REPUBLIC OF SERBIA
CENTER FOR INVESTIGATION OF ACCIDENTS IN TRANSPORT
SECTOR FOR INVESTIGATION OF ACCIDENTS IN RAILWAY TRAFFIC
Nemanjina 11, 11000 Belgrade

No.: ŽS - 04/18

No.: 340-00-1/2018-2-2-45

Date: 29.11.2019.

FINAL REPORT ON INVESTIGATION OF SERIOUS ACCIDENT

Type of accident:	Serious accident on the level crossing
Train No.:	7821
Place:	City of Niš, settlement Donje Međurovo, area of the switch block 2 of the station Međurovo
Date:	21.12.2018.
Time:	07:30

This report presents the results of investigation of serious accident, overtaking of the train No. 7821 on the road vehicle bus, which occurred 21.12.2018. at 07:30 on the main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - State border - (Tabanovce), on the level crossing secured with traffic signs on the road and the necessary zone of visibility, which is located in the area of the station Međurovo.

Director of the Center for Investigation of Accidents in Transport of the Republic of Serbia established the Working Group for the investigation of this accident by the Decision No. 340-00-1/2018-2-2-3 of 28.12.2018.

In accordance with the Article 33 of the Law on Investigation of Accidents in Air, Rail and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18) and the Article 23 of the Directive 2004/49/EC of the European Parliament and of the Council of EU (Railway Safety Directive), Center for Investigation of Accidents in Transport drafted and published this Final Report.

In this report, all sizes and measurements are expressed in accordance with the International System of Units (*SI*).

The meaning of abbreviations used in the text is explained in the Glossary.

CINS has been established in accordance with the Law on Investigation of Accidents in Air, Rail and Waterborne Traffic ("Official Gazette of RS" No. 66/15). The founder is the Republic of Serbia and the holder of founding rights is the Government of the Republic of Serbia.

Department for investigations of railway traffic accidents and international cooperation carries out tasks within the competence of the Centre for investigation of accidents in traffic in relation to rail traffic with the aim of possible improvement of safety on the railways by issuing safety recommendations. The investigation procedure in the field of railway traffic is conducted on the basis of the provisions of the Law on Investigation of Accidents in Air, Rail and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18).

CINS conducts investigations after serious accidents on the railway system with a view to possible improvement of railway safety and the prevention of new accidents caused by the same or similar causes. Serious accident in railway traffic means any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety.

In addition to serious accidents, CINS may also investigate other accidents and incidents that could lead to a serious accident, including the technical failure of structural subsystems or interoperability constituents.

CINS has the discretion to decide whether to open an investigation of other accidents and incidents.

CINS is independent in its work and performs independent accident investigations. The aim of an investigation is to identify the causes and the possibility of improving safety on the railways and to prevent accidents by issuing safety recommendations.

Professional activities related to safety investigations are independent of judicial inquiry or any other parallel investigations which objective is to determine responsibility or the degree of guilt.

Glossary:

CINS	Center for Investigation of Accidents in Transport
IŽS	Serbian Railways Infrastructure
ZJŽ	Community of Yugoslav Railways
RS	Republic of Serbia
US	Constitutional Court
a.d.	Joint Stock Company
APB	Automatic track block
TT	Telephone - telegraph
TK	Telecommand
RDV	Radio - dispatch connection
MUP	Ministry of Interior
OJT	Basic Public Prosecutor
ETP	Electro-technical affairs
KM	Contact network
DMV	Diesel motor train
JP	Public Enterprise
JKP	Public Communal Enterprise
ZOP	For track maintenance
EVP	Electro traction substation
PU	Police Department

C O N T E N T :

1. Summary

1.1. Short description of the serious accident

On 21.12.2018. at 07:30 on the main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), on the level crossing secured with traffic signs on the road and the zone of necessary visibility located in the area of the station Međurovo at km 250+065, overtaking of the train No. 7821 on the road vehicle bus of the brand Mercedes Benz type O 530 of license plate NI 152-ŠJ occurred.

1.2. The causes of the serious accident determined by investigation

The direct and immediate cause of the serious accident is that the road vehicle bus was found on the track just before the train arrived, thus creating a dangerous situation related to the occurrence of this serious accident.

The basic cause of the serious accident is non-compliance with the provisions of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision of the US, 55/2014, 96/2015 - other law, 9/2016 - decision of the US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) by the bus driver.

The fact that the prescribed zone of necessary visibility was not provided (but there was a necessary visibility, refer to paragraph 3.4.2) does not in any way diminish the obligation of the driver of the road vehicle bus, as he was obliged to obey the traffic signs I-33: "Crossing the road with the railway line without barrier or half-barrier", I-35: "Approaching the point of crossing of the road and the railway line", I-34: "Andrejin krst" and II-2: "Obligation of stopping", to stop and make sure that whether the train was approaching, and what the necessary visibility existence allowed to him.

On the line, before approaching the respective level crossing from the direction of the station Niš to the station Međurovo, that is, to the crossing Belotince, in front of the first entrance switch on the entering side of the station Međurovo, in the direction of the train movement, signalling mark 209:"Watch out, level crossing" is not set in accordance with provisions of the Article 46 of the Singalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96). Not setting of this signalling mark in the manner prescribed by provisions of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96) could have contribute to the situation that the train driver, in front of the respective level crossing, not give an aspect of a signal 67 "Watch out", as determined by the provisions of the Article 29 under B, Point 11 under v) and Article 46, Point 5 of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96).

As the speedometer equipped with the DMV 711-075 / 076 records the use of the locomotive siren, it can be reliably established that the train driver did not give the aspect of a signal 67: "Watch out" in the manner prescribed by the Article 29 under B, Point 11 under a), k) and lj) of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96). Bearing in mind the fact that the train driver was familiar with the line on which he had driven the train, he had the possibility that, nevertheless that the signalling mark 209: "Watch out, level crossing" was not set, by giving the aspect of a signal 67: "Watch out" warn on the arrival of the train. Not giving this aspect of a signal in the manner prescribed by the provisions of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96) may have contributed to the occurrence of this serious accident.

1.3. Main recommendations and information on subjects to which the report is submitted

Aiming to achieve the possible improvement of railway safety and to prevent occurrence of new accidents, CINS has issued the following safety recommendations:

Ministry of Construction, Transport and Infrastructure:

SR_24/19 Ministry of Construction, Transport and Infrastructure, that in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), defines methodology (the manner) of determining (calculating) the elements of the zone of necessary visibility given in Annex 9 (d_{pz} - the length of stopping of the road vehicle and $S_{pžv}$- the length of approaching of the railway vehicle).

SR _25/19 Ministry of Construction, Transport and Infrastructure, that in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), defines the procedure when there exists a necessary visibility according to the definition from the Article 2 Paragraph 1 under 12) of this Rulebook and it is not possible to determine the zone of necessary visibility. In particular, it should be borne in mind that by setting the traffic sign II-2: "Obligation of stopping", while providing the necessary visibility, enables the safe passage of road vehicles over the crossing.

SR_26/19 Ministry of Construction, Transport and Infrastructure that in the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), makes corrections in the expression:

$$t_a = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

so that in front of s there is a sign "-", and not the sign "+" (refer to paragraph 3.4.2).

SR_27/19 Ministry of Construction, Transport and Infrastructure that in the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), harmonize the description of the position of point B given in Article 14, Article 15 and Annex 6 (refer to paragraph 4.3.4).

SR_28/19 Ministry of Construction, Transport and Infrastructure that makes amendments to the Rulebook on traffic signalling ("Official Gazette RS", No. 85/17) which would allow the instalment of traffic sign II-2: "Obligation of stopping", and in front of the crossing of the road over the track in the level, with the purpose of stopping the occurrence of the new similar accidents and improvement of traffic safety (refer to paragraph 4.3.4.).

SR_29/19 Ministry of Construction, Transport and Infrastructure to consider the possibility that in the Law on traffic safety on the roads ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) Article 153 Paragraph 2 to harmonize with the Article 97 Paragraph 1 of the Law on safety of railway traffic ("Official Gazette RS", No.41/2018) in terms of more precise provisions for the installation of traffic lights (refer to paragraph 4.3.4.).

Directorate for Railways:

SR_30/19 "IŽS"a.d. to conduct expertly based risk assessment on level crossings. Given that the accidents on the level crossings (by reviewing every crossing individually) are rare events, it is not possible to assess risk solely on the number of accidents which occurred on the individual level crossings. Risk assessment, as a precautionary measure, should be made jointly for all level crossings in accordance with all relevant parameters, whether the accidents occurred or not.

SR_31/19 "IŽS"a.d. to make the act "Level Crossing Program" according to the previously done risk assessment on the level crossings with a view to undertake appropriate activities in order to raise the level of traffic safety.

SR_32/19 "Srbija Voz"a.d. to carry out part-time training of traction vehicle staff in the proper implementation of the aspect of a signal 67: "Watch out", in accordance with provisions of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96), with the purpose of the proper application of railway regulations, which has an aim of preventive actions for preventing the circumstances that could contribute to the occurrence of the new similar accidents and improvement of safety in the railway traffic.

2. Direct facts about the serious accident

2.1. Basic serious accident data

2.1.1. Date, time and place of the serious accident

The accident occurred on 21.12.2018. at 07:30 in the area of the settlement Donje Međurovo, on the main arterial route E 70/E 85: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), in the area of the Međurovo station, at km 250+065, on the level crossing secured with traffic signs on the road and the zone of necessary visibility (note: the arterial route mark is taken from the Regulation on the Categorization of Railways, which was in force at the time of the occurrence of the respective serious accident).

The appearance of the serious accident site is given in Fig. 2.1.1.1.

Fig. 2.1.1.1: Appearance of the serious accident site (*Google maps*)

2.1.2. Description of the serious accident and the serious accident site and work of rescue and emergency services

Level crossing is located in the area of the station Međurovo, at the station part of the track, in the settlement Donje Međurovo. It is secured with traffic signs and the zone of necessary visibility.

The road vehicle, the bus of the brand Mercedes Benz, type O 530 of license plate NI 152-ŠJ, was moving in the direction of the settlement Donje Međurovo to Niš. By approaching the level crossing at km 250+065, the road vehicle did not stop in front of the level crossing but continued its drive and in the area of the level crossing has entered the profile of the track just before the arrival of the train.

The train No. 7821 was moving on the main arterial route E 70/E 85: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), from the direction of the station Međurovo to the Belotince crossing. The train operated, regularly, on the route Niš- Kuršumlija - the stop

Merdare. The train consisted of DMV series 711-075/076. After being at the Međurovo station due to passengers' needs, the train No. 7821 was started from the third main running track of the Međurovo station towards the Belotince crossing. After passing of the train through the exit switch area, upon entering the level crossing at km 250+065, there came to overtaking of the train on the road vehicle bus, which has just before the train arrival, entered the profile of the track. The overtaking occurred in such a manner that the forehead of the DMV 711-075/076 has hit the left port side of the road vehicle bus (looking in the direction of the train drive, that is the road vehicle bus).

After the overtaking, the train continued its movement in length of 60 m, after which it stopped, so that the head of DMV 711-075/076 was found at km 250+125. On this occasion, part of DMV 711-075 derailed with both bogies, while part of DMV 711-076 did not derail (Figure 2.1.2.1.).

Figure 2.1.2.1: Appearance of DMV and the bus after the serious accident
(looking at the direction to the train forehead, source: "IŽS"a.d.)

After the hit, the train pushed the road vehicle bus in front of itself in the length of about 10 m, after which the body of the road vehicle bus physically split into two parts in the middle of the road vehicle bus, with each part of the road vehicle bus being discarded out of the track, with one part at each side of the track. The road vehicle bus was found at 13 m from the middle of the level crossing, with the front part of the separated road vehicle bus located on the left side of the track, and the back part of the separated vehicle on the right side of the track (in the direction of the growing mileage, that is, the direction of the train drive). Parts of decoupled bus were found in normal position relative to the axes of the track so that the front end of the front part and the back end of the back part of the road vehicle bus were found neared to the track axes (Figure 2.1.2.2.).

Figure 2.1.2.2: Appearance of DMV and the bus after the serious accident (looking at the direction to the end of the train, source: "IŽS"a.d.)

According to information from a letter from the Section for Traffic and Commercial Affairs Niš, "Srbija Voz"a.d. No. 27/18-I-124 of 16.01.2019. at the time of the serious accident, there were 10 (ten) passengers in the train No. 7821.

In this serious accident, 7 (seven) people were fatally injured, 19 (nineteen) were seriously injured and 17 (seventeen) were lightly injured. All the fatally injured and injured persons were in the road vehicle bus, except for one lightly injured person - train driver of the train No. 7821.

Members of the MUP RS, Police Directorate in Niš, Traffic Police Department in Niš, members of the MUP RS, Sector for Emergency Situations, Emergency Management Directorate in Niš, members of OJT Niš and members of the Institute for Emergency Medical Service Niš came on the site of the serious accident.

Due to this aforementioned serious accident, there was a traffic interruption between the station Međurovo and Belotince crossing. The traffic interruption lasted until 17:30, when the train traffic was regulated.

2.1.3. Decision to launch the investigation, composition of the investigation team and conducting of the investigation

CINS has been informed immediately upon the occurrence of this serious accident. Main Investigator for Railway Traffic received the first notification of the accident occurred 21.12.2018. at 07:50 by telephone by the Assistant Director of the Sector for Operations of "IŽS"a.d, and then by e-mail at 07:58 by the traffic dispatcher of the Central Operations Department of "Srbija Voz"a.d. Based on the information received and the facts identified by the CINS Investigative Team on the site of the serious accident, CINS initiated an investigation of the serious accident in accordance with the Law on Investigation of Accidents in Air, Rail and Waterborne Traffic ("Official Gazette RS" No. 66/15 and 83/18).

The composition of the Working group for investigation of the serious accident is determined by Decision No. 340-00-1/2018-2-2-3 of 28.12.2018. of the Director of CINS based on the Articles 6 and 32 of the Law on investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette RS" No. 66/15 and 83/18).

2.2. Serious accident background

2.2.1. Involved railway staff, contractors, other persons and witnesses

The driver and conductors of the train No. 7821, employed by the railway undertaking "Srbija Voz"a.d, a train driver in the Train Traction Section of Niš and conductors in the Section for Traffic and Commercial Affairs of Niš, participated in the serious accident.

The driver of the bus of brand Mercedes Benz type O 530 of license plate NI 152-ŠJ and the bus passengers were also involved in this serious accident.

The staff of the infrastructure manager staff "IŽS"a.d. did not participate in the respective serious accident.

2.2.2. The train and the passenger vehicle that were involved in the serious accident and their composition

The train No. 7821 and the road vehicle bus of the brand Mercedes Benz type O 530 of license plate NI 152-ŠJ participated in the respective serious accident.

The train consisted of DMV Series 711-075/076. At the head of the train there were the power car 711-075 (numbered 95 72 5711 075-0) and at the end of the train power car 711-076 (numbered 95 72 5711 076-8).

The bus of the brand Mercedes Benz type O 530 of license plate NI 152-ŠJ is a single-decker two-axle low-floor bus with two passenger doors of approximate dimensions: length 12.0 m, width 2.55 m, maximum gross mass 18.93 t, capacity of 30 seating places and 56 places for standing, intended for transportation of passengers on city and suburban relations.

2.2.3. Infrastructure and safety-signalling system

The main arterial route E 70/E 85: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), between the stations Niš and Međurovo is one-track. The stopping distance on the aforementioned railway section is 700 m. According to the Timetable Booklet 9.3. the maximum allowed speed is 70 km/h. On the railway section between the stations Niš and Međurovo there are two level crossings (at km 245+613, secured with traffic signs on the road and the zone of necessary visibilty and at km 247+070, secured with half barriers with light signalization and traffic signs on the road) and two bridges (at km 247+672 steel bridge l=2x18.0 m and at km 247+927 steel bridge l=7.7 m).

In the zone of the mentioned level crossing (level crossing at *km* 250+066 in the area of the station Međurovo), the railway track is in the direction, while the slope (fall, in the direction of the train drive, that is, in the direction of the mileage growth) is 1.04‰ (from km 248+199 to km 254+623 the railway track is in the direction, and from km 248+960 to km 250+080 the slope of the track is 1.04‰). According to the Timetable Booklet 9.3, the maximum permitted speed on the part of the one-track line between the station Međurovo and the Belotince crossing is 70 km/h. In the area of the station Međurovo, the speed over the switch area is 50 km/h in direction, and in the turn, it is 30 km/h. At the aforementioned distance between station, from km 258+950 to km 259+200, by consignment No. 56 of 07.12.2018. of "IŽS"a.d. restricted speed running is introduced with 50 km/h.

Section of the main arterial route E 70/85 between the stations Međurovo and Doljevac is equipped with APB, which is turned on in the device of telecommand of the system Flexicode 560, at which the traffic of trains is regulated in block departments. The regulation of traffic is carried out by dispatcher of telcommand at TK Center Niš. The stations Međurovo and Doljevac are border stations on TK track and are handled by the train dispatcher.

With the view to regulating traffic, on the section between the station Međurovo and the crossing Belotince the main signals are installed that show the bisemic aspects of a signal.

Level crossing at km 250+065,68 (mileage is given according to the data given from the service of construction industry "IŽS"a.d.) represents the point of crossing at level of the main arterial route E 70/E 85: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce) and the local road (2nd class municipal road No.4) which connects the city with the settlement Donje Međurovo in the territory of Palilula city municipality.

The arterial route mark is taken from the Regulation on the Categorization of Railways ("Official Gazette RS" No. 115/2013 and 57/2017), which was in force at the time of the occurrence of the respective serious accident, and the mark for the road according to the letter of Service of the Head of the City Administration, the Secretariat for Communal Affairs, Energy and Transport, City Administration of the City of Niš, No. 255/2019-09 of 29.01.2019. in accordance with the Decision on the Categorization of Municipal Roads and Streets in the City of Niš ("Official Gazette of the City of Niš" No. 85/2014).

The track and the road intersect at 90°. The local road is made of asphalt pavement. Near the road crossing, the pavement width is 5.5 m. The road on the crossing is made of wooden sleepers. The total width of the wooden sleepers is 2.75 m and length 7.5 m, looking in the direction of the railway track.

The condition of the asphalt pavement near the road crossing is tidy, with no damage observed. The local road, from the direction of Niš and from the direction of Donje Međurovo to the respective level crossing, is on the rise. The road on the mere crossing is horizontal.

Appearance of the level crossing, looking from the road, is shown in Fig. 2.2.3.1. and 2.2.3.2.

Figure 2.2.3.1: Appearance of the level crossing (view from the direction of the center of Donje Međurovo)

Figure 2.2.3.2: Appearance of the level crossing (view from the direction of Niš)

On the respective local road, before approaching the level crossing from the direction of Donje Međurovo, on the supporter which is located on the right side next to the track and is 240 m away from the level crossing, the traffic signs are set: I-33: "Crossing of a road with a railway line without barriers or semi-barriers" and I-35: "Approaching the intersection point of a road and

railway line" (Fig. 2.2.3.3.); on the supporter located on the right side of the road next to the track and 160 m away from the level crossing, the traffic sign : I-35: "Approaching the intersection point of a road and railway line" is set (Fig. 2.2.3.4.); on the supporter located on the right side of the road next to the track and 80 m away from the level crossing, the traffic sign I-35: "Approaching the intersection point of a road and railway line" is set (positioned incorrectly, facing opposite the direction from which the road vehicles approach, Fig. 2.2.3.5.) and on the supporter located on the right side of the road next to the track and 9.98 m away from the nearer rail of the railway track, the traffic signs I-34: "Andrejin krst" and II-2: "Obligation of stopping" are set. Behind aforementioned traffic signs, there is set a clearance gate, whose supporters are positioned on either side of the road, so that the left supporter is 8.45 m and the right supporter 8.2 m away from the nearest rail track of the railway. No signs were placed on the supporters of the gates and on the gate itself, but only a signboard - a warning of high life-threatening voltage (Figure 2.2.3.5.). In addition to the traffic signs indicated, no other traffic signs were placed in this section of the local road in the mentioned direction (traffic sign: II-30: "Speed limit" is not set).

Figure 2.2.3.3: Appearance of traffic signalization (view from the direction of the center of Donje Međurovo)

Figure 2.2.3.4: Appearance of traffic signalization (view from the direction of the center of Donje Međurovo)

Figure 2.2.3.5: Appearance of traffic signalization (view from the direction of the center of Donje Međurovo)

Figure 2.2.3.6: Appearance of traffic signalization (view from the direction of the center of Donje Međurovo)

On the respective local road, before approaching the level crossing from the direction of Niš, on the supporter on the right side of the road next to the track and 240 m from the level crossing, a traffic sign is set: I-33: "Crossing of a road with a railway line without barriers or semi-barriers" (traffic sign I-35: "Approaching the intersection point of road and railway track" is not set, Figure 2.2.3.7); on the supporter located at the right side of the road next to the track and is 160 m away from the level crossing the traffic sign I-35: "Approaching the intersection point of a road and railway line" is set: (Fig. 2.2.3.8.), on the supporter located on the right side of the road next to the track and 110 m away from the level crossing, the traffic sign III-24: "Settlement" is set (Fig. 2.2.3.9.), and on the supporter located on the right side of the road next to the track and 80 m away from the level crossing, the traffic sign I-35: "Approaching the intersection point of a road and railway line" is set (Fig. 2.2.3.10.). Behind aforementioned traffic signs, there is a clearance gate set, whose supporters are positioned on either side of the road, so that the left supporter is 28.9 m and the right supporter 27.2 m away from the nearest rail of the railway track. There are also no traffic signs on the supporters of the gate and on the gate itself, but only a signboard - warning of high voltage life - threatening (Fig. 2.2.3.10.). In addition to the mentioned traffic signs, no other traffic signs were placed in this section of the local road in the aforementioned direction (traffic signs: II-30: "Speed limit", I-34: "Andrejin krst" and II-2: "Obligation of stopping" were not set.

Figure 2.2.3.7: Appearance of traffic signalization (view from direction of Niš)

Figure 2.2.3.8: Appearance of traffic signalization (view from direction of Niš)

Figure 2.2.3.9: Appearance of traffic signalization (view from direction of Niš)

Figure 2.2.3.10: Appearance of traffic signalization (view from direction of Niš)

On the respective level crossing there were no traffic lights on either side of the road (observed for different directions of movement of road vehicles) announcing the approach of a train, since it is a level crossing with a modern pavement - asphalt, which is not in accordance with Article 153 of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41 / 2018, 41/2018 - other law and 87/2018). This Article of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41 / 2018, 41/2018 - other law and 87/2018) is in conflict with railway legislation governing this issue.

On the above mentioned local road, in the immediate vicinity of the level crossing, on the section from Niš to the level crossing, in the middle of the track there is a full dividing line, while on the part of the road from Donje Međurovo to the level crossing there is no dividing line. There are no other road markings (longitudinal, transversal and other). In the vicinity of the level crossing, the track was cleared of snow and sprinkled with ridge. The track appearance in the vicinity of the level crossing is shown in Figures 2.2.3.11. and 2.2.3.12.

Figure 2.2.3.11: Appearance of the track in the vicinity of the level crossing (view from the direction of Niš)

Figure 2.2.3.12: Appearance of the track in the vicinity of the level crossing (view from the direction of Donje Međurovo)

Looking in the direction of the growing mileage (from the direction of the station Niš to the Belotince crossing), before reaching the respective level crossing and after the respective crossing, the railway is in direction in the length of 6424 m (from km 248+199 to km 254+623).

At the point of the level crossing, the slope of the railway line (fall, looking in the direction of train drive, or in the direction of mileage growth) is 1.04‰.

The angle of intersection of the track and the road is 90º. According to the information provided by the Sector for Construction Affairs "IŽS"a.d. (Letter No. 20 / 2019-99 of 23.01.2019), the width of the level crossing is 7.8 m, and the area is 46.8 m^2. The track structure on the level crossing is made of wooden sleepers. The condition of the wooden sleepers is tidy, without damage.

On the railway line, before entering the respective level crossing from the direction of the Belotince crossing to the station Međurovo, at km 250+559 a signalling mark 209: "Watch out, level crossing" was set (the mileage is determined according to the mileage marked on KM pillars, Figure 2.2.3.13.). The signalling mark is set on the left side of the railway track, looking in the direction of the growing mileage, that is, on the right side of the railway, looking in the direction from the Belotince crossing to the station Međurovo, at 2.9 m from the nearer rail track of the

railway. The paint on the red and white areas on the signalling mark is partly peeled. The signalling mark is partly covered with vegetation.

On the railway line, before entering the respective level crossing from the direction of the station Niš station to the station Međurovo, or towards the Belotince crossing, signalling mark 209: "Watch out, level crossing" is not set (in accordance with the provisions of Article 46 of the Signalling Rulebook ("Official Gazette of ZJŽ", No.4/96 and 5/96), signalling mark 209: "Watch out, level crossing" was to be set in the area of block 1 of the station Međurovo, in front of the first entry switch, Figure 2.2.3.14.).

Figure 2.2.3.13: Appearance of the signalling mark 209: "Watch out, level crossing"
(view from the direction of the Belotince crossing)

Figure 2.2.3.14: Appearance of the switch block 1 of the station Međurovo (view from the direction of the station Niš)

On the right side of the railway track, between the station Međurovo and Belotince crossing, looking in the direction of the growing mileage, in front of the level crossing, there is an orchard partly fenced with a hedge consisting of densely planted trees and shrubs approximately 3 m high. The orchard is positioned between the railway and the local road so that it extends 45 m along the railway line and 60 m along the road. The minimum distance of the orchard from the right rail of the railway track is 9 m, and from the left edge of the track of the respective local road, looking from the direction of Donje Međurovo to Niš, 2 m. The appearance of the orchard is shown in Figure 2.2.3.15.

Figure 2.2.3.15: Appearance of the orchard (view from the direction of Donje Međurovo)

On the right side of the track, between the station Međurovo and the Belotince crossing, as viewed in the direction of increasing mileage, beyond the respective level crossing, there is a space surrounded by the fence made partly of the wall of solid building material of height of 2.6 m (that hinders the view), and partly of the grid metal structure set at low foundation (that does not hinder

the view). The fenced area is located between the railway track and the local road so that it extends along the railway track at a length of 60 m, and along the road at a length of 90 m. The minimum distance from the fenced area from the right rail of the railway track is 13 m, and from the right edge of the track of the respective local road, as viewed from the direction of the Donje Međurovo to Niš, is 3 m. The appearance of the fenced area is shown in Figures 2.2.3.16. and 2.2.3.17.

Figure 2.2.3.16: Appearance of the fenced area (view from the direction of Niš)

Figure 2.2.3.17: Appearance of the fenced area (view from the direction of Donje Međurovo)

The described facilities (orchard and fenced area) are partly located in the infrastructure belt and partly hindered the view from the local road to the railway line and from the railway line to the local road. However, the driver of a road vehicle moving from the direction of Donje Međurovo to Niš, when stopping in front of the traffic signs I-34: "Andrejin Krst" and II-2: "Obligation of Stopping", placed in front of the road crossing on the same supporter, has an uninterrupted view of the railway line in both directions, that is, it is possible to spot a road vehicle stopped in front of the aforementioned traffic signs (Figures 2.2.3.18 and 2.2.3.19).

Figure 2.2.3.18: View from the road to the railway line in the direction of Belotince crossing from the point at which the traffic signs are set

Figure 2.2.3.19: View from the road to the railway line in the direction of the station Niš from the point at which the traffic signs are set

The spatial arrangement and the impact on the visibility of the described facilities to the right of the railway line is shown in Figure 2.2.3.20.

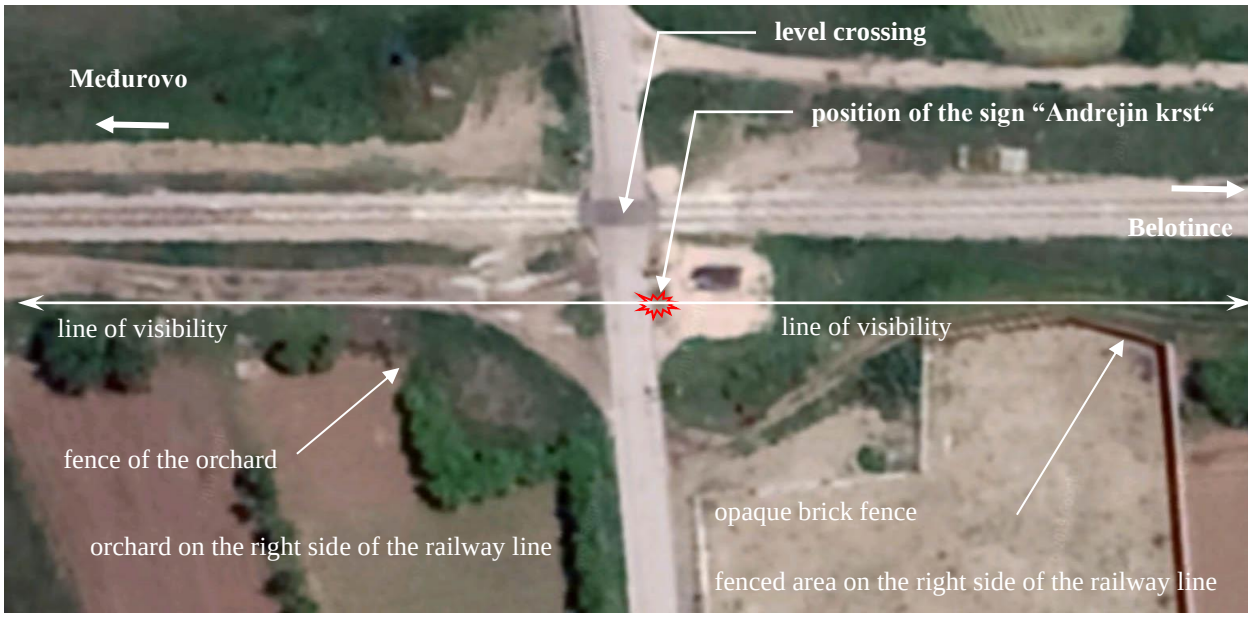


Figure 2.2.3.20: Satellite image of the level crossing area (source: *Google maps*)

On the left side of the railway line, no objects and vegetation were observed in the vicinity of the level crossing that would affect the view from the road to the railway line.

2.2.4. Communication tools

On the section of the main arterial route E *70/E 85* between the station Međurovo and the Belotince crossing, communication between the staff in charge of traffic regulation and traction vehicle staff is performed by telephone via local TT connection. All official positions on the railway line are included in the communication network, telephones beside all the main signals and TK dispatcher at the position of TK Jug at TK Center Niš. Communication on this network is recorded on the register device, located at Section for ETP Niš, TT Section Niš, so this type of communication is considered evidence based.

This railway line is equipped with RDV devices that are operational and via which communication is possible between the staff of the traction vehicle and TK dispatcher. Communication via RDV are recorded on the register device, located at Section for ETP Niš, TT Section Niš, so this type of communication is considered evidence based.

For communication at TK Center Niš, at the position of Senior Dispatcher, fixed telephone network is also operational, connected to a register device located at the Section for ETP Niš, TT Section Niš, so this type of communication is considered evidence based.

2.2.5. Works at or near the serious accident site

In the vicinity of the serious accident site no works have been carried out.

2.2.6. Activation of the emergency plan for railways and the sequence of events

Infrastructure manager "IŽS"a.d immediately informed CINS, i.e., the Main investigator for railway traffic about the occurrence of the serious accident, and then also the railway undertaking "Srbija Voz"a.d. The Railway Infrastructure Manager "IŽS"a.d. and Railway Undertaking "Srbija Voz"a.d, established a joint investigative committee that conducted an investigation of the accident in accordance with applicable regulations. Upon completion of the investigation, the Investigation Report U-529/18 was drafted.

According to the allegations from the Letter of Section for Traffic and Commercial Affairs Niš, "Srbija Voz"a.d. No. 27/18-I-124 of 16.01.2019., at the time of the occurrence of a serious accident, there were 10 (ten) passengers in the train No. 7821. Since they were not injured in a serious accident, the conductors immediately began to assist the passengers who had fallen to the floor immediately from the severity of the crash. They helped them get off the floor and informed of the circumstances occurred. There were no injured among the passengers, so they left the train immediately by themselves. After the passengers left the train, the conductors began assisting the injured in the road vehicle.

According to the allegations from the Letter of "IŽS"a.d. No. 1/2019-345 of 08.02.2019., after hearing the sound of the crash and noticing that the train was standing in the level crossing zone, the on - duty train dispatcher sent the intern train dispatcher to the site, who informed him of the occurrence of a serious accident upon arrival on the site. The train dispatcher on duty immediately informed the ambulance, the police and all interested parties in the "IŽS"a.d about the occurrence of a serious accident. Following the occurrence of a serious accident, due to the damage caused at the KM pillar (on the KM pillar No. 47 breakage of the bypass isolator and damage to the bypass line), it came to reaction of protection in the EVP, after which the voltage on the part of the line between the stations Međurovo and Doljevac was switched off.

Lifting of the derailed DMV is carried out by engaging the breakdown train, owned by "IŽS"a.d., Section for Technical wagon affairs Niš. After lifting and extrusion of DMV from the site has been done, repair of the damages done on KM facilities.

Repair of the damages done on KM facilities is finished at 17:30, when the permission for electro traction has been given.

The interruption of traffic between the station Međurovo and the Belotince crossing lasted until 17:30, when the railway line was opened for the traffic of trains.

2.2.7. Activation of the emergency plans of public rescue services, police and medical services and sequence of events

Due to this serious accident, members of the MUP RS, Police Directorate in Niš, the Traffic Police Department in Niš, members of the MUP RS, Sector for Emergency Situations, Emergency Management Directorate in Niš, members of OJT Niš and members of the Institute for Emergency Medical Services Niš were hired.

Letter from the Institute for Emergency Medical Care Niš No. 691 of 11.02.2019. data were submitted that on 21.12.2018. at 07:31 a call was received at the Reception Service via the number "194" for an intervention at the Međurovo level crossing near Niš on the occasion of a traffic accident with injured passengers involving a train and a local city bus. The first in a series of multiple calls for the same accident was an eyewitness, that is, a passer-by. The call was received as the first line of urgency. On the site of a serious accident (traffic incident), the closest and fastest

teams were dispatched in the first order of urgency to care for the injured in a mass accident, and later, after a few minutes, in the second order of emergency. Institute for Emergency Medical Care Niš sent a total of 11 (eleven) ambulances; all 7 (seven) medical field teams (doctor, nurse-technician and driver) from the regular daily composition, 2 (two) emergency medical teams and 2 (two) ambulance vehicles with medical escort (nurse-technician and driver). The first team arrived on the site 3 (three) minutes after the call was received via "194". A total of 23 patients were examined. Three patients died on the spot, that is, immediately after the injury. Twenty patients were examined, treated according to the doctrines of emergency medicine, of which 19 (nineteen) were transported to the appropriate clinics of the University Clinical Center Niš, depending on the injury. According to the diagnoses from the medical reports of the examined patients, these are the localizations of injuries on the body from injuries of the head to the injuries of the lower extremities.

By letter of MUP RS, Sector for Emergency Situations, Emergency Management Directorate in Niš, 09/20 No.: 404-20/19 of 08.02.2019., data were submitted that on 21.12.2018. Niš Fire and Rescue Brigade of the Emergency Management Directorate in Niš received a report from the Police Directorate of Niš that a traffic incident had occurred at the level crossing in the settlement of Donje Međurovo. 13 (thirteen) executive officers were sent to the site with 5 (five) vehicles (three fire trucks and two off road vehicles). Arriving at the site, it was discovered that on the level crossing, the train hit and halved the bus. There were several injured and fatally injured persons on the site which were on the bus, beside the bus and under the train. Niš. Fire and Rescue Brigade crew released a person stuck in the bus seat with the help of a hydraulic breaker, pulled one injured person out of the bus and pulled one injured person under the train. All the injured were taken by the ambulance team. Following the release and care of the injured, two fatally injured persons were pulled under the train. After taking care of all the injured and removing the injured, Niš Fire and Rescue Brigade, with the help of pneumatic pillows, carried out lifting of one part of the bus to check that there were no persons under the bus. Environmental checks were carried out as well as the check of the entire train.

By Letter of OJT Niš 14 KT No.3506/18 of 03.04.2019., data was provided that OJT Niš, on the serious accident (traffic incident) that occurred on 21.12.2018. at 07:30 in the area of the station Međurovo, was informed by PU in Niš. On this occasion, the Deputy Public Prosecutor on duty came to the site and undertook all necessary actions and measures to detect and secure the traces of the criminal offence and the items that can serve as evidence, as well as to collect any information that may be useful for the successful conduct of criminal proceedings.

From MUP RS, PU Niš, Traffic Police Department in Niš, CINS did not receive the information on engagement on the site.

2.3. Dead, injured and material damage

2.3.1. Passengers, third parties and railway staff, including contractors

In this serious accident, 7 (seven) people were fatally injured, 19 (nineteen) were seriously injured and 17 (seventeen) were lightly injured. All the fatally injured and injured persons were on the road vehicle bus, except for one lightly injured person - the train driver of the train No.7821.

Among the passengers and conductors from the train No. 7821 there were no injured nor fatally injured.

Table 2.3.1.1: Review of fatally injured and injured persons

	Passengers	Railway staff	Third parties	Total
Fatally injured	-	-	7	7
Seriously injured	-	-	19	19
Lightly injured	-	1	16	17

Clinical Center Niš submitted data on fatally injured and injured persons (Letter No. 1463/1 of 22.05.2019.).

2.3.2. Goods, luggage and other assets

In this serious accident there was no damage to the luggage in the railway vehicles. There is damage to the road vehicle, bus. CINS does not have any data on the damage assessment of the road vehicle the bus.

2.3.3. Railway vehicles, infrastructure and environment

In the respective serious accident, the infrastructure was damaged (the railway line and KM facilities) and the railway vehicle (DMV 711-075/076).

The structure of the material damage is given according to the following:

On DMV 711-075/076:	3 500 000.00	RSD
Total costs of lifting the derailed DMV:	45 663.90	RSD
On the railway line:	489 040.00	RSD
On KM facilities:	85 709.04	RSD
Total direct material damage:	**4 120 412.94**	RSD

The damage is stated in the official currency of RS (Dinar - *RSD*).

According to the official middle exchange rate of the National Bank of Serbia on 21.12.2018, which was 1 EUR (Euro) = 118.2709 RSD (Dinars), the total material damage occurred in the respective serious accident amounts to 34 838.77 EUR.

Material damage on the railway infrastructure and the railway vehicles is shown according to the documents that confirm the stated damage amounts, and which are submitted by "IŽS"a.d. and "Srbija Voz"a.d.

2.3.4. External conditions - weather conditions and geographic characteristics

The site of respective serious accident is located in the area of the settlement Donje Međurovo, on the section located in the geographically plain terrain.

The geographic coordinates of the accident site are: 43º 17' 55.47" *N* and 21º 49' 53.76" *E*.

Railway section where the level crossing is located is in direction and on the slope 1.04‰ (rise, viewed in the direction of the train drive, that is, in the direction of the growing mileage).

By Letter of Republic Hydrometeorological Institute, No: 925-1-5/2019 of 14.01.2019. data were submitted that, at the Meteorological Station Niš - airport, which is climatologically representative for the area of Donje Međurovo, on 21.12. 2018, the maximum air temperature was 4.4 °C, the minimum air temperature -5.4 °C, and the minimum air temperature on 5 cm above the ground - 7.8 °C. No precipitation was observed during the day. The ground was covered with snow throughout the day. In the period between 07:00 and 09:00, the visibility was 3.0 km, half of the sky was covered with clouds and light fog was observed.

Values measured at Meteorological Station Niš - airport on 21.12.2018. in the period from 07:00 to 09:00 are shown in Table 2.3.4.1.

Table 2.3.4.1: Values measured at Meteorological Station Niš - airport

Hour	**07:00**	**08:00**	**09:00**
Air pressure (mb)	1004.6	1005.0	1004.9
Air temperature (°C)	-4.0	-4.2	-2.2
Relative humidity (%)	100	100	100
Visibility (km)	3.5	3.0	2.0

Meteorological visibility is the translucency of the atmosphere, which is expressed by the greatest distance at which an observer of normal vision can recognize items known to him in the surroundings, by daytime observation, and light sources by night-time observation.

At the time of the on-site investigation of the respective serious accident by the CINS Investigative Team, it was day. The weather was partly cloudy with no wind. There was a noticeable light fog. The ground was covered with snow. Snow was removed from the road track and covered with a ridge. Visibility was good. The air temperature was about 0 °C.

3. Minutes on the investigation and interviews

Data, facts and evidence regarding the respective serious accident were collected and determined on the basis of:

- On-site investigation which was carried out by the investigative team of CINS,
- materials submitted by infrastructure manager "IŽS"a.d,
- materials submitted by railway undertaking "Srbija Voz"a.d,
- materials submitted by the City Administration of the City of Niš and
- materials submitted by OJT Niš.

For the respective accident, the investigation on-site and investigation was carried out by joint investigative committee of infrastructure manager "IŽS"a.d. and railway undertaking "Srbija Voz"a.d.

Members of MUP RS, Police Directorate Niš, Traffic Police Department in Niš and members of OJT Niš carried out investigation on-site.

3.1. Summary of testimonies

From "IŽS"a.d and "Srbija Voz"a.d. the minutes of the hearing of dispatcher of the station Međurovo, who was working at the time of occurrence of the respective serious accident, and the train driver of the train No. 7821 and the Reports on irregularities during operation of the conductor (K-91) of the train No. 7821 were submitted.

3.1.1. Railway staff

The train driver stated: "I started the service at the station Niš at 02:18. My first task was to drive the train train No. 7841/7840 and then drive of train No. 7821. From the moment of receiving the service to the moment of the accident, I did not notice any technical malfunctions on the set. At Međurovo station, the weather was clear, with no precipitation, visibility was good. Handling of the train No. 7821 was performed at the Međurovo station according to the Timetable Booklet. After handling the passengers, the conductors were on their seats and the dispatcher dispatched the train. I looked at the exit signal that showed the aspect of a signal: "Free, expect free or cautiously". Then I checked whether the doors were closed and the stairs retracted. After checking everything, I started the train with observing the train route and the telemetry of the train while monitoring the train speed. In the area of the exit switches I gave an aspect of a signal: "Watch out" by the front siren of the train. After that I noticed the movement of the bus and with the estimation that it would not stop in front of the level crossing, I started fast braking and emergency braking at a speed of about 65 km/h. It came to a crash into the bus and derailment of the power wagon 711-075 off the rails. I remained stuck in the seat behind the driver panel. After stopping the train and suffering shock I found that I had no serious physical injuries. I freed myself from the deformed seat. I turned off the diesel engines that were operating and pressed the fuses for for the power supply. I immediately called the police but was informed that police had already been notified of the accident. I left the driver's cab and came into the passenger compartment. In a state of great shock, I was able to forcibly open the door for passengers to leave the train. Due to feeling dizzy and nauseous, I sat in the passenger compartment and waited for medical help. After being

provided with medical help on the site, I was transported to the new Clinical Center Niš. I have nothing more to say".

The first conductor stated: "On 21.12.2018. on the train No. 7821 I was the first conductor. After leaving the Međurovo station, I was in the front of the train, more specifically near the restrooms, I was checking the train tickets and heard the driver giving a siren because of the level crossing. After a long siren, I suddenly felt the train braking. The passenger I was checking the ticket fell to the floor and I tried to help him. I felt a strong hit and fell to the floor. On the right side of the train I saw a vehicle that we had hit. We derailed off the rails. It was scary. The train leaned slightly to one side. I helped the passenger get up, asked him and the other four passengers if they were injured, helped to get the train driver out of the engine space. I went outside and saw a colleague conductor helping people on the bus we hit. I called an ambulance and joined in helping the injured."

The final conductor stated: "On 21.12.2018. I was the final conductor on train 7821 on the Niš - Merdare route. Immediately after leaving the Međurovo station, I heard intense siren, braking and finally a hit. As the hit carried me away and the passengers on the train fell, I looked outside. The scene was scary. I just threw away my purse and immediately went out to get the injured off the bus. The weather was not ideal because of the snow and a light fog, but I cannot say whether it affected and how much, since visibility was good when we called at Međurovo station. I have nothing else to add because I'm still under impression and stress".

The train dispatcher stated: "I received the service on 21.12.2018. at 07:00. Visibility in the area of Međurovo station was good. I saw the train at 700 to 800 m, it was clear without precipitation. Reception and departure of train No. 7821 was carried out properly. Upon dispatch of the train, I returned to the station facility and heard the train siren, followed by a blunt thud. I saw train No. 7821 was standing behind the exit switch, somewhere around the level crossing. I sent a train dispatcher intern on the site. Emergency sirens were heard even before I heard from the train dispatcher intern. The intern informed me by phone that the train had hit the bus and that there were many injured. At the same time, I was called by an energy dispatcher and asked if I had electric traction in the station. I informed him of the traffic situation at the station, after which he switched off the voltage. I reported the accident to the senior dispatcher, TK dispatcher and station head. I have nothing more to say".

From "IŽS" a.d. Report of train dispatcher on irregularities during operation (S-23) regarding the serious accident, submitted by the train dispatcher of Međurovo station. The submitted train dispatcher's Report on Irregularities during operation (S-23), coincides in all relevant facts, with the statements made in the Minutes of the train dispatcher's hearing.

3.1.2. Other witnesses

The witnesses to this accident (the passengers in the train No. 7821 and third parties) were not heard and the statements were not submitted from them.

3.2. Safety management system

3.2.1. Organizational frame and manner of issuing and executing orders

In accordance with the Rulebook of Safety Management System, "IŽS"a.d. of the resulting serious accident has informed CINS.

In accordance with the Rulebook of Safety Management System, "Srbija Voz"a.d. of the resulting serious accident has informed CINS.

Railway infrastructure manager "IŽS"a.d. and railway undertaking "Srbija Voz"a.d, in accordance with Law on safety in railway traffic (*"Official Gazette RS" No. 41/2018*), formed a joint investigative committee that conducted an investigation of the respective accident. Upon completion of the investigation, a Report on the investigation of U-529/18 has been made.

3.2.2. Requirements that must be fulfilled by railway staff and the way they are applied

"Srbija Voz"a.d. through Safety Management System Manual (SMS) has provided competence management, i.e. processes that all employees who are directly involved in the performance of rail transport are trained and competent for planning the workload.

Regarding the respective serious accident, involving the train driver and conductors employed at "Srbija Voz"a.d, all activities related to professional training, competence and planning office hours are conducted in accordance with applicable regulations.

3.2.3. Procedures for internal audits and controls and their results

"Srbija Voz"a.d. as a railway undertaking, has established Safety Management System Manual. The general purpose of the safety management system (SMS) is to ensure that "Srbija Voz"a.d. achieves its business goals in the safe manner.

Rolling stock must maintain required technical level of correctness and must follow the maintenance plans (*EV-62*) and its cycles of control-technical checks and execution of the regular repairs, so that they would be as reliable as possible in the traffic, according to the Rulebook on maintenance of railway vehicles and other law and by-laws, which are integral part of Safety Management System Manual of "Srbija Voz"a.d.

Regarding the respective serious accident, regular and corrective maintenance of the railway vehicles (DMV 711-075/076) was carried out in accordance with the applicable regulations.

"IŽS"a.d. as infrastructure manager has established Safety Management System Manual. Safety Management System includes the organization and all the procedures and processes that have been established in "IŽS"a.d. for safe regulation of railway traffic.

Risk control related to the maintenance of the railway infrastructure (subsystems infrastructure, energy, control, management and signalling-track section) and railway vehicles for that "IŽS"a.d. uses for maintenance is based on the implementation of the defined activities of regular and corrective maintenance and their monitoring and control. Regular and corrective maintenance involves constant supervision, control, inspections, repairs and adjustments.

Requirements, standards and procedures to maintain at the "IŽS"a.d. are determined on the basis of legal regulations, general and individual acts of society, the manufacturer's instructions and standards.

Regarding the respective serious accident, regular and corrective maintenance of the level crossing was done according to valid regulations, in part relating to track maintenance as well as undertaking the measures so that the correct traffic signalization would be set.

The part relating to railway signalization, regular and corrective maintenance of the level crossing was not done in accordance with the applicable regulations. Signalling mark 209: "Watch out, level crossing" from direction of Niš towards the Međurovo station, at the time of the on-site investigation by the CINS investigative team, it was not in the place determined by the applicable railway regulations. Signalling mark 209: "Watch out, level crossing" from the direction of Belotince to the station Međurovo at the time of conduction of the on-site investigation by the investigative team of CINS was found on the position determined by applicable railway regulations, but the paint on the red and white areas on the signalling mark was partly peeled and the signalling mark was partly covered by vegetation.

3.3. Relevant international and national regulations

3.3.1. Law on Traffic Safety on the Roads ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018)

IV Traffic rules

...

23. Traffic at the crossing of the road across the railway line

Article 100:

At the crossing of the road over the railway line, the driver is obliged to let the rail vehicle pass moving along the railway line.

The driver approaching the crossing of the road through the railway line, is obliged to adjust the movement of the vehicle so that it can stop it in front of the traffic closure device at the level crossing or in front of the signalling device announcing the approach of the train, or to stop the vehicle before coming to the railway line.

...

VII traffic signalization

1. General provisions

Article 132 (excerpt)

...

Traffic participants are obliged to adapt their movement in the points or sections of road marked with signs of danger, to the dangers to which these signs warn them.

...

6. Marking of the crossing of the road across the railway line

Article 153 (excerpt)

The crossing of the road over the railway line must be marked by the prescribed traffic signalization.

At the level crossing with a modern pavement (asphalt, concrete, cube, etc.), traffic lights must be placed over the railway line to announce the approach of the train.

...

3.3.2. Law on Railway ("Official Gazette RS "No. *41/2018*)

II Railway infrastructure

...

1. Management of public railway infrastructure

...

Obligations of the infrastructure manager

Article 10. (excerpt)

The infrastructure manager shall ensure the safe and unobstructed organization, regulation and management of railway traffic, the unimpeded access and use of public railway infrastructure and the access to the facilities entrusted to him for the management and services provided in those facilities to all interested applicants for the allocation of infrastructure capacity, on equal, non-discriminatory and transparent terms, as well as permanent, continuous and high-quality maintenance and protection of railway infrastructure.

...

National Public Railway Infrastructure Program

Article 48 (excerpt)

...

Based on the National Program, the infrastructure manager prepares an annual Program of construction, reconstruction and maintenance of railway infrastructure, organization and regulation of railway traffic with a design for the next four years.

...

7. National Public Railway Infrastructure Maintenance

Article 55 (excerpt)

Public railway infrastructure must be maintained in a condition that ensures safe and unobstructed rail traffic, as well as quality and orderly transport, in accordance with the regulations governing railway safety and technical regulations and standards.

Maintenance of public railway infrastructure includes regular maintenance and corrective maintenance.

The maintenance technological unit consists of all elements of the public railway infrastructure. Maintenance intervenes on individual elements which in this way are brought to condition that does not impair the technological function of the line and prevent the creation of bottlenecks on the line.

...

3.3.3. Law on Safety in Railway Traffic ("Official Gazette RS "No. 41/2018)

II Railway vehicles

1. Technical conditions

...

Devices and traction vehicles equipment

Article 51. (excerpt)

Locomotive must possess:

...

8) device for sound signalling;

...

The power train must, in addition to the devices and equipment referred to in paragraph 1 of this Article, also have

...

XIII Crossing of railway lines and roads

...

Conditions for crossing the railway line and road, pedestrian or bicycle path

Article 97 (excerpt)

The conditions for the crossing of the railway line and the road, with regard to the position where the crossing can be made and the measures for the safe operation of traffic at level crossings depend on the traffic density, the transparency of the railway, the speed of the drive on the railway and the road and the local conditions.

…

3.3.4. Traffic signalization Rulebook ("Official Gazette RS" No. 85/17)

1. Traffic signs

...

1.1. Signs of danger

Article 17

Signs of danger serve to alert road users to a hazard that is threatening them at a particular place, or part of the road, and to inform them about the nature of that danger.

Article 18 (excerpt)

The signs of danger are:

...

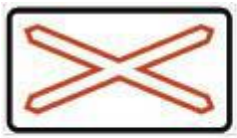
27) the sign “crossing of a road with the railway line with barriers or half-barriers” (I-32), indicates the entry at the level crossing of a railway line with a road, secured with barriers or half-barriers;

I-32

28) the sign “crossing of a road with the railway line without barriers or half- barriers” (I-33), indicates the entry at the level crossing of a railway line with a road, that is not secured barriers or half- barriers;

I-33

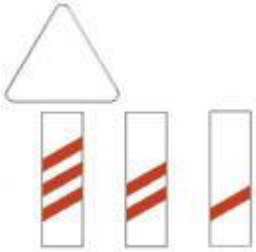
29) the sign “Andrejin krst”, indicates approach to the level crossing of road and railway line with one track (I-34) or with two or more tracks (I-34.1);



I-34

I-34.1

30) the sign “approaching to the point of crossing of the road and railway line” (I-35), indicates the distance to the point of crossing of the road and the railway line in level;



I-35

...

Placing the signs of danger

...

Article 23.

Notwithstanding from Article 22, Paragraph 1 of this Rulebook:

...

5) signs I-34, I-34.1 shall be placed at the crossings of the road and the railway line, at a distance of 5 m from the nearest railway track, and if the circumstances require so, not less than 3 m, that is, not more than 10 m;

6) signs I-34, I-34.1 shall be placed on a common supporter above the traffic lights if the crossing of the road over the railway line is equipped with the same;

7) the sign I-35 is placed with three sloping lanes at 240 m in front of the point of level crossing of the road and railway line, then with two sloping lanes at 160 m, and the last one with one sloping lane at 80 m in front of the level crossing of the road and railway line. The lower side of the sloping lanes is closer to the pavement. The sign I-32 or I-33 is placed above the sign with three sloping lanes.

...

Article 25.

Signs of explicit orders that stipulate priority of passage are:

...

2) the sign “obligation of stopping” (II-2), indicates an order for the driver to stop the vehicle and give priority to the passage of vehicles moving on the road which it encounters;

II-2

...

Placing of signs of explicit orders

...

Article 33. (excerpt)

Notwithstanding from Article 32 of this Rulebook:

...

2) sign II-2 shall be placed in the immediate vicinity of the crossing, preferably at a visibility point, at which the vehicle must be stopped to allow passage to other vehicles which are moving on the road it encounters;

...

3.3.5. Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measure to secure the safe traffic ("Official Gazette RS" No. 89/2016)

III. Measures to secure the safe traffic on the level crossings

Article 10. (excerpt)

Measures to ensure safe traffic at level crossings depend on the density of traffic, the transparency of the railway, the speed of travel on the railway and the road and on the local conditions in accordance with the law governing the safety and interoperability of the railway.

Traffic at the road crossings referred to in paragraph 1 of this Article shall be ensured by:

1) traffic signs on the road and the zone of necessary visibility;

2) traffic lights and traffic signs on the road;

3) automatic half- barriers with light traffic signs and traffic signs on the road;

4) barriers and traffic signs on the road;

5) direct regulation of traffic at the road crossing and special measures, and

6) protective fences and traffic signs or bypasses and traffic signs at pedestrian and bicycle road crossings.

...

Article 11.

By traffic signs on the road and in the zone of necessary visibility the traffic at the level crossing of the railway and the road is secured, if the maximum permitted speed on the line is up to 100 km/h, unless the traffic management on the level crossing is provided as prescribed by Article 10 Paragraph 2 Point 2)–4) of this Rulebook.

Article 12.

By providing the necessary zone of visibility referred to in Article 11 of this Rulebook, road traffic users shall be provided with a smooth and uninterrupted view of the railway on either side of the road, pedestrian or bicycle path, in order to detect the oncoming railway vehicles on the line in a timely manner so that they can stop the road vehicle and interrupt the movement of pedestrians or bicycles before they enter the railway line, or in front of a traffic sign marking the point where the road crosses the railway line at the level of the track.

Article 13.

The zone of necessary visibility at the crossing is measured along the axis of the railway line from its crossing with the axis of the road to one and the other side of the railway line and along the axis from its crossing with the axis of the railway line to one and the other side of the road, according to the review of determining the necessary visibility zone for road vehicles in Annex 6, which is printed with this Rulebook and forms its integral part (hereinafter: Annex 6).

The size of the zone of necessary visibility shall be determined on the basis of the maximum allowed speed on the railway line so as to ensure that road vehicles can be stopped in a timely and secure manner in front of a traffic sign signalling the point of crossing of the railway line and the road, or that road vehicles can safely start crossing the railway.

In the area of the zone of necessary visibility, facilities and plants cannot be built, items and materials left behind, and there can be no vegetation that could hinder visibility, or actions that interfere with the visibility of the railway line cannot be performed. The size of the zone of necessary visibility cannot be the reason for the reduction of the maximum allowed speed on the line.

Maintenance of the zone of necessary visibility is carried out in the part of the rail belt and in the zone of necessary visibility outside the rail belt.

The height of the zone of necessary visibility includes a space, between 1.0 and 2.5 m in height, measured above the pavement level, above the point on the road from which the road traffic participant should have an unobstructed and uninterrupted view to the point of the zone of necessary visibility on the railway line, as well as the space above the point of necessary visibility on the railway line between 1.5 and 4 m in height, measured above the upper edge of the rail of the railway line.

Article 14.

The necessary visibility is determined according to the formula

$$L_{ppp} = AS = SC = t_{pdv}\frac{V_{ž}}{3{,}6} \quad [m]$$

whereas:

L_{ppp} – length of necessary visibility from the road to the railway line (*m*);

t_{pdv} – the total time it takes for a road vehicle of maximum allowed length to start from point B (the point in front of the traffic sign marking the point where the road crosses the railway) and with its rear part to cross the freeway boundary of the railway line on the other side of the crossing (imaginary line l normal to axis of the road) (s);

$V_{ž}$ – the maximum allowed speed on the railway line in the zone of the level crossing (*km/h*).

Total time required that the road vehicle of the maximum allowed length cross over the area of the level crossing, that is, the size „t_{pdv}" is determined according to

$$t_{pdv} = t_a + t_v \quad [s]$$

wherein:

t_a – the time required that the road vehicle after starting reach V_p = 4 *km/h* with the supposed evenly accelerated movement (*s*);

t_v – the time of drive of the road vehicle from reaching V_p to crossing the line *l* with its rear part (*s*).

The time required that the road vehicle after starting to reach V_p, that is, the size „t_a" is determined according to:

$$t_a = \frac{V_p}{3{,}6 \cdot a} \quad [s]$$

wherein:

$V_p = 4\ km/h$ – the speed of the road vehicle on the level crossing;

$a = 1\ m/s^2$ – acceleration of the road vehicle (from the moment of starting from the point B to the moment of reaching V_p).

The time of drive of the road vehicle from reaching V_p to crossing the line *l* with its rear part (*s*) that is, the size „t_v" is determined according to

$$t_a = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

wherein:

m – the distance of the traffic sign presenting a point where the road crosses over the railway line from the axis of the railway line measured along the axis of the road (*m*);

n – the distance of the line *l* from the axis of the railway line measure along the axis of the road (*m*);

d – the maximum length of the road vehicle, which is 25 (*m*);

s – the road that the road vehicle passes from starting from the point B to reaching V_p (*m*);

V_p – the speed of the road vehicle on the point of the level crossing.

If, on a road crossing a railway line, the length of the road vehicle is of limited or greater length, then that limited or greater length of the road vehicle is taken as relevant for calculation.

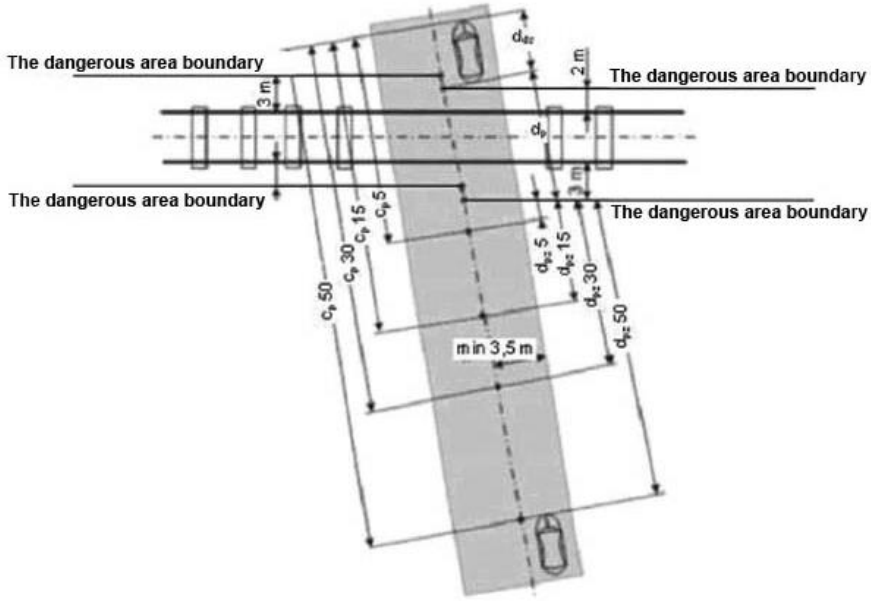
Article 15.

A speed limit sign is placed on the road in front of the crossing, which is also representing the beginning of the zone of necessary visibility of the crossing zone.

The speed limit traffic sign shall be placed at the point of the road where the zone of necessary visibility (point B) begins at the distance of the stopping of the road vehicle specified in Annex 5, Annex 6 and Annex 7, which are printed with this Rulebook and form its integral part.

...

Annex 5: The zone of crossing of the road over the railway line on the level crossing

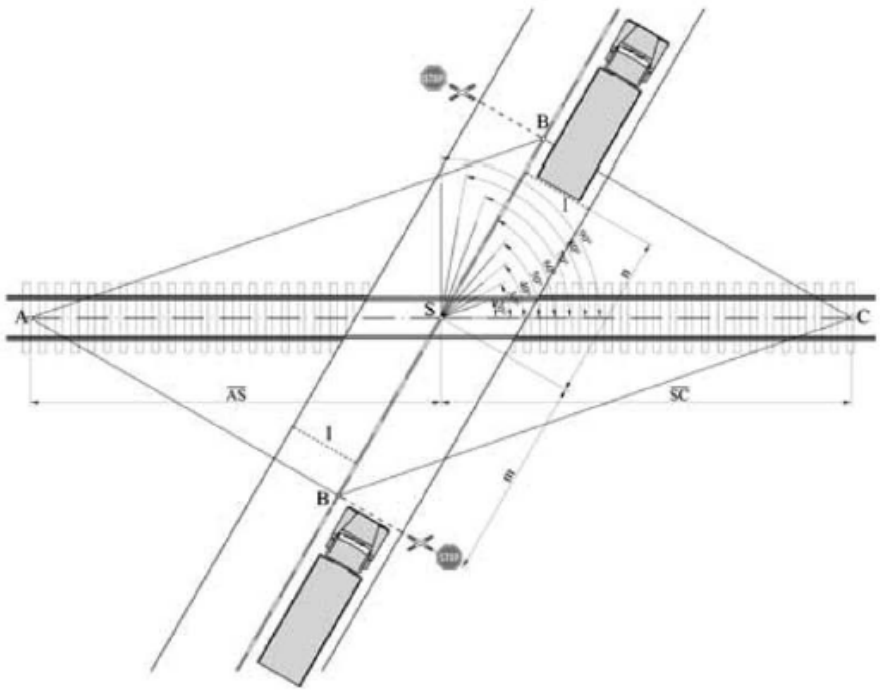


Where:

Z_p – Zone of crossing the road over the railway level crossing is a part of the way, from the point of which the driver of road vehicle should start braking so that the vehicle can safely stop before the traffic sign that indicates a place of the road crossing over the railway line, to the place where the longest road vehicle, with the most exposed part of the rear, crosses the level of the crossing zone and leave the dangerous area boundary on the side of the departure of the level crossing, which is: $Z_p=d_{pz}+d_{dv}+d_p$ (m);

t_{zp} – the time required for a road vehicle to leave safely the zone of transition. Time "t_{zp}" is calculated on the basis of the sum of the length of the stopping distance of a road vehicle "d_{pz}", the length of the longest vehicles "d_{dv}" and the length of level crossing "d_p", with respect to the speed of road vehicles: $t_{zp}=Z_p/V_{dv}$ (s), wherein "t_{zp}" is the time of leaving the zone of the level crossing, "Z_p" zone crossing of level crossing in meters and "V_{dv}" speed of the road vehicle expressed in "m/s". The minimum time required for a road vehicle to leave safely the zone of the level crossing "t_{zp}" is calculated based on the sum of the length of the stopping of the road vehicle, which is 5 m, the length of the longest road vehicle "d_{dv}" and length of the level crossing "d_p*"* with respect to speed of road vehicle is 5 km/h (1.38 m/s): $t_{zp}=Z_p/1{,}38$ (s), wherein: "t_{zp}" is the time of leaving the zone of level crossing in seconds and "Z_p*"* the level crossing zone in meters for the speed of road vehicles 5 km/h. Indices 50, 30, 15 and 5 indicate speed of driving of the road vehicle in km/h.

Annex 6: The zone of necessary visibility on the level crossing over the railway line (level crossing):

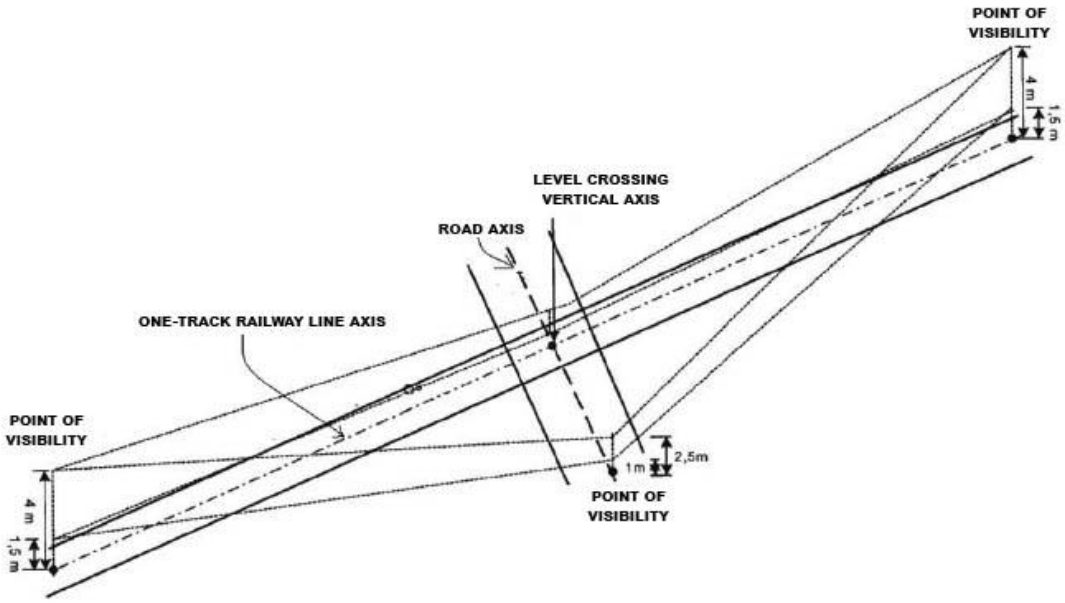


Where:

B – Place on the road from which the participant in road traffic must, when approaching the level crossing, due to the speed limit on the road, have a continuous overview to the point of visibility on the track at point A and C. Point of the visibility from the road on the railway is the length of the stopping distance of road vehicle before the traffic sign that indicates a place of crossing the road over the railway;

A and C – Point of visibility on the track away from the level crossing, at which a participant in road traffic must, from the point of visibility on the road at the point B, to have possibility to reliably see the rail vehicle coming on the track and to stop the road vehicle before the traffic sign which represents the place of crossing the road over the railway. The point of visibility is determined by calculating the road of approaching the rail vehicle.

Annex 7: Three-dimensional representation of the zone of necessary visibility on the crossing of the road over the railway line (level crossing):



3.3.6. Signalling Rulebook ("Official Gazette ZJŽ"No. 4/96 and 5/96)

Section V: Aspect of a signal of the driving and station staff

Aspect of a signal of the staff of the traction vehicles

Article 29. (excerpt):

A. Basic provisions. Aspects of a signal

1. By aspect of a signal of traction vehicle staff gives traction vehicles trains the necessary orders and warnings for trains, station and service personnel and, in certain cases, other persons.

...

2. Aspect of a signal of the traction vehicle staff are given by the train driver with the siren of the traction vehicle.

...

3. Aspect of a signal 67: "Watch out", one long sound: ————

...

Б. The purpose and use of the aspects of a signal

11. Aspect of a signal 67: "Watch out" is given by the train driver

- at all the trains:

a) in cases where it is necessary to warn about the arrival of the train or to be removed from, that is, away from the track. This also applies to the driver of each power-driven vehicle while manoeuvring.

...

v) in front of the signalling mark "Track warning "and according to the provision of the Point 5 of the Article 46 of this Rulebook;

...

đ) before entering the tunnel, before approaching the bridge or viaduct, and before exiting the tunnel, that is before crossing over the bridge or viaduct;

...

ĸ) in front of every level crossing, larger notch, bridge or other larger facilities that hinder the view;

...

lj) when it is necessary in the interest of general security and warning the other persons and removing the animals of the track;

...

Section VII: Signalling marks

...

Track warnings

Article 46 (excerpt)

1. Signalling mark 209: "Watch out, level crossing" a pillar painted in random red and white stripes.

...

3. Track warning is set at the right part of the track for the direction of the relevant direction of driving.

...

Track warning is set in front of the level crossing at the distance of 500 m on the main arterial route and on the routes of the 1st order, and on 200 m on the side tracks.

4. If the level crossing is located at the station side of the track on the exit side of the station in the direction of movement of the train, the track warning shall be placed in front of the first entry switch at the entrance side of the station in the direction of movement of the train but not less than 500 m ahead of the level crossing.

5. Signalling mark 209: "Watch out, level crossing" warns the train driver that at this sign he must give the sign 67: "Watch out" and repeat it several times until arriving at the level crossing, for notifying the traffic participants that the train is approaching the level crossing.

...

3.4. Functioning of the railway vehicles and technical installations

3.4.1. Control, command and signalling

In the area of the station Međurovo and at the railway section between the station Međurovo and Belotince crossing the control, command and signalling devices were correct and operational.

3.4.2. Infrastructure

The condition of the infrastructure (in terms of condition of tracks and facilities) on the railway section between the station Međurovo and Belotince crossing was in order and in that sense, there were no irregularities that could adversely affect the safety of railway traffic.

On the main arterial route E70/E85 from the direction of Belotince crossing before the respective level crossing the set signalling mark 209: "Watch out, level crossing" was found at the position in the manner prescribed by the provisions of Article 46 of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96), but the paint on red and white areas of the signalling mark was partly peeled and the signalling mark was partly covered by vegetation. From the direction of the station Niš, that is the station Međurovo, no signalling mark 209: "Watch out, level crossing" has been set in front of the level crossing: in the manner prescribed by the provisions of Article 46 of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96).

The length of the necessary visibility, according to provision of the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016) is calculated according to the formulae:

$L_{ppp} = t_{pdv} \cdot V_{\check{z}} / 3.6$ [m]

$t_{pdv} = t_a + t_v$ [s]

$t_a = V_p / (3.6 \cdot a)$ [s]

$t_v = ((m+n+d+s)/V_p) \cdot 3.6$ [s]

wherein for the respective case:

1. For the direction of Donje Međurovo to Niš:

$V_{\check{z}} = 70$ km/h
$V_p = 4$ km/h
$a = 1$ m/s^2
$m = 9.98+0,8=10.78$ m
$n = 2+0.8=2.8$ m
$d = 25$ m

$t_a = 4$ km/h $/(3.6 \cdot 1$ m/s$^2) = 1.11$ s

$s = ((0+4)/(2$ km/h$\cdot 3.6) \cdot 1.11$ s $= 0.62$ m

$t_v = ((10.78$ m$+2.8$ m$+25$ m$+0.62$ m$)/4$ km/h$) \cdot 3.6 = 39.2$ s

$t_{pdv} = 1.11$ s $+ 39.2$ s $= 40.31$ s

$L_{ppp} = 40.31 \cdot 70$ km/h $/ 3.6 = 783.81$ m

Note: given that on the road in the direction from Donje Međurovo to Niš in front of the level crossing the traffic signs have been set (set on the same supporter) I-34: "Andrejin krst" and II-2: "Obligation of stopping", at calculating the value m the distance of the supporter where the aforementioned traffic signs have been set is taken, from the nearer rail of the railway line.

2. For the direction of Niš to Donje Međurovo:

$V_{\check{z}} = 70$ km/h
$V_p = 4$ km/h
$a = 1$ m/s^2
$m = 3+0.8=3.8$ m
$n = 2+0.8=2.8$ m
$d = 25$ m

t_a = 4 *km/h* /(3.6·1 m/s^2) = 1.11 *s*

s = ((0+4)/(2 *km/h*·3.6)·1,11 *s* = 0.62 *m*

t_v = ((3.8 *m*+2.8 *m*+25 *m*+0.62 *m*)/4 *km/h*)·3.6 = 32.22 *s*

t_{pdv} = 1.11 *s* + 32.22 *s* = 33.33 *s*

L_{ppp} = 33.33·70 *km/h* / 3.6 = 648.08 *m*

Note: given that on the road in the direction from Niš to Donje Međurovo in front of the level crossing the traffic sign denoting the point where the road crosses over the railway line has not been set (traffic sign I-34: "Andrejin krst"), at calculating the value m the value for the dangerous area boundary is taken, given in the Annex 5 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016)

Calculation of the necessary visibility is made according to the formulae given in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016). This has been made for the reason that the Rulebook is in force and in application.

We consider that the formula for calculating t_v is not correct.

Namely, according to the provisions of Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016), the formula for calculating t_v is given as follows: $t_v=((m+n+d+s)/V_p)\cdot 3.6$, where it is stated that s is the path the road vehicle crosses starting from point B to achieving a constant speed V_p, and t_v the time of driving the road vehicle from achieving a constant speed V_p to the crossing the dangerous area boundary with the rear part of the road vehicle. Therefore, it would be correct for the given formula to be *-s* instead of *+s*.

Calculation made with the corrected formula for t_v would give a shorter $L_{ppp.}$

According to the aforementioned calculation, in the event that the road vehicle stopped in front of the supporter where the traffic signs: I-34: "Andrejin krst" and II-2: "Obligation of stopping" have been set, it is required to secure such a necessary visibility that the driver of the road vehicle from that point must see the train that is on the railway line at a distance of 784m from the level crossing and nearer to the level crossing.

In the direction from the center of Donje Međurovo to Niš (the direction in which the road vehicle bus was moving) there is a necessary visibility in line with the provisions of the Article 2 Paragraph 1 under 12) of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016).

On the road from the direction of the center of Donje Međurovo in front of the level crossing the traffic sign II-30: "Speed limit" has not been set, which would, according to provision of the Article 15 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016), represent the beginning of the zone of necessary visibility. Given the existence of the facilities described in the Point 2.2.3. (the orchard and the fenced area), the zone of necessary visibility from the direction of Donje Međurovo to Niš is non-existent and

it cannot be secured without removing the aforementioned facilities, but the secure crossing of the road vehicle over the railway line is secured by existence of the necessary visibility.

Figure 3.4.2: Necessary visibility for the direction of drive of the train and direction of drive of the bus (source: *Google maps*)

According to the Letter JP “Directorate for construction of the city of Niš” No. 03-137/1 of 25.01.2019., the works of maintenance of the road of same category and the respective road was carried out by the contractor “M Univerzitet” Niš in accordance with the Agreement which was in force until 31.12.2018., while supervision over the performance of these works is carried out by JP “Directorate for construction of the city of Niš”. The enterprise in charge of maintenance of traffic signalization on the municipal roads and streets on the territory of the city of Niš is JKP “Parking Servis” Niš. The review of the condition of traffic signalization on the respective level crossing by JKP “Parking Servis” Niš is executed on 16.11.2018. and it is stated that the vertical traffic signalization was in the given moment complete and set according to the Rulebook on traffic signalization.

On-site investigation made by the CINS’ investigative team it was determined that traffic signalization on the respective level crossing was not complete (refer to paragraph 2.2.3.)

Between the joint stock company for managing the public railway infrastructure “IŽS“, in the capacity of the railway infrastructure manager and JP “Directorate for construction of the city of Niš“, in capacity of the road infrastructure manager and the city of Niš, in the capacity of financier, the Agreement on maintenance of the level crossing on local and uncategorized roads has been concluded (“IŽS“a.d. No. 1/2017-5393 of 13.09.2017., JP “Directorate for construction of the city of Niš“ No. 05-3991/17 of 11.09.2017, and RS, City of Niš, Mayor No. 3074/2017-01 of 15.09.2017.) The Agreement was concluded for an indefinite period. The Agreement regulates the type and scope of roads maintenance works, the amount of costs for ensuring safe and unobstructed traffic at the level crossings, the labour costs of railway workers performing level crossing works, the method of payment of these costs and other issues.

From “IŽS“a.d. (Sector for Construction Affairs) by Letter No. 20/2019-99 of 23.01.2019. the data has been submitted that on the respective level crossing in the previous year there have been no major construction works before occurrence of the respective serious accident. The works on fastening the accessories and cleaning of grooves as well as visual check of the condition of the level crossing have been made (which is recorded in the workbooks under No. 4591/102/7265 and dated 18.04.2018.) and measurement of the width and depth of the grooves for the passage of rail vehicles (which is recorded in the Record of the measurement of the width and depth of the

grooves for the passage of rail vehicles in the area of the ZOP Section Niš - track section Niš - Crveni Krst under ordinal No. 15 and dates 28.04.2018 and 12.10.2018.).

Regarding the maintenance of the infrastructure, at the level of "IŽS"a.d. there is no separate Program for dealing with the level crossings, but the priorities are planned within the works on the superstructure.

Railway infrastructure manager "IŽS"a.d. (Sector for Construction Affairs) has, by Letter No. 20/2019-99 of 23.01.2019., submitted the data that with the view to maintaining safety ZOP Section Niš sent Letter No. 20/2018-3.1-1963/1 of 02.11.2018. to the Manager of Road Infrastructure, JP "Directorate for Construction of the City of Niš" Nis on the obligation of maintaining transparency and supplementing the missing traffic signalization.

3.4.3. Means of communication

At the time of occurrence of the respective serious accident, in the area of the station Međurovo and on the section between the station Međurovo and Belotince crossing, the means of communication were operating and functional. On the means of communication, no faults or interferences have been recorded.

DMV 711-075/076 is not equipped with RDV devices.

3.4.4. Railway vehicles

At the time of occurrence of the respective serious accident, the train No. 7821 was moving in the direction from the station Međurovo to the Belotince crossing (from the start to the end of the railway line, in the direction of growing mileage).

The train composition consisted of DMV of series 711-075/076.

DMV series 711 of manufacturer "Metrovagonmaš"a.d. from Mitiščije, Russia, is intended for transport of passengers on standard gauge tracks of 1435 mm, equipped with low platforms. It functions as independent (autonomous) transport vehicle. DMV consists of two motor wagons, driven by a powertrain (diesel engine and hydraulic power transmitter). The interior is connected to one space unit with comfortable second-class seats (120 seats in total for sitting) and space intended for standing (126 places in total according to the criterion of 4 passengers/m^2). The passenger compartment is fully air-conditioned and equipped with security video surveillance.

In accordance with the Article 51 of the Law on Safety in Railway traffic ("Official Gazette RS" No. 41/2018) DMV series 711-075/76 is equipped with the device for giving the sound signals (siren).

On DMV 711-075/076 device for measurement and recording the speed type TELOC 1500 of manufacturer Hasler Rail, from Bern, serial No. 16065199 with speed indicating instruments serial No. 11022840 and 15109078 and speed encoder serial No. 11081700. For the aforementioned case, from "Srbija Voz"a.d. the Report on examination and check of the correctness of device for measurement and recording the speed TELOC 1500 of 31.03.2018 and Certificate No.59 on correctness of the measuring and recording device TELOC 1500 Annex 1 No. 2.34-ZA/2017-1522 of 29.12.2017. and Annex 2 No. 2.34-ZA/2017-1523 of 29.12.2017. have been submitted, confirming that electronic speeding device *TELOC 1500*, serial No. 16065199 is correct and in accordance with the Annex 6 of the Rulebook 230.

Processing the data taken from the memory of the electronic speeding device DMV 711-075/076 (document Data from the speeding tape No. 33/2019-199 of 22.01.2019, submitted by "Srbija Voz"a.d.), it is determined that the train No. 7821 departs from the station Niš at 07:17:18 (km 243+718) and it stops at Međurovo station at 07:25:07 (km 249+462). On the route Niš - Međurovo, the train speed is between 12 and 71 km/h. From station Međurovo the train No. 7821 departs at 07:25:39 and accelerates. At 07:26:27 (about km 250+039) at a speed of 68 km/h, the driver starts fast braking with a pneumatic brake. At 07:26:27 (about km 250+045), at 67 km/h, the driver will operate the siren button. At 07:26:28 (about km 250+055), at the speed of 67 km/h the driver enters the braking with the hydropneumatics brake and serves the "danger" button. At 07:26:28 (about km 250+061) at 66 km/h the driver shuts off the traction. At 07:26:37 (about km 250+123) the train stops. Kilometre positions are given in relation to the Međurovo station facility (km 249+462).

3.5. Traffic operation and management

3.5.1. Actions taken by the staff that manages traffic regulation, control and signalling

The traffic of the train No. 7821 from the station Međurovo and Belotince crossing was operating in block department. The train No. 7821 has been, after finishing handling of the passengers, from the station Međurovo dispatched regularly (by aspects of signal of the train dispatcher and the aspects of signal of the exit signal).

Train staff, via accompanying documents, received orders and notifications on the train traffic on this section.

3.5.2. Exchange of voice messages in relation to the serious accident

Immediately before the occurrence of the respective serious accident, verbal communication between the staff that regulates the traffic (train dispatcher) and the train driver has been achieved, with the view to handling the passengers during the regular operation of the train No.7821 in the station Međurovo and its dispatch in the direction to the Belotince crossing. From the dispatch of the train No.7821 from the station Međurovo to the occurrence of the respective serious accident there was no communication between the train driver and the staff that regulates the traffic.

Communication between the staff that regulates the traffic and the train driver was not achieved even after the occurrence of the respective serious accident.

The train dispatcher at Međurovo station first received information about the serious accident audibly (he heard the blunt hit caused by overtaking of the train on the bus), then visually (he noticed that the train was standing at the height of the level crossing) and verbally (information received from the train dispatcher intern which he has sent on the site). Based on the information gathered, the train dispatcher of the station Međurovo informed the Senior Dispatcher and TK dispatcher in the Operations Department Niš and the station chief about the serious accident occurred.

The train conductors from the train No. 7821 notified an ambulance of a serious accident occurred by calling from a mobile phone network.

Train driver of the train No. 7821 informed the police of a serious accident occurred, by calling from a mobile phone network.

3.5.3. Measures taken to protect and secure the place of serious accident

After the occurrence of the serious accident, section of the main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), between the station Međurovo and Belotince crossing was closed for traffic.

The protection and security of the site of the serious accident (securing conditions for the operation of emergency and rescue services that provided assistance to the injured and the securing and protecting the evidence) were carried out by members of the PU Niš.

No other measures have been taken to secure the site of a serious accident.

3.6. Interface between men, machine and organisation

3.6.1. Working hours of the staff involved

For the railway staff, data was submitted based on which it is clear that the train driver and the conductors of the train No. 7821 had legally stipulated rest before coming to work and that on work they did not spend a period longer than the maximum specified by law.

3.6.2. Health-related and personal circumstances that have effects on the accident, including the presence of physical or mental stress

For railway staff data were submitted which show that the train driver and the conductors of the train No. 7821 were trained and medically fit to perform the job. The train driver of the train No. 7821 has the license to operate the traction vehicle No. RS 714 2017 0440 issued by the Railway Directorate on 01.01.2017. valid until 18.09.2022. and Additional Permit to operate certain types of traction vehicles on certain infrastructures No. 041335 issued by "Srbija Voz" a.d. 01.01.2017, valid until 18.09.2022., confirming that the train driver is authorized to drive (the traction vehicle) DMV of series 711 on lines 9.3.1 Niš - Tabanovce and 9.3.2 Niš - Doljevac - Merdare.

A blood sample was taken from the train driver at the request of the Deputy Public Prosecutor from OJT Niš for analysis of the presence of alcohol. In the blood sample taken from the driver, no alcohol was detected by analysis.

3.6.3. Design of the equipment that has influence on the interface between user and machine

The main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), between the station Međurovo and Belotince crossing is designed so that by all parameters satisfies the criteria for safe traffic of trains with the speeds regulated by the Timetable Booklet.

According to the designed condition, there are APB devices switched on the TK devices in TK Center Niš. The station Međurovo is a border station on TK line and is operated by the train dispatcher. Traffic on this section, from the central position is regulated by TK dispatcher at the position TK Jug at TK Center Niš in cooperation with train dispatcher of the station Međurovo.

For the purpose of traffic regulation, spatial and protective signals have been installed on the section of the railway line between the Međurovo station and the Belotince crossing showing bisemic aspects of a signal.

On the section of the railway line between Međurovo station and Belotince crossing, communication between railway traffic control staff and traction vehicle staff is made by telephone via a local TT connection.

This line is also equipped with functioning RDV devices that enable communication between the traction vehicle staff and the TK dispatcher (Note: DMV series 711s are not equipped with RDV devices).

Managing the DMV series 711 is operated by the train driver via controls from the driver's cabs designed upon manufacture of DMV. On DMV 711-075/076 any complaints or irregularities observed on the systems and controlling devices have not been recorded.

3.7. Previous accidents of similar nature

Based on data obtained from the "IŽS"a.d. (Letter No. 1/2019-1449 of 23.05.2019), for the period between 01.01.2006. and 21.12.2018., on the main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), on the level crossing in the area of the station Međurovo, at km 250+065, there has been an emergence of four (4) accidents. A review of the accidents occurred on the respective level crossing in the mentioned period is given in Table 3.7.1.

Table.7.1: Review of the accidents occurred on the level crossing in the area of the station Međurovo at km 250+065 in the period from 01.01.2006. to 21.12.2018.

Ordinal No.	Date	Time	Short description	Fatally injured	Injured
1	18.07.2008.	23:05	Overtaking of the train No. 11392 (just loc.461-203) on the road passenger vehicle.	-	1
2	07.03.2009.	22:56	Overtaking of the train No. 44705 on the road passenger vehicle.	-	-
3	25.12.2009.	20:45	Overtaking of the road passenger vehicle on the train No. 34907 (just loc.444-018).	-	1
4	15.07.2013.	14:07	Overtaking of the train No. 4909 on the road passenger vehicle.	1	-

The cause of all the aforementioned accidents is the negligence of the drivers of the road vehicles. All the fatally injured and injured persons were in road vehicles.

4. Analyses and conclusions

4.1. Final review of the course of events and adoption of conclusions about the occurrence based on facts determined during the investigation and interviews

On 21.12.2018. at 07:30 at the level crossing at km 250+065 of the main arterial route *E 70/E 85*: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce), it came to the overtaking of the train No. 7821 (DMV 711-075/076) on the road vehicle bus of brand Mercedes Benz type O 530 of license plate NI 152-ŠJ.

The serious accident occurred at a level crossing located in the area of the Međurovo station, at the station part of the track, in the settlement of Donje Međurovo. The level crossing is provided with traffic signs on the road and an area of necessary visibility. The railway line is main arterial, single-track and electrified.

The road is one of the local roads of the city of Niš (second class municipal road No. 4), which connects the city with the settlement of Donje Međurovo on the territory of the Palilula municipality. The local road is made of asphalt pavement. The driveway at the mere crossing is made of well-fitted and levelled wooden sleepers. In the zone of the level crossing, the road pavement width is 5.50 m, while the width of the crossing itself (the part paved with wooden sleepers) is 7.50 m. The condition of the asphalt pavement near the road crossing is tidy, with no damage observed. At the time of the accident, the pavement was cleared of snow and sprayed with ridge.

At the respective local road, from the direction of Donje Međurovo, before entering the level crossing on the supporter on the right side of the road, beside the roadway, the following traffic signs were set: I-33: “Crossing the road with the railway line without barrier or semi-barrier” (at a distance of 240 m from the level crossing) and I-35: “Approaching the point of crossing of the road and the railway line” (at distances of 240 m, 160 m and 80 m from the level crossing). Traffic sign: I-35: “Approaching the crossing of road and railway line”, placed at a distance of 80 m from the level crossing, was set improperly (facing the opposite direction from which road vehicles come). On a separated supporter, which is located 9.98 m away from the nearest railroad track, traffic signs were placed: I-34: “Andrejin krst” and II-2: “Obligation of stopping”. Other traffic signs were not set on the local road before entering the level crossing from the direction of Donje Međurovo.

There is a properly set signalling mark 209: “Watch out, level crossing” on the railway line from the Belotince crossing. From the direction of the station Niš, no such signalling mark existed, which is in contradiction with the provisions of Article 46 of the Signalling Rulebook (“Official Gazette of ZJŽ” No. 4/96 and 5/96). The track and the road intersect at 90º.

No speed limit sign was posted on the local road from the center of Donje Međurovo which, according to the provisions of Article 15 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic (“Official Gazette RS”, No. 89/2016) represents the beginning of the zone of necessary visibility, but immediately before the level crossing, traffic signs were set: I-34: “Andrejin krst” and II-2: “Obligation of stopping”. The driver of the road vehicle bus was obliged to stop the vehicle in front of traffic sign II-2: “Obligation of stopping” and to make sure that the train was approaching. From where the traffic sign was placed, the driver of the road vehicle bus had the opportunity to spot the oncoming train in a timely manner.

At the time of occurrence of the respective serious accident, the temperature was about -4ºC, the weather was partly cloudy, visibility was good, light fog was observed. The road in the level crossing area was not illuminated.

The road vehicle bus was moving from the center of Donje Međurovo to Niš. The train was coming from the direction of Niš and was approaching the road vehicle on the left (seen in the direction of movement of the road vehicle bus). According to his own statement, "the driver gave an aspect of a signal:" Watch out" in the area of the exit switches with the front siren of the train, after which he noticed the movement of the bus with the evaluation that the bus will not stop in front of the level crossing, he introduced the fast braking and emergency braking at the speed of about 65 km/h". The first conductor wrote in the Irregularities Report on the work of the conductor (K-91): "I examined the train tickets and heard that the driver was giving a siren because of the crossing. After a long siren, I suddenly felt the train brake". The Final Conductor wrote in the Irregularities Report on the work of the conductor (K-91): "Just after leaving Međurovo station, I heard intense siren, braking and finally a hit".

In the document Speedometer Data No. 33/2019-199 of 22.01.2019. submitted by "Srbija Voz"a.d, it can be stated that just before the occurrence of this serious accident, the train driver of the train No. 7821 at the speed of 68 km/h first started fast braking with a pneumatic brake, then operated the siren button, started braking with a hydropneumatics brake, operated the "Danger" key and switched off traction. From the introduction of fast braking brakes until the traction was switched off, it took 2 s, for which the train had travelled about 22 m.

In this serious accident, 7 (seven) persons were fatally injured, 19 (nineteen) persons sustained serious injuries and 17 (seventeen) persons sustained light injuries. The interruption of railway traffic lasted from 07:30 to 17:30. There are damages to the DMV 711-075/076. The damage to the road vehicle bus is total.

4.2. Discussion - Analyses of facts determined during the investigation and interviews with the view to drawing conclusions regarding the causes of the serious accident and effect of rescue services

4.2.1. Analysis of movement of the train and road vehicle

4.2.1.1. General data

The train No. 7821 on 21.12.2018. operated in the composition of DMV of series 711-075/076.

The DMV 711-075/076 is equipped with a speedometer recording device with a memory electronic card on which the registered data is provided. It is an electronic register device manufactured by Hasler Rail - Bern type TELOC 1500. In this regard, the provisions of the Instructions 230, the Instruction on the operation of the high-speed device on traction and other vehicles and the processing of the registration tape ("Official Gazette of the ZJŽ" No. 6/80, 8/90 and 4/05) apply, in particular Annex 6 of the aforementioned Instruction.

4.2.1.2. Basic data

Basic data that are properly registered on the speed record of DMV 711-075/076 show the following condition:

- Part of the speeding record under consideration relates to the day 21.12.2018.,
- Part of the speeding record under consideration relates to the train No. 7821,
- The analysed part of the speeding record refers to the part of the transport route from km 243+718, which corresponds to the station area of the station Niš, that is, the place of departure of the train from the departure station to km 250+123, which corresponds to the location on the station part of the track in the area of block 2 of the station Međurovo, at which the DMV, after hitting the bus and the resulting derailment of the first part of the DMV, stopped. The stopping point is 59.8 m from the mileage of the crossing, which corresponds to the point identified by the MUP RS criminal technician, determined on the site during on-site investigation.
- Managing the DMV was constantly done by the train driver with the personal No. 0440,
- Starting station of the train is the station with the code 4102, which corresponds to the station Niš,
- Direction of the drive was “Forward” and was not changed during the train traffic.

4.2.1.3. The speed of the train 7821

The speed of the train is recorded on the speeding record. The analysis of this data shows the following:

- The maximum speed of train No. 7821 of 70 km/h was not exceeded when the train was moving, which was in accordance with the text of the timetable, that is, it was in accordance with the allowed tolerances of 2%. The highest train speed of 71.28 km/h was achieved on the section from km 247+153.8 to km 247+237.5, which corresponds to the open line at the distance between stations Niš - Međurovo. This condition represents a length of 83.7 m with a duration of 4.26 s. It is emphasized that the speed is within the permitted tolerances of 2% (a consequence of the change of wheel range, the tolerance allowed for the speedometer device and the tolerance applicable for drive under automatic control of train speed).
- In all respects, the driver complied with the speed limit over the switch areas of the station Niš from 20 km/h and 50 km/h at the station Međurovo, which is in accordance with the text of the timetable. Similarly, for example, in the area of exit switches of block 2 of Međurovo station, the train speed was between 35.73 km/h and 38.71 km/h (train accelerating),
- train acceleration analyses after the departure of the train from Niš and Međurovo stations are orderly and there are no irregularities or inconsistencies with regard to the driver's regular procedures, that is, regular and usual acceleration of the train,
- analysis of train deceleration while stopping at Međurovo station where regular train operation is envisaged is orderly and without irregularities or inconsistencies, that is, corresponds to the regular course of train stopping,

- train handling at the Međurovo station, where the train schedule envisaged regular train handling for the purpose of passenger handling (the Timetable Booklet 9.3 provides for a 1 minute duration), which was respected and lasted from 7: 25: 07.020 to 7:25: 39.120 which is just over half a minute,
- on the section of the railway line from the station Međurovo to the place of occurrence of the serious accident, i.e. the hit of the train on the bus, the speed of the train is in accordance with the text of the timetable and at no time was greater than 68.35 km/h. At this speed, the train was moving even at the moment it was at a distance of about 7.8 m ahead of the point of hit on the bus. Before that, the train was moving at a speed for 27.6 m (took about 2.5 s). At 7.8 m before the hit of the train head into the side of the bus, the speed of the train begins to decrease, falling from 68.35 km/h to 66.99 km/h. At the moment of the hit, the speed of the train is currently falling from 66.99 km/h to 64.64 km/h,
- This is followed by a further decrease in speed, which is obviously abrupt and is a consequence of irregular movement of the train after the overtaking and derailment.

4.2.1.4. Handling of the train brakes

On the speeding record the data on pressures in the main air duct and pressures in the brake cylinders and data on the traction and braking of the train are duly recorded. The analysis of these data shows the following facts:

- traction of the train, especially in starting conditions from Niš and Međurovo stations and regulating the regular speed of the train, was carried out without any disorder or irregularities in relation to the regular and normal condition;
- the main air pipe of the train was correct and functional without significant drops or changes in pressure, and obviously the pressure was regularly supplemented so that no irregularities or inconsistencies were involved in the process;
- the pressure in the brake cylinders was varied according to changes in the pressure in the main pipe and the changes were in accordance with the normal functioning of these facilities,
- the braking of the train and its stopping at the Međurovo station was carried out by gradual braking, whereby the pressure in the main air pipe was reduced or maintained in accordance with the functioning of the hydrodynamic, i.e. pneumatic brake, and there were no irregularities or inconsistencies in this domain, neither in the functioning of the technical system nor in the mode of operation by the train driver,
- related to the course of use and operation of the brakes on the train just before the occurrence of a serious accident, it is seen that the braking was introduces to about 29 m in front of the point of hit of the train on the bus, when the pressure in the main duct is currently falling from 5.126 bar to 4.758 bar, followed by a pressure rise in the brake cylinders causing a decrease in speed. Obviously, this is a fast braking that is started by a hydrodynamic brake and a fast braking procedure by a pneumatic brake.

4.2.1.5. The use of locomotive siren

The use of the locomotive siren is also registered in the memory of the speedometer, and in this regard it can be seen that the locomotive siren was used only once on the part of the transport route from the station Niš, that is, the departure station of train No. 7821 to the point of stopping of DMV after the occurrence of the accident (just before overtaking of the train on the bus), even though between the stations Niš and Međurovo there are two level crossings and two bridges (refer to paragraph 2.2.3.), where, according to provisions of the Article 29 of the Signalling Rulebook ("Official Gazette ZJŽ" No. 4/96 and 5/96) there is an obligation of giving the aspect of a signal 67:"Watch out" by the locomotive siren.

The locomotive siren on train No. 7821 was used with a duration of about 1.5 s, where the DMV crossed the path of about 25.8 m, moving at a speed that decreased from 68.35 km/h to 64.64 km/h. The start of use of the locomotive siren was approximately 22.6 m before the point of hit of the DMV head on the left side of the bus, or slightly more than 1 s before hitting the bus at a speed of 68.35 km/h. The locomotive siren was also used at the time when the train struck the bus, that is, at the time of the train speed drop to 64.64 km/h with a duration of just under 0.5 s after the hit into the bus.

Such use of the locomotive siren was not in accordance with the provisions of Article 29 under B Point 11 under a), k) and lj) of Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96) (refer to paragraph 3.3.6.).

4.2.1.6. Serving the alertness device

The use of DMV alertness device is also registered in the speedometer memory. It can be seen that the alertness device from the departure station Niš to the place of the occurrence of a serious accident at the level crossing was in use and served 48 times. The alertness device was serviced at the prescribed intervals with the duration of service so that there was no disorder or irregularity. The alertness device did not work for a moment, which means that the driver properly maintained this safety device on the train. For the last time before a serious accident occurred, the alertness key was operated at about 29 m ahead of a train hit into a bus with a duration of just under a second.

4.2.1.7. Using the danger key

The use of the danger key is also registered in the memory of the speedometer. An analysis of that part of the speeding record shows that this button was used by the driver in the respective case, and it was at about 16.7 m after the end of the fast braking process, which corresponds to a distance of about 12.0 m ahead of the point of hit of the train on the bus. Based on the available documentation, it is not possible to determine the manner of movement of the road vehicle immediately prior to the occurrence of a serious accident.

4.2.2. Analysis of the effect of rescue services

To assist the injured in this serious accident, members of the Institute for Emergency Medical Services Niš and members of MUP RS, Sector for Emergency Situations, Emergency Management in Niš came to the site.

The first team of the Institute for Emergency Medical Services Niš arrived on the site 3 (three) minutes from the received call via the number "194". 9 (nine) medical field teams (doctor, nurse-technician and driver) and 2 (two) ambulance vehicles (nurse-technician and driver) came to the site. A total of 23 patients were examined. Three patients died on the spot, that is, immediately after the injury. Twenty patients were examined, treated according to the doctrines of emergency medicine, of which 19 (nineteen) were transported to the appropriate clinics of the University Clinical Center Niš, depending on the injury.

13 (thirteen) officers of the Niš Fire and Rescue Brigade, Niš Emergency Management Directorate with 5 (five) vehicles (three fire trucks and two off road vehicles) arrived at the site. The Niš Fire Brigade crew released a person stuck in the bus seat with the help of a hydraulic breaker, pulled one injured person out of the bus and pulled one injured person under the train. All the injured were taken by an ambulance team. Following the release and care of the injured, two fatalities were pulled under the train.

After taking care of all the injured and removing the fatally injured persons, the Niš Fire and Rescue Brigade, with the help of pneumatic pillows, performed the lifting of one part of the bus to check that there were no persons under the bus. Environmental checks were carried out as well as the entire train check.

4.2.3. Inspection control

CINS, pursuant to the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS", No. 66/15 and 83/18), by letter No. 340-00-1/2018-2-11 of 09.01.2019. addressed to the Ministry of Construction, Transport and Infrastructure, Inspection Division, Railway Inspection Group and letter No. 340-00-1/2018-2-12 of 09.01.2019. addressed to the Ministry of Construction, Transport and Infrastructure with a request to submit the following:

- how many inspections (regular, extraordinary, control and additional) were carried out at the respective level crossing located at km 250+065,68 of the E70/E85 main arterial route: Belgrade - Mladenovac - Lapovo - Niš - Preševo - state border - (Tabanovce) and

- for each inspection performed, submit the Record on Inspection Report and Decision on the ordered measures (if any).

CINS did not receive the answers to the Letters.

4.3. Conclusions on the causes of the serious accident

4.3.1. Direct and immediate causes of the accident

The direct and immediate cause of the serious accident is that the road vehicle bus was found on the track immediately before the train arrival, thus, creating a dangerous situation related to the occurrence of this serious accident.

4.3.2. Basic causes deriving from skills, procedures and maintenance

The basic cause of the serious accident is non-compliance with the provisions of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision of the US, 55/2014, 96/2015 - other law, 9/2016 - decision of the US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) by the bus driver.

The fact that the prescribed zone of necessary visibility was not provided (but there was a necessary visibility, refer to paragraph 3.4.2) does not in any way diminish the obligation of the driver of the road vehicle bus, as he was obliged to obey the traffic signs I-33: "Crossing the road with the railway line without barrier or half-barrier", I-35: "Approaching the point of crossing of the road and the railway line", I-34: "Andrejin krst" and II-2: "Obligation of stopping", to stop and make sure that whether the train was approaching, and what the necessary visibility existence allowed to him.

On the line, before approaching the respective level crossing from the direction of the station Niš to the station Međurovo, that is, to the Belotince crossing, in front of the first entrance switch on the entering side of the station Međurovo, in the direction of the train movement, signalling mark 209:"Watch out, level crossing" is not set in accordance with provisions of the Article 46 of the Singalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96). Not setting of this signalling mark in the manner prescribed by provisions of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96) could have contribute to the situation that the train driver, in front of the respective level crossing, not give an aspect of a signal 67 "Watch out", as determined by the provisions of the Article 29 under B, Point 11 under v) and Article 46, Point 5 of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96).

As the speedometer equipped with the DMV 711-075/076 records the use of the locomotive siren, it can be reliably established that the train driver did not give the aspect of a signal 67: "Watch out" in the manner prescribed by the Article 29 under B, Point 11 under a), k) and lj) of the Signalling Rulebook ("Official Gazette of the ZJŽ" No. 4/96 and 5/96). Bearing in mind the fact that the train driver was familiar with the line on which he had driven the train, he had the possibility that, nevertheless that the signalling mark 209: "Watch out, level crossing" was not set, by giving the aspect of a signal 67: "Watch out" warn on the arrival of the train. Not giving this aspect of a signal in the manner prescribed by the provisions of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96) may have contributed to the occurrence of this serious accident.

4.3.3. Main causes deriving from legal framework and safety management system

N/A.

4.3.4. Additional observations on deficiencies and shortcomings established during the investigation, but without relevance for conclusions about the causes

According to the provisions of Article 153, paragraph 2 of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018), at the crossing of the road with the modern pavement (asphalt, concrete, cube, etc.) over the railway line traffic lights announcing the approach of the train must be set. In the present case, the road was with an asphalt pavement curtain, and in the area of crossing of the road through the railway line, no traffic lights were set to announce the approach of the train.

Provision referred to in Article 153, Paragraph 2 of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law , 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018), does not exist in the Law on Railway Safety ("Official Gazette of RS" No. 41/2018) and Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" 89/2016). Article 97, paragraph 1 of the Law on Railway Safety ("Official Gazette of RS", No. 41/2018) provides that the conditions for crossing the railway and road, with regard to the place where the crossing can be carried out and measures for the safe operation of road traffic on the level crossings depend on traffic density, rail line transparency, speed on the railway and road, and on local conditions.

Provision from Articles 10 and 11 of Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" 89/2016) defines that the measures to ensure safe traffic at level crossings depend on traffic density, railway line transparency, line speed and road and on meat conditions in accordance with the law governing railway safety and interoperability and that road signs and the necessary visibility zone provide safe traffic at the point of crossing of the railway and the road at the level of the track, if the maximum permitted speed on the line is up to 100 km/h and if the traffic safety at the crossing is not carried out: by light traffic signs and traffic signs along the way; automatic semi barriers with light traffic signs and traffic signs on the road or barriers and traffic signs on the road. This ordinance does not prescribe the obligation to place traffic lights announcing the approach of a train, depending on the type of pavement.

In the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" 89/2016) the provisions relating to point B of Article 14 (the point in front of the traffic sign indicating the point where the road crosses the railway) and Article 15 (the place of the road where the necessary visibility zone begins) are inconsistent with each other and with the content of Annex 6 of the same Rulebook. In the drawing in Schedule 6, point B is marked next to a traffic sign indicating the place where the road crosses the railway (traffic sign: I-34: "Andrejin krst") and traffic sign: II-2: "Obligation of stopping", while in the text below the drawing in Annex 6 states that point B is located along the stopping distance of the road vehicle in front of the traffic sign marking the point of crossing the road over the railway (traffic sign: I-34: "Andrejin krst").

In the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" 89/2016), the formula is given and the methodology for calculating the value (length) of required visibility (L_{PPP}),) is accurately explained, but the methodology for

determining (calculating) the elements of the required transparency zone given in Annex 9 (d_{pz} - stopping length of the road vehicle and $S_{pžv}$ - approaching length of the railway vehicle is not explained).

For traffic sign II-2: "Obligation of stopping" in Article 33, paragraph 1, under 2) of the Rulebook on traffic signalling ("Official Gazette of RS", No. 85/17) is defined to be placed in the immediate vicinity of the crossing, preferably at a place of transparency, at which the vehicle must stop to give passage to other vehicles which are on its way. According to Article 25, paragraph 1, under 2) of the same Rulebook, the traffic sign II-2: "Obligation of stopping", indicates an order to the driver to stop the vehicle and to give passage to the vehicles on which it encounters.

At the level crossing in question, traffic sign II-2: "Obligation of stopping" is placed in front of the crossing of the road in a level on the same supporter with the traffic sign I-34: "Andrejin krst" (at the place beyond which there is no crossing). Such placement of the aforementioned traffic sign is not in accordance with the provision of Article 33, paragraph 1, under 2) of the Rulebook on Traffic Signalling ("RS Official Gazette", No. 85/17).

Fully respecting the provisions of Articles 100 and 132 paragraph 4 of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other Law, 9/2016 - US Decision, 24/2018, 41/2018, 41/2018 - other Law and 87/2018) and Article 17, Article 18 Paragraph 1 under 28), 29) and 30) and Article 23 paragraph 1 under 5), 6) and 7) of the Rulebook on traffic signalling ("Official Gazette of RS" No. 85/17) we consider that at the crossings of the road over the railway line, in addition to the setting of danger signs, placement of the traffic sign II-2: "Obligation of stopping" (which is an explicit character order that informs road users of prohibitions, restrictions and obligations) would have a positive effect on the safety of both types of traffic (rail and road), especially in cases where level crossing the road over a railway line secured by road signs and with the required zone of necessary visibility, there is the required visibility, but it is not possible to provide the zone of necessary visibility.

5. Measures taken

Following the occurrence of the respective serious accident, the track construction of wooden sleepers on the road crossing was replaced with rubber panels (letter "IŽS"a.d, Sector for Construction Affairs No. 20/2019-99 dated 23.01.2019).

Preliminary design for reconstruction of the Niš - Preševo - state border - (Tabanovce) railway line, section Niš - Brestovac from km 244+600 to km 267+430, which was approved for financing from IPA Fund grants (letter "IŽS"a.d. Development Sector No. 26/2019-78 dated January 29, 2019), a technical solution is designed to secure the respective road crossing with a modern electronic device with half-barriers, road light and sound signals and switching points for automatic switching on and off of the device by the train. and the control of the road crossing was foreseen in the station Međurovo.

At the request of CINS, "IŽS"a.d. electronically submitted information on 04.10.2019. that after the occurrence of the respective serious accident, the security level was increased, and the level crossing was arranged. Installation of a pushbutton electronic device, light road signalling, road barriers, video surveillance and light was carried out. The crossing is operated by the crossing guard. After raising the security level, the crossing was put into operation on 04.01.2019. at 15.00.

6. Safety recommendations

Aiming to achieve the possible improvement of railway safety and to prevent occurrence of new accidents, CINS has issued the following safety recommendations:

Ministry of Construction, Transport and Infrastructure:

SR_24/19 Ministry of Construction, Transport and Infrastructure, that in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), defines methodology (the manner) of determining (calculating) the elements of the zone of necessary visibility given in Annex 9 (d_{pz} - the length of stopping of the road vehicle and $S_{pžv}$- the length of approaching of the railway vehicle).

SR _25/19 Ministry of Construction, Transport and Infrastructure, that in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), defines the procedure when there exists a necessary visibility according to the definition from the Article 2 Paragraph 1 under 12) of this Rulebook and it is not possible to determine the zone of necessary visibility. In particular, it should be borne in mind that by setting the traffic sign II-2: "Obligation of stopping", while providing the necessary visibility, enables the safe passage of road vehicles over the crossing.

SR_26/19 Ministry of Construction, Transport and Infrastructure that in the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), makes corrections in the expression:

$$t_a = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

so that in front of s there is a sign "-", and not the sign "+" (refer to paragraph 3.4.2).

SR_27/19 Ministry of Construction, Transport and Infrastructure that in the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), harmonize the description of the position of point B given in Article 14, Article 15 and Annex 6 (refer to paragraph 4.3.4).

SR_28/19 Ministry of Construction, Transport and Infrastructure that makes amendments to the Rulebook on traffic signalling ("Official Gazette RS", No. 85/17) which would allow the instalment of traffic sign II-2: "Obligation of stopping", and in front of the crossing of the road over the track in the level, with the purpose of stopping the occurrence of the new similar accidents and improvement of traffic safety (refer to paragraph 4.3.4.).

SR_29/19 Ministry of Construction, Transport and Infrastructure to consider the possibility that in the Law on traffic safety on the roads ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) Article 153 Paragraph 2 to harmonize with the Article 97 Paragraph 1 of the Law on safety of railway traffic ("Official Gazette RS", No.41/2018) in terms of more precise provisions for the installation of traffic lights (refer to paragraph 4.3.4.).

Directorate for Railways:

SR_30/19 "IŽS"a.d. to conduct expertly based risk assessment on level crossings. Given that the accidents on the level crossings (by reviewing every crossing individually) are rare events, it is not possible to assess risk solely on the number of accidents which occurred on the individual level crossings. Risk assessment, as a precautionary measure, should be made jointly for all level crossings in accordance with all relevant parameters, whether the accidents occurred or not.

SR_31/19 "IŽS"a.d. to make the act "Level Crossing Program" according to the previously done risk assessment on the level crossings with a view to undertake appropriate activities in order to raise the level of traffic safety.

SR_32/19 "Srbija Voz"a.d. to carry out part-time training of traction vehicle staff in the proper implementation of the aspect of a signal 67: "Watch out", in accordance with provisions of the Signalling Rulebook ("Official Gazette of ZJŽ" No. 4/96 and 5/96), with the purpose of the proper application of railway regulations, which has an aim of preventive actions for preventing the circumstances that could contribute to the occurrence of the new similar accidents and improvement of safety in the railway traffic.