One did not supply the materials stipulated to be replaced in the approved maintenance plan of the tracks and switches.
- 4.1.8. One did not perform a realistic analysis at the end of the year 2007, concerning the replacement of the switches for 2007. One supplied smaller quantities against those needed, that are not in accordance with the size of the requested sleepers. So in 2007, from an approved necessary of 541 special sleepers, one supplied 308 pieces, from which 64 were supplied over the requested sizes. This led to a supply of 244 sleepers requested on sizes. The real percentage of the sleepers supplied on sizes is 45% not 57% as is written in the achievements global situation for 2007.
- 4.1.9. The head team job from district 2 Beclean, Mogoseni team is vacant and the railway safety responsibilities/competences, according to the Instruction 305/1997 concerning the establishment of the deadlines and order for the track inspection, was not designed/re-assigned by the track section management.
- 4.1.10. The exceeding of instruction deadline for the unsuitable special sleepers replacement of the switches.

**4.2 Primary causes** that led to the railway accident are connected to the framework for the regulation and implement of the railway safety management system concerning the maintenance and repair of the switches that have the next failures:



- 4.2.1. The missing of a connection between the inventoried necessary and the supply with some pegs, whose unsuitable presence on the track is not accepted by the regulations ( sleepers on switches, sleepers on bridges, and so on ).
- 4.2.2. The missing of a periodicity of some maintenance and repair works at the tracks and switches.
- 4.2.3. The lost of the technical abilities of the staff involved in switches maintenance and repair, by supplying switches from time to time and the rehabilitation from the knowledge and practical abilities point of view.

### **4.3 Deficiencies and lacks found out during the investigation**, but without relevance for the conclusions on the causes

During the railway accident investigation was found out a series of failures, for which is responsible the operating staff, happened after the accident as follows:

- On the 27<sup>th</sup> of May 2008, one day after the accident occurrence, on the switch no. 1 was 10 unsuitable switches, and the track bed was muddy and chocked about 80% ( picture 11 ). The situation is the same also on the 19<sup>th</sup> of June 2008§
- On the same date, on the cross-over 1-5 consisting in 2 panels of 30 sleepers, 17 sleepers were unsuitable
- Both before the 26<sup>th</sup> of May 2008 and after this day all the staff from the district 2 Beclean was distributed on the worksite for the renewal of the running track 1 Mogoseni – Beclean, work performed by the track section L8 Bistrita with own means, though on the 19<sup>th</sup> of June 2008 were not added the fastenings on the switch 5 ( picture 7-9), and on the switch 1 were muddy areas and unsuitable sleepers.
- After a month from the accident, the management of the Track Division did not supply the District 2 Beclean with switches special sleepers, did not plane screening works on the switches and continued to perform renewal of the running track with the district staff.



**Picture 11** – The situation of the switch no. 1 track bed

## **5. Measured taken as consequence of the event;**

5.1 6 employees from the track section L8 Bistrita were disciplinary punished and the damages resulted from the railway accident were recouped from them.

5.2 Discussion with all staff of the railway accident causes and circumstances.

## **6. Recommendations**

- 6.1. The re-viewing of the sleepers' inventory in order to draw up a plan for the replacement of the unsuitable sleepers and the establishment of the necessary running conditions.
- 6.2. The performance of an analysis concerning the progress of the sleepers wear on the switches within 5 years at least, in connection with the supply progress and track sleepers replacement for switches of the running lines, main lines and arrival – departure lines.
- 6.3. The performance of an analysis concerning the running speed slackening progress, on the switches, establishing the percentage of all causes.
- 6.4. The performance of an analysis concerning the means for keeping and improving the technical and practical abilities of the staff involved in the management, maintenance and repair of the switches, by internal trainings like staff training or in special institutes.
- 6.5. The analysis of the opportunity to perform a study on the Romanian railway network situation, concerning the track maintenance activity.

The final report will be sent to the National Railway Company CFR SA, to the National Company for Passenger Railway Transport CFR Calatori SA and to the Romanian Railway Safety Authority.

Romanian Railway Safety Authority will look after the observance of these recommendations.