



MINISTRY OF TRANSPORTS AND INFRASTRUCTURE
ROMANIAN RAILWAY AUTHORITY - AFER

ROMANIAN RAILWAY INVESTIGATING BODY



INVESTIGATING REPORT

on the railway accident occurred between
Ciocanesti railway station and Baldana railway station, at km 26+700,
on February 7, 2010



*Final edition
March 8, 2010*

NOTICE

As regards the railway accident occurred **on February 7, 2010**, around **6:35** o'clock on the activity area of **Railway District Bucuresti**, running section Chitila- Titu (double track line, non-electrified), between Ciocănești railway station and Bâldana railway station, at the km 26+700, on the first running line, **by firing the wagon no. 50532057480-7, from the passenger train no. 9101**, the Romanian Railway Investigating Body developed an investigating action according to the provisions of the Law no. 55/2006 on railway safety. By this investigation action, were collected and analyzed information on the railway accident occurrence and also were established the conditions and was determined the cause.

The action of the Romanian Railway Investigating Body didn't have as purpose to establish the guilt or the responsibility in this case.

Bucharest, *March 8, 2010*

I give my positive opinion

Director
Dragos FLOROIU

I find the observance of the legal provisions on the development of the investigating action and drawing the present investigating report that I'm proposing for approval.

Chief Investigator
Sorin CONSTANTINESCU

The present Notice is a part of the Investigating Report of the railway accident occurred on February 7, 2010, around 6:35 o'clock on the activity area of Railway District Bucuresti, running section Chitila- Titu (double track line, non-electrified), between Ciocănești railway station and Baldana railway station, at the km 26+700, on the first running line, by firing the wagon no.50532057480-7, from the passenger train no. 9101.

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I. PREAMBLE

I.1. Introduction

As regards the railway accident occurred on February 7, 2010, around 6:35 o'clock on the activity area of Railway District Bucuresti, running section Chitila- Titu (double track line, non-electrified), between Ciocanesti railway station and Baldana railway station, at the km 26+700, on the first running line, by firing the wagon no. 50532057480-7, from the passenger train no. 9101, the Romanian Railway Investigating Body developed an investigating action according to the provisions of the Law no. 55/2006 on railway safety aimed to prevent some accidents with similar causes, by establishing the conditions and determining the causes.

The OIFR's investigating action didn't have as purpose to establish the guilt or the responsibility, its aim being to improve the railway safety and to prevent the railway incidents or the accidents.

I.2. Investigation process

On February 7, 2010, OIFR was informed by the Romanian Railway Safety Authority on the occurrence of a railway accident on the activity area of the Railway District Bucuresti. To the place of the railway accident occurrence went specialists within OIFR that found that between Ciocănesti railway station and Baldana railway station, at the km 26+700, as regards the running of the passenger train no.9101, on the first running line occurred the firing of the wagon no. 50532057480-7, the last from the train consist.

To the place of the accident also went specialists within Romanian Railway Safety Authority, representatives of the involved public passenger railway undertaking - SNTFC „CFR Calatori” SA, of the public railway infrastructure manager - CNCF „CFR” SA, of the Police of Railway Transport and of the Romanian Gendarmerie and also representatives of the Inspectorate for Emergency Situations of Dambovita.

Taking into consideration that the occurred facts represent a fire of a passenger wagon, that is qualified as accident, on the basis of the article 19 paragraph 2 of the Law no.55/2006 on the railway safety, the director of OIFR decided to open an investigation action. In this way, by decision no.17 of February 8, 2010 of OIFR's director was appointed an investigating commission composed of:

- | | |
|---------------------|--------------------------|
| ▪ NICOLESCU Mircea | - investigator in charge |
| ▪ ZAMFIRACHE Marian | - investigator |
| ▪ DRĂGHICI Marin | - investigator |
| ▪ BURLEA Sorin | - investigator |

A. SUMMARY OF THE ACCIDENT

A.1. Short description

On February 7, 2010 around 6:35 o'clock on the activity area of Railway District Bucuresti, running section Chitila- Titu (double track line, non-electrified), between Ciocanesti railway station and Baldana railway station, at the km 26+700, on the first running line, by firing the wagon no. 50532057480-7, the last from the consist of the passenger train no.9101, that was running from Bucuresti Nord to Pietrosita.

Following the accident occurrence, the wagon no. 50532057480-7, was damaged in 95%.

Following the fire, two passengers were intoxicated with smoke, being transported to Titu Hospital.

A.2. Direct causes, underlying and root causes

A.2.1. Direct causes

Direct cause of the accident – opened fire in the wagon, in the area of compartment no. 9 which was determined by an external source (flame, cigarette, self-ignition of inflammable materials, etc.) independent of electric installations of lightning and heating the wagon.

Factors that led to a fast and a general development were determined by the fast move of the air masses inside and outside the wagon determined by:

- the functioning of the wagon ventilation system;
- the atmospheric conditions – strong wind (the intensification of the wind was of 43 km/h);
- the train's circulation with a speed of maximum 60 km/h (with influence only on the initial phase).

A.2.2. Underlying causes

There weren't identified underlying causes of this railway accident.

A.2.3. Root causes

There weren't identified root causes of this railway accident

A.3. Severity level

According to the provisions of article 3, item 1 of the Law no.55/2006 on the railway safety, the event is qualified as railway accident.

A.4. Safety recommendations

There weren't identified elements that could lead to the issuing of safety recommendations.

The present investigating report will be transmitted to the public railway infrastructure manager - CNCF „CFR” SA, of the public passenger railway undertaking SNTFC „CFR Calatori” SA and the Romanian Railway Safety Authority.

B. THE INVESTIGATING REPORT

B.1. Description of the accident

The passenger train no. 9101, consist of 5 wagons, 20 axles, 242 tons, 150 meters, hauled by the locomotive DA 526 (belonging to the engine shed Ploiesti) was composed of the rake of coaches of the train no. 9108 that arrived to Bucuresti Basarab railway station on February 6, 2010.

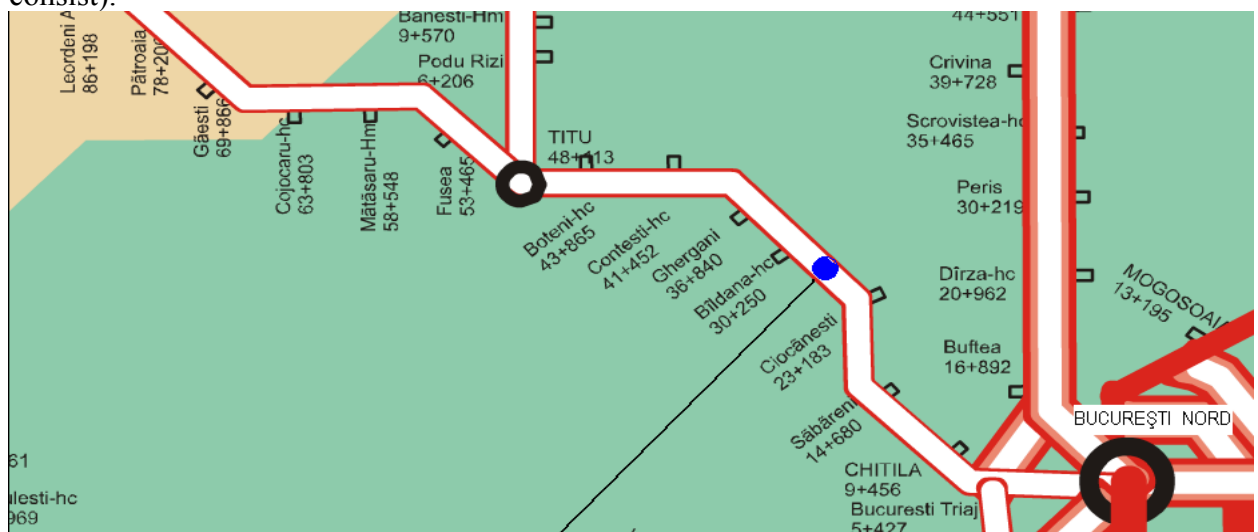
The technical inspection performed to the consist of train no. 9101 was performed by the personnel of Bucuresti Basarab Wagon Repair and Maintenance Depot on February 6/7, 2010 by following the technological process:

- the rake of coaches was put to disposal of the operating staff to line 10 D of the technical group at 20:15 o'clock;
- between 20:15 o'clock and 23:30 o'clock were performed the mandatory works and examinations that must be ensured by wagons examiners with the occasion of the technical inspection performed to the consist of the passenger train, including the test of the train set from the fixed stand of high voltage.
- the locomotive was connected to the train and brake at 04:15 o'clock;
- preheating of the train set was performed to the fixed stand of high voltage between 3:00 o'clock and 4:00 o'clock and to the hauling locomotive between 04:15 o'clock and 05:15 o'clock;
- at 05:15 o'clock was finalized the complete braking test performed with the hauling locomotive.

The train was dispatched from the technical group of Bucuresti Basarab Wagon Repair and Maintenance Depot to Bucuresti Nord railway station group A at 05:22 o'clock, after reparking from line 10 D to line 5 D.

At 5:34 o'clock the train was parked to line 1 to Bucuresti Nord railway station group A, from which was dispatched to Pietroșita railway station at 05:55 o'clock.

The train circulated between Bucuresti Nord railway station and the place of the railway accident occurrence having stops to the railway stations Chitila at 6:12 o'clock, Ramificatie Sabareni at 6:19 o'clock and Ciocanesti at 6:31 o'clock. After leaving from Ciocanesti railway station, the train circulated approximately 4500 meters with a maximum speed of 70 km/hour and was stopped on the running line at 6:36 o'clock due to the emergency signal operating by the train inspector as result of the fire from the wagon no. 50532057480-7 (the last from the train consist).



The place of the accident - km 26+700

Photo 1 Geographic location of the place of the accident

The conductor communicated with the engine driver by radiophone station and uncoupled the wagon on fire from the rest of the train set at 6:38 o'clock.

At 6:40 o'clock on the basis of disposal of the Traffic Controller the running line was closed on both running lines between Chitila and Titu.

At 6:56 o'clock the train was dispatched from the running line on the basis of disposal of the Traffic Controller and the running order that was given by the conductor to the engine driver at Baldana railway station where two passengers intoxicated with smoke were transported by ambulance to Titu Hospital.

B.2. Accident circumstances

B.2.1. Involved parties

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

The locomotive DA no. 526 and the wagons that consisted the train no.9101 are the property of the railway undertaking SNTFC „CFR Calatori” SA.

The commission questioned the employees of SNTFC „CFR Calatori” SA that participated to the technical inspection of the train no. 9101 on February 7, 2010, the engine driver, the train staff, employees of CNCF „CFR” SA, that supervised the train no. 9101 by visual inspection when passing through the railway stations and also three passengers that were in the fired wagon.

B. 2.2. Composition and equipments of the train

The passenger train no. 9101, consists of 5 wagons, 20 axles, 242 tons, 150 meters was running on Bucuresti Nord – Pietrosita. The electric heating of the train was ensured by the generator type INDA of the diesel-electric locomotive endowed with a device of surveying the functioning type EPSAI.

The safety and vigilance devices, the INDUSI installation from the traction locomotive's endowment were active and were functioning according to the instructions, the automatic brake being active.

B.2.3. Means of communications

The communication between the engine driver, crew member and the movement inspectors was ensured by the radiophone installation.

B.2.4. Launching the railway emergency plan

Immediately after the occurrence of the railway accident, the launching of the intervention plan for giving first aid to victims, removing the damages and reestablishing the circulation of trains, had three components:

- approval of the unique national system for emergency calls 112 referring to fires, accidents, medical emergencies, disasters and other events that involve fast intervention of the specialized services by the inspector of the train no.9101, following which at the

accident place came the representatives of the Inspectorate for the Emergency Situations Dambovită and those of the Operational Department of the Railway Transport Police, and in the railway station Baldana a crew of the Ambulance Dambovită. Because of the snow storm the representatives of the Inspectorate for Emergency Situations Dambovită arrived at the accident place by foot (without specific intervention equipments) and the Ambulance took those two persons poisoned with smoke in the railway station Baldana.

- application of the “Procedure for the rescue of the passengers and intervention in case of fire at a running passenger train” no. 107/1/438/2008 of the Railway County București, by the train crew and driver by stopping the train and isolation of the fired wagon from the rest of the rake of coaches.
- notification of the railway accident through the information flow, stipulated in the annex 2 from the Instructions for the prevention and inquiry of the railway accidents and incidents – no. 003, at the accident place were present the representatives of the National Railways Company „CFR” SA – railway infrastructure manager, National Railway Passenger Company „CFR Calatori” SA – railway undertaking, and of Romanian Railway Safety Authority, of the Romanian Railway Investigating Body.

B.3 Accident consequences

B.3.1 Losses and casualties

Following the railway accident two persons from the compartment no. 9 of the fired wagon were taken to the hospital. They were carried with the train 9101 from the accident place to the railway station Baldana and then with the ambulance.

Those two persons were diagnosed at the hospitalization as follows:

- first person – poisoning with carbon monoxide;
- second person – poisoning with carbon monoxide, hypothermic shock, burn level II at the left ear.

When they left the hospital, the main diagnosis for both persons was “smoke poisoning”, the secondary diagnosis being:

- first person – smoke inhalation laryngitis;
- second person –hypothermic shock, burn level II at the left ear, corneo-conjunctivitis thermal burn shock, epistaxis stopped spontaneously.

B.3.2 Material damages

At the accident place, the fired wagon situation was as follows:

- the wagon no. 50532057480-7 – was insulated on the line I, at the km 26+700;
- the wagon body was fired about 95%;
- the frame of the wagon was twisted, the vertical bend of the frame was 170 mm;
- the running gears had no specific traces of braking run;



- the buffing and coupling gears in good operation condition, not being affected by the fire;



- electric couplers were in their hangers, in good condition, without any spark-over trace, but affected by the fire smoke;
- the wagon body horizontally twisted, of about 25 mm at the compartments 6-7;
- the railway infrastructure and its equipments were not affected by the incident.

The material damages value, that is **89533.96 lei** is equal with the value for the replacement of the wagon no. 50532057480-7, for which the commission in charge established that it would be taken out of running, because it could not be submitted to any repair.

B.3.3 Consequences of the accident in the railway traffic

The traffic was suspended on the track section Chitila – Titu, between the railway stations Chitila and Titu, between 06:40 o'clock and 7:43 o'clock, when the traffic was opened, excepting the line I between the railway stations Ciocanesti and Ghergani. The traffic was opened on both lines at 10:57 o'clock.

Following the railway accident, 7 passenger trains delayed, total delay 460 minutes.

B.4 External circumstances

According to the address of the Meteorology Administration, on the 7th of February 2010, at the meteorology point Titu, situated at about 22 km from the incident place, at 6:00 o'clock, the air temperature was about -2^o C, the wind speed was 43 km/h.

B.5 Investigation process

B.5.1 Summary of the testimonies of the railway personnel

The train master stated as follows:

- he took over the rake of coaches from the line 10D from the preparation point of the Wagon Inspection Bucuresti Basarab;
- the rake coaches was re-dispatched at the line 5D from the line 10D, because it was coupled to another rake of coaches and was taken to the railway station Bucuresti Nord A;
- observing that the tail lamps of the rear wagon did not operate and asked for the intervention of the electrician from the railway station Bucuresti Nord A;
- the electrician notified him that the rear lamps would operate in running, in the batteries loading;

- after leaving the railway station Bucuresti Nord of the train, he left at the last wagon up to the railway station Chitila in order to check the electrician statements concerning the operation of the tail lamps;
- he confirmed that the rear lamps operated at once after leaving the railway station Bucuresti Nord;
- after the train departure from the railway station Chitila, he went to the front wagons (in the running direction (because he had to check the tickets in the first two wagons from the train));
- passing through the last wagon of the train he observed that there were about 15 - 20 passengers, in the compartment 9 being 2 passengers;
- in the railway station Sabareni he was in the last but one wagon of the train;
- at about 2 minutes after the departure of the train from the railway station Ciocanesti, he began to check the tickets, after the checking of the tickets from 2 compartments he heard the ticket collector crying “a wagon from the rear of the train burn”;
- he went to the emergency signal and when he reached the last but one wagon, because of the smoke he could not go on and opened the first side door on the right in the running direction;
- he looked out to the rear wagon and saw that it flamed at the compartment 9, and the wind was strong from the right of the running direction;
- he handed the emergency signal from the last but one wagon, then left it and went on the right side in the direction of the train running to the rear wagon;
- he opened the first door in the direction of the rear wagon running, where he saw a passenger fallen on the front platform, in the front of WC;
- he took the passenger out of the wagon and left him on snow, then de-coupled the fired wagon from the rest of the train and then the train was shunted at distance from the fired wagon;
- he called some passengers and carried the poisoned persons to the first class wagon (the third from the train consist);
- he drew up the necessary documents thus the train 9101 run on, up to the railway station Baldana, where the ambulance and firemen waited.
- the rest of the train run on without problems up to the terminal railway station.

The ticket collector stated as follows:

- on the 7th of February 2010, after the inspection of the wagons together with the train preparer and the electrician, he took over the wagons of the train;
- at the pushing of the train from the technical point of the railway station Bucuresti Basarab to the railway station Bucuresti Nord he was notified by the exterior movement inspector of the railway station that the tail lamps of the rear wagon were not on;
- he called the electrician in the railway station Bucuresti Nord A, that notified that the tail lamps would operate during the running, in the batteries loading conditions;
- after dispatching the train from the railway station Bucuresti Nord A, he left in the rear wagon up to the railway station Chitila, moving then to the third wagon of the train in order to close the doors of all wagons;
- passing through the last wagon of the train, he observed in the compartment 9 two passengers lying on the seats and in the compartment 8 a passenger who was identified as employee of CNCF “CFR” SA;
- shortly after the departure from the railway station Ciocanesti he heard the passengers crying “the train is burning”
- he run to the rear of the train and handed the emergency signal of the last but one wagon and then rang up 112;
- after de-coupling the fired wagon and shunting the rake of wagons a distance from it, he left in the wagon on the running line;

- in the railway station Sabareni he was in the last but one wagon from the train composition.

The driver stated as follows:

- he coupled the locomotive at the passenger train 9101, at about 4:15 o'clock and after changing the driving cab, the electric heating coupled without any problem;
- from the coupling of the train electric heating at the technical point of the railway station Bucuresti Basarab and up to the km 26+700 he did not observe any problem in the operation of the heating equipments of the train and he was not notified by the crew of train about something in this respect, and the heating equipment was not accidentally cut off;
- he cut off the heating after observing that the last wagon was smoking, at the emergency braking generated by the handling of the emergency signal by the train crew;
- on all running distance up to the km 26+700 on-board ammeter showed an increase of the power taken by the heating equipments of the train wagons between 70 and 100A;
- at the fire place he carried out shunting in order to de-couple the fired wagon and then hauled the train 9101 in accordance with the running order handed by the conductor;
- after de-coupling the rear wagon and coupling the train heating, the on-board ammeter positions were about 60-70 A, and no other problem was observed.

The electrician of the Wagons Inspection Bucuresti Basarab, who checked the operation of heating and lighting equipments from the wagons of the slow train no. 9101 on the 7th of February 2010, stated as follows:

- he did not made any intervention at the wagon 50532057480-7, because both the heating equipment and the lightning operated normally;
- the train no. 9101 was previously heated at the fixed bench of high voltage between 3:00 o'clock and 4:15 o'clock and then from the hauling locomotive;
- he checked the coaches together with the crew of train without observing any problems.

The electrician of the Wagons Inspection Bucuresti Basarab, who checked the operation of heating and lighting equipments from the wagon 50532057480-7 at the arrival of the train no. 9108 in the Wagons Inspection, on the 6th of February 2010 stated as follows:

- the train no. 9108 arrived in the Wagons Inspection with the heating and lighting equipments in good operation;
- the crew of the train found no problem in the operation of the heating and lighting equipments.

The electrician of the Wagons Inspection Bucuresti Grivita, who was called by the crew of the train to make interventions at the train no. 9101 from the 7th of February 2010 in the railway station Bucuresti Nord A stated as follows:

- at the request of the crew of the train no. 9101, he checked the rear wagon and found out that the tail lamps were closed because of the batteries, that were discharged;
- because the wagon 50532057480-7 had the batteries box at the side of the platform and the platform from the line 1, was at the same level as the wagon flat, he could not change the batteries;
- from the platform, in the front of the wagon, where he went on, he did not observed any sign of overheating insulation (specific smell, smoke).

The train preparer who inspected the operation of the heating equipment from the wagons of the train no. 9101 on the 7th of February 2010, stated as follows:

- he did not find any failures in the operation of the heating and lightning equipments at the wagons of the train no. 9101 from the 7th of February 2010, neither during the inspections performed during the technical inspection of the coaches or during the pre-heating and those performed together with the crew of train;

- at the reception of the coaches by the crew of train, the rear lamps of the rear wagon operated.

The movement inspector from the railway station Ciocanesti stated as follows:

- he did not observed anything special at the train 9101;
- he did not observed some smoke or other fire signs at the rear wagon;
- the train were signaled as proper.

B.5.2 Summary of the testimonies of the passengers that were present in the wagon that was set on fire

The witness no. 1 from the compartment no. 8 of the fired wagon stated as follows:

- between Bucuresti Nord – Ciocanesti he did not observed smoke in the wagon and no strange noises;
- after leaving the railway station Ciocanesti, he smelled smoke in the compartment and opened the door and observed more smoke on the corridor, so he closed quickly the compartment door, then he observed flame in the corner on the window side, on the joint wall with the compartment 9;
- He went out on in the corridor towards the last but one compartment of the train, observing that the other compartments that he passed were without passengers, with smoke but without flame;
- he outlined that those 2 passengers, who were taken to the hospital, were in the compartment no. 9 of the wagon no. 50532057480-7.

The witness no. 2 from the compartment no. 5 or 6 of the fired wagon stated as follows:

- he travelled in one of the middle compartment of the fired wagon (5 or 6);
- after the railway station Ciocanesti, he smelled smoke and went out in the corridor and saw behind the wagon smoke and flame;
- he alarmed the passengers and run to the front wagons and notified the conductor.

The witness no. 3 from the compartment no. 5 or 6 of the fired wagon stated as follows:

- he travelled in one of the middle compartment of the fired wagon (5 or 6);
- after about 30 minute from the departure from the railway station Bucuresti Nord he was woken up by a person who informed him that the wagon fired;
- he saw a smoke cloud and run to the front wagons.

B.5.3 Safety Management System

In order to comply with its tasks, SNTFC “CFR Calatori” SA and CNCF “CFR” SA established and implemented their own safety management.

One did not observe problems in the application of its provisions.

B.5.4 Norms and regulations

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

- Instructions on the technical inspection and maintenance of the operated wagons no. 250/2005;
- The technical schemes of the coaches series 2057 upgraded;
- Regulations for the traffic of the trains and shunting of the railway vehicles no. 005/2005.

B.5.5 Sources and references for investigation

- the inquiry file no. 2120/83/2010 of the railway accident, drawn up by the inquiry commission, established in accordance with the provisions of the Instructions for the prevention and inquiry of the railway accidents and incidents no. 003/2000;
- photos made soon after the accident by the members of the inquiry commission;
- the results of the checks and tests performed on parts and subassemblies of the electric equipment of the fired wagon;
- the minutes for the reading of the records of the equipments for the measurement and registering of the speed with permanent memory (type IVMS) from the locomotive for the hauling of the train no. 9101 from the 7th of February 2010;
- the records of the equipments for the diagnosis and signaling type EPSAI on the locomotive for the hauling of the train no. 9101 from the 7th of February 2010;
- the documents on the trains running;
- the statements and questionnaires of the involved employees;
- the statements of the passengers from the fired wagon.

B.5.6 Rolling-stock functioning

B.5.6.1 Locomotive of the passenger train no. 9101: DA 526

The locomotive is endowed with an inverter type INDA – HI 400K – 1500T for the power supply of the circuits for the heating of the coaches coupled at the electrical - diesel locomotive and the equipment for the protection, diagnosis and signaling EPSAI-02.

The inverter for heating type INDA – HI – 400K – 1500T is protected against the accidental appearance of the following failures: short-circuit on the AC outlet and overload on AC outlet (by limiting the voltage), and the equipment type EPSAI monitors the current intensity, ensuring the acoustic signaling in the case of a protection activation and storage those data.

After checking the data downloaded from the memory of the equipment for the protection, diagnosis and signaling type EPSAI for the train 9101 from the 7th of February 2010, no incidents were observed in the operation of the static inverter in the meaning of the putting in action of the protection at short circuit.

B.5.6.2 The fired wagon no. 50532057480-7

B.5.6.2.1 Technical characteristics of the wagon:

- brake type KE – GPR;
- bogie type Minden – Deutz;
- bogie pitch : 2500 mm;
- wagon wheel base: 17200 mm;
- the wagon length over the buffers: 24500 mm;
- the maximum speed: 140 km/h;
- characteristics of the electric equipment and of the heating system:
- heating system with warm modulated air, with two channels and automatic regulation;
- the ventilation is made by the heating pipe, the engine fan supplied from the batteries;
- the electric heating equipment operates at 1500 voltage single phase alternating current of 50 Hz;
- the lighting equipment was supplied with continuous current of 24V;
- periodical inspections performed:
- major overhaul type RK in 1983;
- general overhaul type RK in 1998;

- last periodical overhaul type RP was performed on the 2nd of April 2009 in the SC Workshops Grivita SA.

B.5.6.2.2 Findings at the wagon

Bogies, buffing, traction and coupling gears and breaking equipment

- the running gear had no traces of thermic overheating and neither other signs of braked running;
- the brake blocks were between instructional limits, without traces of un-ordered braked running;
- the emergency brake valve deteriorated after the fire;
- the traction and coupling gears in good operation condition;
- the buffing gear in good operation condition.

The external wagon body:

- burn about 95%;
- on the external side of the wagon body the paint burnt from about 200 mm from the interior level of the body, and at the whole for fresh air inspiration was observed a thermic influence more visible, that is the paint at the frame was burnt;
- vertically distorted at its middle.

Pipes and subassemblies of the ventilation equipment from the wagon body

- the handle for the valve for the mixture of the re-circulated air was put and assured thus the air circulation can be done only on the position “re-circulation” (without acceptance of external air);



- after opening the inspection cover of the mixture chamber, one found out that the mixture valve put on so the air circulation can be done only by re-circulation, as well as traces of open flame burning, affecting seriously the air admission pipes from the interior of the wagon as well as of the pipes to the filtration chamber;
- at the opening of the inspection cover from the filters chamber, one found out traces of open flame burning, that affected the air filters, metallic hall as well as the admission area to the blower;
- the air filters were affected from the thermic point of view progressively decreasing from the mixture chamber to the fan blower;
- from the filter room it was found that the air blower was partially thermic affected;
- the fan does not have traces of thermical damage or soot deposits.

The battery for the electric heating of the air and overflow conduits (pipes) towards the interior of the wagon body.

- when removing the inspection cover from the electric heating battery, there were no evidence of thermic damage or soot on the sockets and electric contacts from the electric resistance;

- after opening the over-voltage plate fuse support (SST), it was found that the fuse was in good conditions of operation and had traces of soot deposits on it;



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pipes on compartment branch line 1-5 and 6-10, no evidence of thermic damage from interior to its exterior was found, in exchange there was found evidence of thermic damage from exterior to its interior;

- the air pipes from the compartment no. 9, had deeper evidence of thermic damage against the air pipes of the other compartments, and areas where the metal plate was perforated due to thermic damage.

Wagon body interior

- the air pipes from the compartment no. 9, had deeper evidence of thermal damage against the air piper of the other compartments, and areas where the metal plate was perforated due to thermic damage;
- the interior facilities burned at 100 %;
- inside the wagon, the windows frames from the compartments no. 9 and 10 are more thermic damaged than the ones from the others compartments.

Electric equipment

- traces of electric contact between the electric conductors of the lighting and heating equipment were not found, that lead to a short-circuit. Traces of a high voltage electric equipment overload were not found, that lead to the insulation melting and to a short-circuit;
- there weren't found on the switchgear distributing box and ledges linked to the electric equipment connections, thermic damage areas due to a possible short-circuit or due to a incomplete contact;
- there weren't found on the point wire, protection and supply of lighting and heating equipment, short-circuit traces, insulation burning due to a source outside the electric panel;

Under the wagon body:

- the battery boxes interior without thermic damage;
- the main high-voltage conductor doesn't present traces of a short-circuit;
- the fusible fuses of the battery doesn't present traces of a short-circuit;
- after opening the cover of the electric switch box of the high-voltage contactors, the interior wasn't thermic damaged and from the contactors examination it was found out the proper state of the fixed and mobile contacts surface;
- the main sealed electric switch box was thermal unaffected, the fusible fuses of 50 A and of 2 A were in good conditions of operation.
- **Inside the wagon body:**
 - the insulation of the electric equipment was completely burned;
 - the control unit was over 95 % destroyed;
 - the electrical fuses of 80A were identified (corresponding to the safety and command circuit of the lighting equipment) and 63 A (corresponding to the safety and command circuit of the train heating plant), of which the 80 A fuse was in good conditions of operating and the 63 A fuse was discontinued without spark-over traces.

The automatic heat-regulator of the electric heating battery had the slide bearings at the temperature of 83°C and respectively 75°C, they were verified on the bench.

When checking the no air fuse it was found out that it was thermic affected by fire, the conductors from the entry of the safety box were solder together due to burning of the insulation.

B.5.6.2.3. Data on the behaviour in operation of the wagon

- last periodic inspection on 03.04.2009 – SC Atelierele Grivița SA;
- there were no failures within the warranty period of the wagon;
- from the 1st October, when the heating of the passengers trains start according to Annex 7 Article 2 of “Instructions for the technical inspection and wagon maintenance in operation” the wagon does not appear in the records of Wagon Inspection București Basarab with failures at the heating electric equipment or lighting.

B.5.6.2.4. Conclusions referring to the functioning of the electric installations of the wagon

Corroborating the findings on the wagon and the ones resulted from the tests, the following conclusions can be draw:

- all the findings preclude the possibility of spreading the fire from the electric heating battery area, in support of this assertion are the followings:
 - at the electric heating battery there were no thermal traces or soot on the sockets and electric contacts from the electric resistance;
 - the over-voltage plate fuse was in good conditions of operating;
 - the automatic heat-regulator of 90°C that has the role of electric heating battery protection, corresponded to the tests conducted on bench;
 - on the hot air connection piece circuit (inside it) the thermic influence is most pronounced in the mixing valve of cold air / recirculated air and the lowest in the way out area from the electric heating battery towards the compartments;
- the thermal influence pronounced in the mixing valve area and then descending to the air filters, the ventilated motor blower, no air fuse, the heating battery and the cold/hot air mixing chamber, is due that the ventilated motor worked also after the start of the fire, causing circulation and directing the fire from the inside of the wagon through the recirculated air hole towards the hot air/recirculated air mixing chamber;
- there is no evidence to support the possibility of a short-circuit to the high and low voltage equipment.

B.6. Analysis and conclusions

B.6.1. Analysis on the fire starting and spreading

Generally the fire is a complex burning process with indeterminate development, including other physical and chemical phenomenon (heat transfer, formation of flames, gas exchange with the environment, structural changes of material). In most cases the development of a fire can be divided in 5 phases: the place where flash up the fire, the slow combustion phase, the active combustion phase, the generalize combustion phase and the decrease phase.

From the fire traces one can be determined that the fire spread hapened quickly, without the slow combustion phase, fact which is explained mainly by two types of accelerators

- a. the rapid movement of the air masses caused by:
 - gale outside;
 - ventilation inside the wagon;
 - the ventilation indicates that the wagon was running with a speed up to 70km/h (only in the first phase of the fire);
- b. the type of the materials used for construction of the wagon furniture items (polyvilyn, cloth and plastic) and construction of the interior walls of the wagon box and their insulation (PAL, PFL, polystyrene), which enhances the combustion.

The same conclusion regarding the quick spread of fire and the lack of the combustion phase can be found in the train staff and witness statements, who said that at the stopping of the train in the Ciocanesti railway station there were no traces of fire, and after approximately 5 minutes the wagon was burning, with flames.

Regarding the setting of the fire flash up by analyzing, in this case, the fire in which the spread happened quickly and the extinguishing was practically taken for granted (there was no intervence with water or foam) after burning all the fuel elements existing on the wagon, is not conclusiv.

In this situation, given the findings at the wagon and the tests at some elements of the electric heating equipment, which eliminates the possibility of a short-circuit on the wagon electric equipment for determining the fireplace, the statements of the train staff and of the three witnesses were taken into account, who were in the set on fire wagon, have been taken into account, and mentioned that they saw flames in the compartment no.9 or in the nearby areas:

- | | |
|-----------------|---|
| ▪ the conductor | “at the last but one compartment of the wagon”; |
| ▪ witness no.1 | “in the corner of the compartment (compartment no.8), in the area with the window on the common wall with compartment no. 2 from the rear (compartment no. 9)”; |
| ▪ witness no.2 | “I went into the corridor and saw in the rear of the wagon smoke and a back-fire light”. |

Regarding the way that the fire had spread, two phases are taking into account:

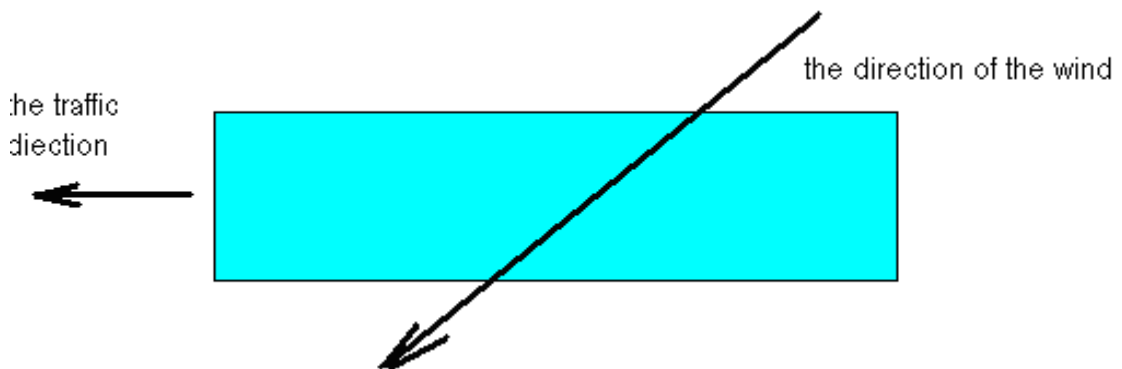
- first phase with a very short term (on the distance from the Ciocanesti railway station to km 26+700 – approximately 5 minutes) in which besides the accelerators that have influenced the combustion in the phase no. 2, also the ventilation and the air speed acted due to the train movement, phase in which the fire wasn't developed;
- the second phase was influenced only by the speed of the wind and wagon ventilation, regarding the air masses.

As the first phase was very short, the spread and development analysis can be made only on the second stage. Items to be considered are deformations of the wagon box and the degree of destruction by melting aluminium components (window frames) of the wagon, due to the temperatures reached.

Thus the data recorded by the report in connection with the verification of the wagon by the technical commission and from the photos taken at the time of the accident result that the wagon was more damaged on the right side in the traffic direction, respectively the side with the passage corridor where it can be observed a high degree of destruction by melting the window frames.



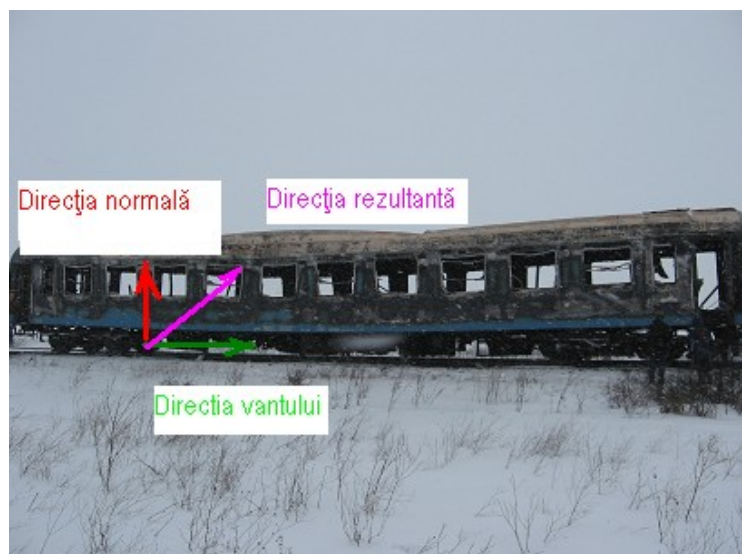
Also taking into account the maximum chassis flexure of 15 cm of the wagon box in horizontally plane on the right side in the traffic direction, can be concluded that the combustion process has been intensified on this side due to the strong wind that blew on the transversal-oblique direction of the wagon from left to right in the traffic direction.



The direction of the wind and the area where the fire started may also offer an explanation on how the deformation of the wagon roof took place.

In general the fire spreads from bottom to up, searching for places like chimneys because in such places the ascending development of the combustion processes is favourable. The shape of the fire is like a cone pointing down located in the fireplace. The cone dihedral angle is directly proportional to the size of the fire area and its intensity.

The roof is more damaged between the compartments no. 6 and 7 due to the fire intensification on a oblique-vertical direction resulted from two forces from two directions (vertical direction given by flame and horizontal direction given by wind).



B.6.2 Conclusions

From the findings and checks at the wagon pieces and parts it result that there are no elements that sustain the possibility of a short-circuit at the high and low voltage equipment.

The existence of a short-circuit would have meant the burning of the conductor insulator cover, with a strong release of smoke, a process that would take place in a long period of time, which would have allowed the train staff (which left the wagon after Chitila railway station) and passengers from that wagon to feel smoke, fact that didn't happen.

The findings on the thermic damage more pronounced of the hot air distribution pipes from the compartment no.9 and of the window frames from the compartments no. 9 and 10, (given that the window frames from the others compartments are less affected and the left side of the wagon is less affected than the right side in the traffic direction) and the witnesses statements lead to the conclusion that the fire started by a source of fire from the compartment no. 9.

The fire was spreading quickly due to the wind (on a oblique-transversal direction) and of the airflow caused by the ventilation equipment.

B.7 Accident causes

B.7.1 Direct cause

The direct cause of the accident – open fire inside the wagon, in the area of compartment no. 9 determined by an external source (flame, cigarette, ignition of combustible materials), independent from the heating and electric lighting equipment of the wagon.

The predisposing factors that led to a quick and general spread of fire, were caused by the quickly movement of air masses inside and outside the the wagon determined by:

- the operation of the wagon ventilation system;
- weather conditions – strong wind (the wind had intensifications at the squall up to 43 km/h);
- the train movement with maximum speed of 60 km/h (with influence only in the initial phase).

B.7.2. Underlying causes

It weren't identified underlying causes of this railway accident.

B.7.3. Root causes

It weren't identified root causes of this railway accident.

C. SAFETY RECOMMENDATIONS

It weren't identified elements that could lead to the issuing of safety recommendations.

The present investigating report will be transmitted to the public railway infrastructure manager, CNCF "CFR" SA, National Railway Passenger Company "CFR Calatori" – SA and to the Romanian Railway Safety Authority.

Investigation commission members:

- | | | |
|---------------------|--------------------------|-------|
| • NICOLESCU Mircea | - investigator in charge | _____ |
| • ZAMFIRACHE Marian | - investigator | _____ |
| • DRĂGHICI Marin | - investigator | _____ |
| • BURLEA Sorin | - investigator | _____ |