REPUBLIKA SLOVENIJA
MINISTRSTVO ZA INFRASTRUKTURO

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ANNUAL REPORT OF THE INVESTIGATION BODY FOR RAIL TRANSPORT OF THE REPUBLIC OF SLOVENIA FOR 2019

Ljubljana, 18 September 2020

INTRODUCTION

The investigation body in rail transport investigates accidents and incidents in order to improve railway safety and prevent future accidents.

Since 15 June 2018, the investigation body has operated in accordance with Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety, which was transposed into the legal order of the Republic of Slovenia with the provisions of the Railway Traffic Safety Act published in the Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018.

The annual report on safety investigations in rail transport in the Republic of Slovenia for 2019 includes a presentation of the body's organisation, legal bases for its actions, an overview of accidents and incidents investigated and recommendations issued and accepted in 2019.

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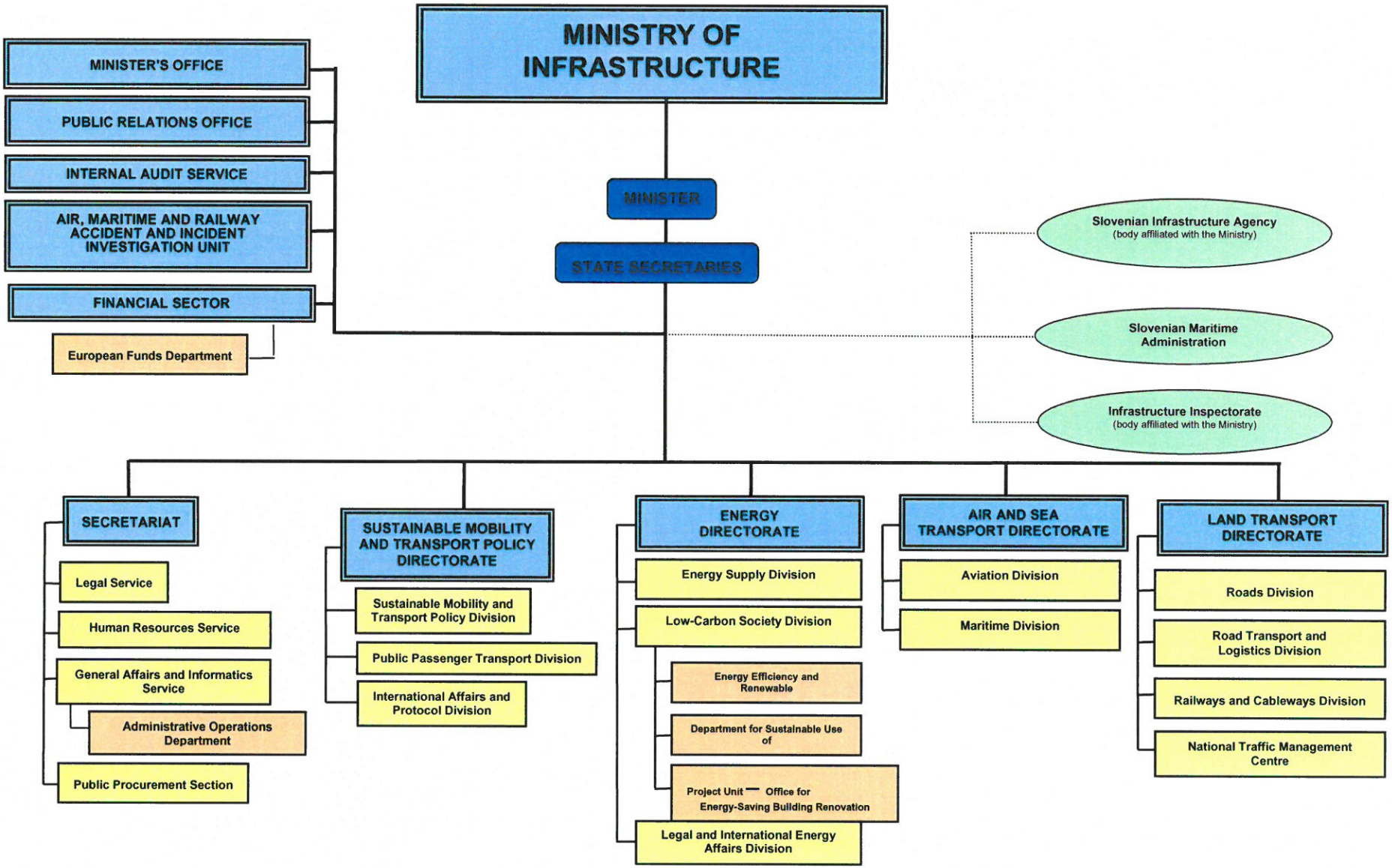
1 PRESENTATION OF SAFETY INVESTIGATION ORGANISATION

Since 22 February 2017, the investigation body in rail transport of the Republic of Slovenia has been operating within the Air, Maritime and Railway Accident and Incident Investigation Unit of the Ministry of Infrastructure, which answers directly to the ministry management. Since its establishment in 2008 and until 22 February 2017, the investigation body has operated as an independent organisational unit, the Railway Accident and Incident Investigation Service.

The investigation body for railway accidents and incidents of the Air, Maritime and Railway Accident and Incident Investigation Unit employs one person, who in addition to investigation, performs other tasks subject to cooperation in the network of EU investigation bodies under the auspices of the European Union Agency for Railways (ERA).

The investigation body in rail transport is organisationally independent from the national safety and regulatory authority in rail transport. The financial resources for its operation are earmarked in the budget.

The head office of the Air, Maritime and Railway Accident and Incident Investigation Unit is at the Ministry of Infrastructure, Langusova ulica 4, Ljubljana.


MINISTRY OF INFRASTRUCTURE
MINISTER'S OFFICE
PUBLIC RELATIONS OFFICE
INTERNAL AUDIT SERVICE
AIR, MARITIME AND RAILWAY ACCIDENT AND INCIDENT INVESTIGATION UNIT
FINANCIAL SECTOR
European Funds Department
MINISTER
STATE SECRETARIES
Slovenian Infrastructure Agency (body affiliated with the Ministry)
Slovenian Maritime Administration
Infrastructure Inspectorate (body affiliated with the Ministry)
SECRETARIAT
Legal Service
Human Resources Service
General Affairs and Informatics Service
Administrative Operations Department
Public Procurement Section
SUSTAINABLE MOBILITY AND TRANSPORT POLICY DIRECTORATE
Sustainable Mobility and Transport Policy Division
Public Passenger Transport Division
International Affairs and Protocol Division
ENERGY DIRECTORATE
Energy Supply Division
Low-Carbon Society Division
Energy Efficiency and Renewable
Department for Sustainable Use of
Project Unit — Office for Energy-Saving Building Renovation
Legal and International Energy Affairs Division
AIR AND SEA TRANSPORT DIRECTORATE
Aviation Division
Maritime Division
LAND TRANSPORT DIRECTORATE
Roads Division
Road Transport and Logistics Division
Railways and Cableways Division
National Traffic Management Centre

1.1 Legal basis (or legal framework)

The legal basis for the operations of the investigation body in rail transport is stipulated by the provisions of Article 19 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018).

The investigation body in rail transport is organisationally, financially and legally independent from the public railway infrastructure manager, railway undertakings, the charging body, the allocation body and the notified body.

The investigation body is also functionally independent of the safety and regulatory authority.

1.2 Role (description of the term) and objective (or mission)

The investigator-in-charge of railway accidents and incidents at the ministry of the Republic of Slovenia responsible for transport is appointed permanently by a contract and conducts safety investigations of serious accidents, other accidents and incidents.

Investigations of serious accidents, other accidents and incidents in rail transport are conducted to improve safety in rail transport. The investigator-in-charge of railway accidents and incidents at the ministry of the Republic of Slovenia responsible for transport cooperates with the investigation bodies of other railways within the EU and in the network of national investigation bodies that operates under the auspices of the European Railway Agency (ERA).

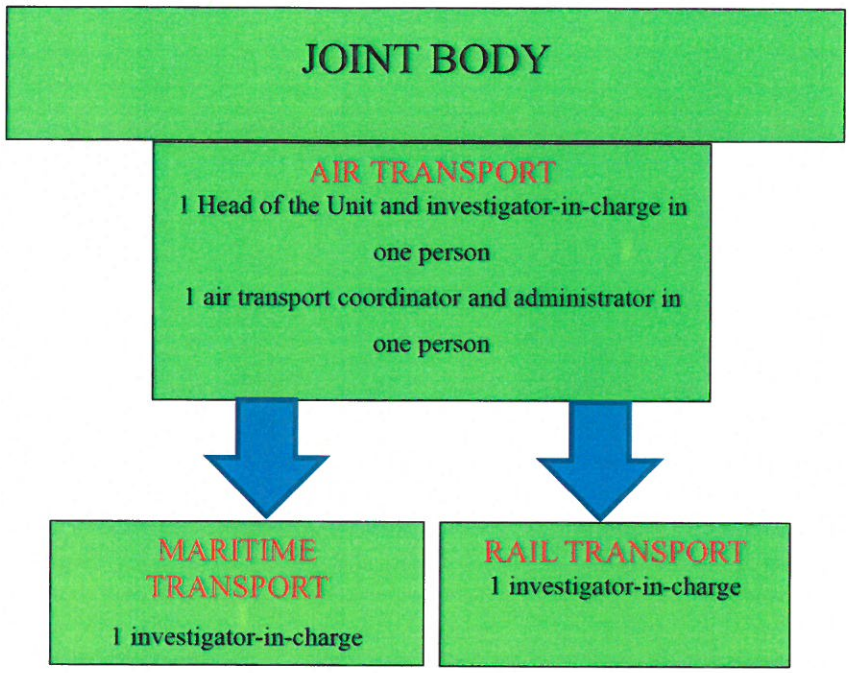
1.3 Internal organisation and subdivisions

The Air, Maritime and Railway Accident and Incident Investigation Unit is with regard to its organisation part of the Ministry of Infrastructure, which is responsible for transport. The Air, Maritime and Railway Accident and Incident Investigation Unit has no subdivisions.

According to the internal staffing structure of the ministry, the Air, Maritime and Railway Accident and Incident Investigation Unit has one workplace, i.e. the investigator-in-charge of railway accidents. When investigating accidents and incidents, the investigator-in-charge of railway accidents and incidents does not manage the funds earmarked in the budget for investigation of railway accidents

and incidents. These funds are managed by the budget item custodian.

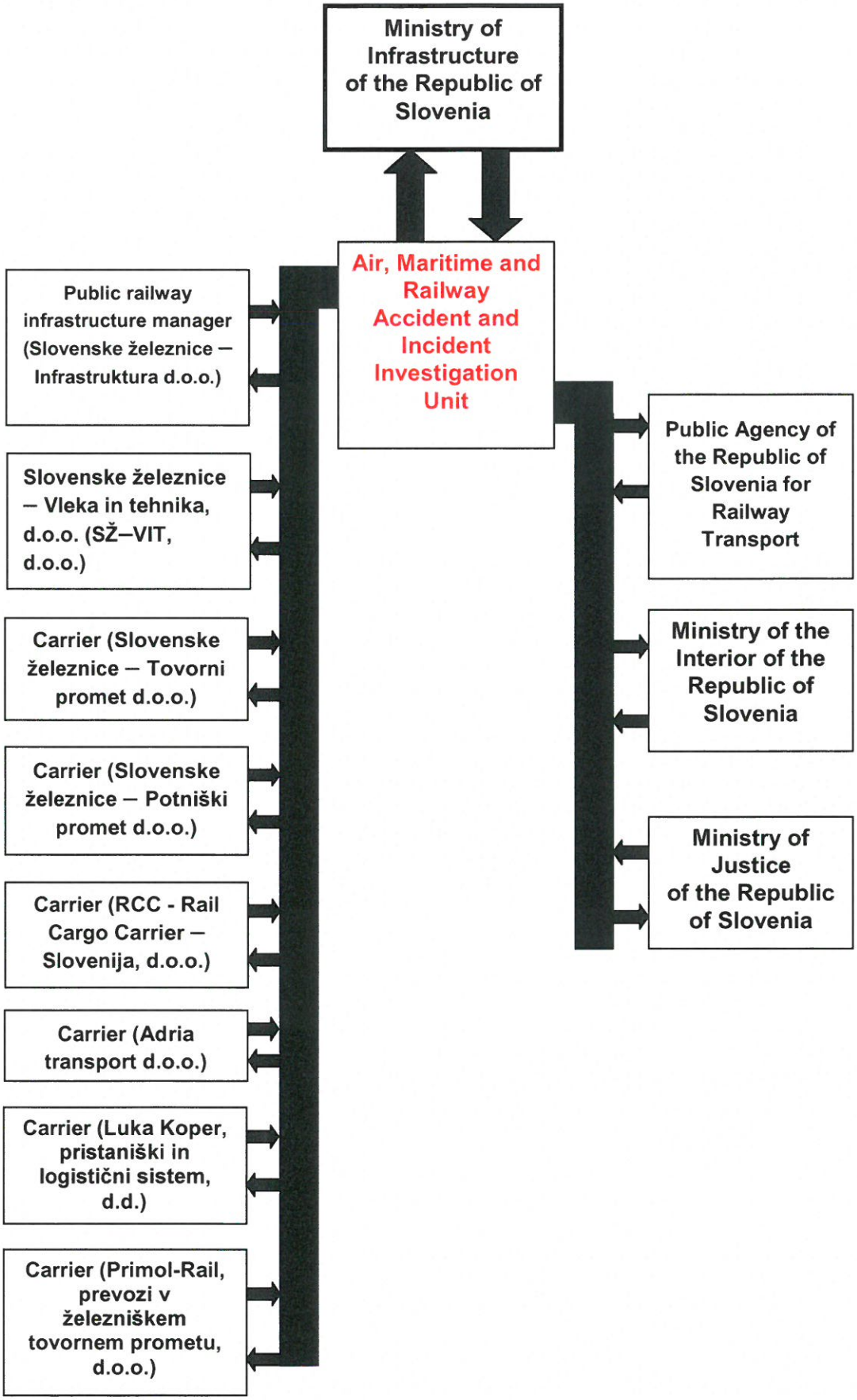
The investigator-in-charge is qualified to carry out all the functions required in an investigation procedure in the case of an accident or an incident.



1.4 Flow chart showing the position of the national investigation body

The Air, Maritime and Railway Accident and Incident Investigation Unit at the ministry of the Republic of Slovenia responsible for transport conducts safety investigations of accidents and incidents separately by individual transport branches, and operates completely independently.

The body responsible for investigations in rail transport cooperates with other national investigation bodies and judicial authorities, the railway safety authority, the railway infrastructure manager, and all licensed railway undertakings in the Republic of Slovenia.


Ministry of Infrastructure of the Republic of Slovenia
Air, Maritime and Railway Accident and Incident Investigation Unit
Public railway infrastructure manager (Slovenske železnice – Infrastruktura d.o.o.)
Slovenske železnice – Vleka in tehnika, d.o.o. (SŽ–VIT, d.o.o.)
Carrier (Slovenske železnice – Tovorni promet d.o.o.)
Carrier (Slovenske železnice – Potniški promet d.o.o.)
Carrier (RCC - Rail Cargo Carrier – Slovenija, d.o.o.)
Carrier (Adria transport d.o.o.)
Carrier (Luka Koper, pristaniški in logistični sistem, d.d.)
Carrier (Primol-Rail, prevozi v železniškem tovornem prometu, d.o.o.)
Public Agency of the Republic of Slovenia for Railway Transport
Ministry of the Interior of the Republic of Slovenia
Ministry of Justice of the Republic of Slovenia

If necessary, the investigation body also cooperates with all national investigation bodies of EU Member States that operate within the network of national investigation bodies under the auspices of the European Railway Agency (ERA).

It acquires all information required to conduct investigation procedures from the aforementioned entities. Since railway accident investigations are conducted as transparently as possible, questioning and the sharing of investigation results are provided to all parties involved as well as interested parties.

The ministry of the Republic of Slovenia responsible for transport ensures the Air, Maritime and Railway Accident and Incident Investigation Unit functional independence and financial funds from the budget. The ministry in no way interferes with the autonomy of the investigation body.

Pursuant to the provisions of Article 8 of the Rules on emergency plans for serious accidents, accidents and incidents of railway (Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 62/2015 of 28 August 2015), the railway infrastructure manager and railway undertakings are obliged to promptly notify the investigation body of any serious accidents, other accidents and incidents in rail transport. On 9 August 2019, new Rules on emergency plans for accidents and incidents of railway (Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 50/2019) were published, in which the provision on notifying the investigation body is included in paragraph twelve of Article 9.

The investigation body is notified by phone and subsequently in writing using the prescribed form ID-1.

1.5 Philosophy of conducting accident investigations (Philosophy and approach to establishing accident investigations, and level of mobility, readiness and timeliness)

The provisions of Article 21 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018), stipulate that the competent authorities, railway undertakings, the railway infrastructure manager and other entities involved must enable the investigation body to efficiently, swiftly and independently carry out its tasks. Past practice shows that the prescribed provisions are consistently observed.

Article 20 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018) stipulates that the investigation body must investigate all serious accidents.

The investigation body may, at its discretion, also decide to investigate accidents and incidents that could cause serious accidents in similar circumstances, including cases of technical errors in structural subsystems or interoperability components of the railway system.

The investigation body takes into account all the provisions of the aforementioned act.

Due to a lack of staff, the body investigating railway accidents and incidents must especially consider which accidents or incidents to investigate in addition to serious accidents.

Outside of its regular working hours, the body investigating railway accidents and incidents must be constantly on standby.

In order to prove their identity, the investigator-in-charge carries an identity card presenting the relevant authorisations. The form of the identity card is prescribed by the competent minister of transport.

The investigator-in-charge's mobility is ensured by an official vehicle of the Air, Maritime and Railway Accident and Incident Investigation Unit or a car of the Ministry of Infrastructure. If a car is not available, mobility is ensured by the investigator-in-charge's personal vehicle.

The aforementioned organisation of readiness and mobility provides for the prompt response to investigate the scene of an event and instigates the investigation procedure.

It takes the investigator-in-charge up to two hours by personal vehicle to reach the most distant location of the Slovenian railway network as per traffic routes available from the place of their residence or workplace, which in this case are located in central Slovenia.

2 INVESTIGATION PROCEDURE

2.1 Cases investigated: mandatory and non-mandatory pursuant to Articles 20 and 22 of the Railway Safety Directive

The investigation body investigates serious accidents, other accidents and incidents in rail transport. As per the provisions of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018), the investigation body must examine all serious accidents, and it also has the discretionary right to decide whether it will also investigate accidents and incidents that could cause serious accidents in similar circumstances, including cases of technical errors in structural subsystems or interoperability components of the railway system.

Pursuant to the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018), a serious accident is any collision or derailment of trains that results in the death of one or more people or serious injuries to five or more people or significant damage to rolling stock and infrastructure or major pollution of the environment, and any other similar accident with an obvious impact on the railway safety or safety management. Significant damage is material damage that may be promptly assessed by the investigator-in-charge of railway accidents and amounts to no less than EUR 2 million.

The investigation body for rail transport in the Republic of Slovenia takes into account the aforementioned provisions and investigates all serious accidents and other accidents and incidents that could cause serious accidents in similar circumstances. Accidents and incidents are investigated at its own discretion.

2.2 Institutions participating in investigations (regularly or exceptionally)

During the investigation, the investigator-in-charge of railway accidents of the ministry of the Republic of Slovenia responsible for transport cooperates with law enforcement, minor offence and judicial authorities. The findings of the Ministry of the Interior and judicial authorities are regularly incorporated in the final reports.

If an investigation procedure requires an analysis of chemical substances and other material, the investigation body engages competent independent licensed organisations with laboratories, such as the Jožef Stefan Institute, Institute for Research in Materials and Applications, Institute of Metal Constructions, etc.

The Institute of Forensic Medicine is included in investigations if victims' bodies need to be examined.

If recordings from devices that record verbal messages are reproduced, expert workers of the railway infrastructure manager who controls such devices are included in an investigation. The expert workers of the infrastructure manager are also involved in analysing the databases of signalling and safety devices. The expert workers of railway undertakings are engaged if databases of train operating records are to be analysed.

2.3 Investigation procedure or the approach of the investigation body (the same as 1.5, although in more detail)

Article 21 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018) stipulates that the competent authorities, undertakings, the railway infrastructure manager and other entities involved must enable the investigation body to carry out its tasks efficiently, swiftly and independently, which has been observed by everyone involved.

Article 21 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018) determines the responsibilities of the competent authority, undertakings, the railway infrastructure manager and other entities involved toward the investigation body. They must ensure:

a) free access to the scene of an accident, serious accident or incident, as well as to any rolling stock, infrastructure facilities and facilities and devices for traffic and signalisation management involved;

b) prompt recording of evidence and supervised removal of wreckage, infrastructure facilities and devices or their constituents for examination and analysis;

c) access and the use of recordings from devices that record verbal massages on the train and a record of the operation of the signalisation and traffic management system;

d) access to the results of victims' post-mortem reports;

e) access to the results of examinations of train staff and other people involved in the accident;

f) the questioning of railway workers involved and other witnesses;

g) access to all suitable information or records of the manager, undertakings involved and the safety authority.

Article 20 of the Railway Traffic Safety Act (ZZelP-1; Official Gazette of the Republic of Slovenia [*Uradni list RS*], No. 30/2018 of 26 April 2018) stipulates that the investigation body must investigate all serious accidents.

After careful consideration, the investigation body may also decide to investigate accidents and incidents that could lead to serious accidents in similar circumstances, including cases of technical errors in structural subsystems or interoperability components of the railway system. In its decision, it takes into account the following:

a) the seriousness of the accident or incident;

b) whether the accident or incident is related to a set of accidents or incidents concerning the entire system;

c) the impact on rail transport safety at the level of the European Union, and

d) requests from infrastructure managers, railway undertakings, the national safety authority or the Member States.

The investigation body in rail transport takes into account all the prescribed provisions referring to investigation procedures. However, it is limited by a shortage of staff, and thus has to make additional decisions on investigating the accidents and incidents that it wishes to investigate.

3 INVESTIGATIONS

3.1 Review of investigations completed in 2019

In 2019, the railway accident and incident investigation body investigated two serious accidents, seven accidents and no incidents:

- derailing of locomotive 363-031 of goods train no. 93724 at point no. 49 at Sežana station on 20 September 2018 at 13:58 after the first axle climbed onto the right diverging point blade due to the poor condition of the blade and reduced stability of the point;
- IC (intercity) passenger train no. 18 travelling on the right track scraped against a machine/drill while drilling, which was loaded in a carriage on a closed left track between Laško and Celje stations at km 524.125 on 23 November 2018 at 14:32, as the drilling machine on the carriage reached beyond the outer side of the left closed track during drilling into the normal clearance profile of the right track;
- collision of passenger train ICS (InterCity Slovenija) no. 20 with a worker at track no. 2 of Kresnice station on 26 November 2018 at 15:30 after the worker stepped into the danger zone of the neighbouring track, despite warnings from the working group's watchman that a train was approaching and omission of the work-site protection as prescribed in point 2.7. Protection method – work in the railway area of the Safety plan study;
- collision of local passenger train no. 3281 with a goods road motor vehicle at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 on 25 May 2019 at 7:43, as the goods road motor vehicle was in the danger zone of the track at the time when half barriers were coming down and it was unable to leave the danger zone in time due to condensed traffic;
- the derailing of international goods train no. 47882 at point no. 1 at Hrastovlje station on 25 June 2019 at 14:40 because the train moved along the right broken point blade no. 1 in deviation when leaving Hrastovlje station on track no. 2 towards Divača station. The point blade broke due to insufficient rigidity of the blade's support (sleepers) and unstable ballast;
- collision of local passenger train no. 3220 with a semi-trailer at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 on 25 July 2019 at 10:32, as the semi-trailer was in the danger zone of the track at the time when half barriers were coming down and the

vehicle was unable to leave the danger zone in time because the road traffic stopped;

- the derailing of international passenger train no. 247 at point no. 1 at km 509.350 at Rimske Toplice station on 6 August 2019 at 10:02 after the left wheels of both axles climbed the second bogie of carriage Ddmee no. 51 55 949 1101-5 into a groove between the left blade and the basic rail of point no. 1 at Rimske Toplice station due to expanded material of the right railhead into the left and right and the deformed angle of the railhead's upper surface that gradually adjusted to the conical shape of wheels of rolling stock;
- the derailing of international goods train no. 41914 at point no. 1 at km 509.358 at Rimske Toplice station on 14 August 2019 at 17:20 after the left wheels of all three axles of the first bogie of locomotive 363-013 with wheel flanges climbed onto the left blade railhead due to expanded material of the basic right railhead into the left and right and the deformed angle of the railhead which gradually adjusted to the conical shape of the rolling stock wheels' tread surface;
- the derailing of international goods train no. 40851 at the connection of points nos. 8 and 9 at Breg station at km 494.664 on 6 November 2019 at 00:58 after the left wheel of the second axle of the first bogie of carriage Sggmrs no. 37 80 495 2537-1, climbed onto the left railhead of the point connection when leaving Breg station on track no. 2 due to the deformation of horizontal geometry along the entire length of the connecting track, which was the result of compression of the track connection due to thrusting of points nos. 8 and 9 from opposite directions.

Type of investigated events	**Number of events**	**Number of victims**		**Damage in EUR (estimated)**	**Trend in comparison with 2018**
		Fatalities	**Severely injured**		
Train collision	0	0	0	EUR 0	0 < 1
Train derailment	5	0	0	EUR 4,293,703.30	5 > 2
Other	4	1	1	EUR 446,907.70	4 < 5

3.2 Investigations conducted and completed in 2019

In 2019, nine investigations of accidents were instigated and six were completed. The investigation procedures of the collision of the passenger train with a

personal road motor vehicle, the collision of the passenger train with a cyclist, the collision of the goods train with a person have been completed and are in the phase of drafting and issuing the final report. All reports of the investigations above will be issued within the prescribed deadline.

All instigated accident and incident investigations were instigated by the railway accident and incident investigation body on the basis of Article 20(2) of Directive 2016/798 of the European Parliament and of the Council, OJ L 138, 26 May 2016.

Investigations completed in 2019				
Date of accident or incident	Type of accident or incident	Place of accident or incident	Legal basis	Date of completion
20 September 2018	Derailment of goods train no. 93724	Sežana station, point no. 49	Article 20 of the ZZelP	19 September 2019
23 November 2018	Scraping of passenger train no. 18 against a machine on a carriage of a railway vehicle	between Laško and Celje stations at km 524.115	Article 20 of the ZZelP	30 October 2019
26 November 2018	Collision of passenger train ICS no. 18 with a worker	at Kresnice station on track no. 2 at km 541.945	Article 20 of the ZZelP	22 November 2019
25 May 2019	Collision of passenger train no. 3281 with a goods road motor vehicle	between Škofljica and Ljubljana Rakovnik stations at level crossing at 146.457	Article 20 of the ZZelP	25 May 2020
25 June 2019	Derailment of international goods train no. 47882	at Hrastovlje station, point no. 1 at km 13.986	Article 20 of the ZZelP	15 April 2020
25 July 2020	Collision of passenger train no. 3220 with a semi-trailer	between Škofljica and Ljubljana Rakovnik stations at level crossing at 146.457	Article 20 of the ZZelP	22 July 2020
19 July 2018	Derailment of international passenger train no. 247	at Rimske Toplice station, point no. 1 at km 509.350	Article 20 of the ZZelP	6 August 2020

14 August 2019	Derailment of international goods train no. 41914	at Rimske Toplice station, point no. 1 at km 509.350	Article 20 of the ZZelP	13 August 2020
6 November 2019	Derailment of international goods train no. 40851	at Breg station, connecting track of points nos. 8 and 9 at km 494+664	Article 20 of the ZZelP	24 April 2020

3.3 Research studies (or safety studies in cases of serious accidents) that were ordered and completed in 2019

In the railway network of the Republic of Slovenia, one serious accident occurred in 2019, i.e. the derailment of six carriages of an international goods train carrying aviation fuel, of which some 7,000 litres were discharged into the environment resulting in substantial material damage. Eight accidents with two casualties also happened in 2019 and nine people sustained minor injuries.

In 2019, two accidents occurred at point no. 1 of Rimske Toplice station due to the poor condition of the point, and two accidents occurred at the level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations involving passenger trains and two goods road motor vehicles. The risk for road users at the above level crossing between Ljubljana Rakovnik and Škofljica stations became too great because of road traffic density increasing over the years. It was recommended that the current level crossing should be removed and constructed at a more suitable location.

At point no. 1 of Sežana station, a goods train derailed in 2018 and an international passenger train and an international goods train derailed at point no. 1 of Rimske Toplice station in 2019. During the investigation procedures, it was determined that reasons for all derailings lie in the dilapidation of individual point elements.

3.4 Summaries of investigations completed in 2019 Brief descriptions, photographs and diagrams, and safety studies

Derailment of cargo train no. 93724 at point no. 49 of Sežana station on 20 September 2018 at 13:58

At 13:58 on 20 September 2018, the flange of the first left wheel of locomotive no. 363-031 climbed onto the right diverging blade of point no. 49 at km 679.987,7 of Sežana station while entering train no. 93724 on track no. 14. After travelling 9.1

metres, the locomotive then derailed first with both wheels of the first axle and then with the wheels of the following two axles of the first bogie while travelling and until stopping, including both wheels of the first axle of the second bogie in the direction of travelling.

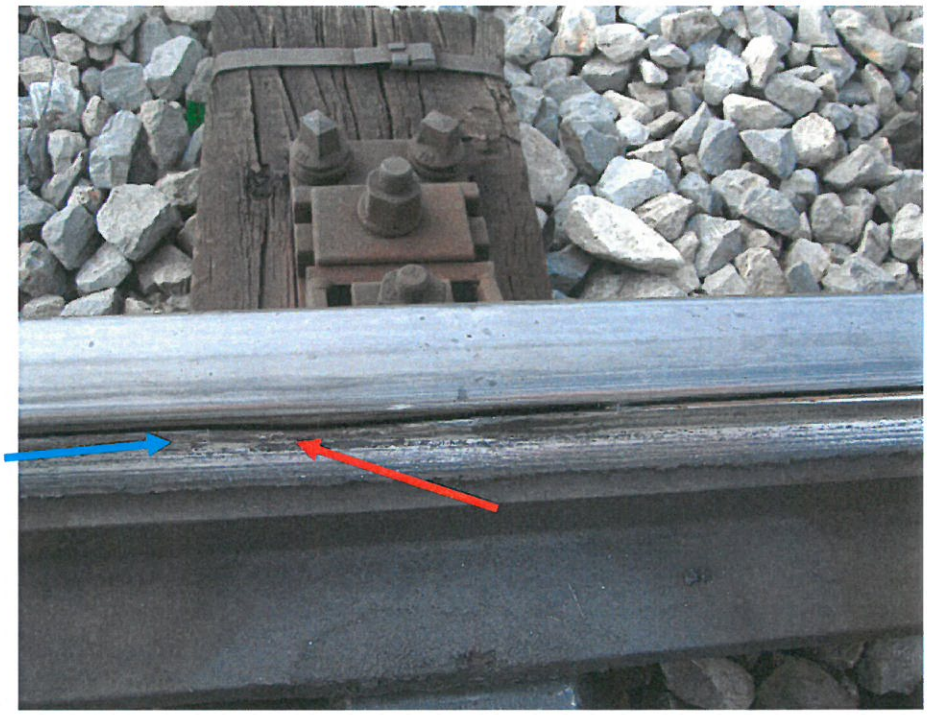


Photo 1: The red arrow points to the site of the flange of the left wheel of the first axle of locomotive no. 363-031 of train no. 93724 climbing onto the right damaged blade of point no. 49 above sleeper 3, while the blue arrow points in the direction of travel.

Train no. 93724 was travelling from the direction of Villa Opicina FS station, Italy. Over point no. 49, it was travelling along the right diverging blade if viewed from the start to the end of the track. It may be concluded with certainty that the left wheel flange climbed the right blade, as can be seen from the traces on the right blade of point no. 49 left during derailing when the flange of the left wheel of the locomotive's first axle climbed onto the groove between the blade and the basic rail.

When travelling in the direction of track no. 14 at Sežana station, the left wheel flange climbed onto the top of the right blade and travelled along the groove between the blade and the basic rail to the point where the blade diverted from the basic rail as per the point's plan and then derailed. The traces of climbing were visible on the right blade above sleeper 3, 1.5 metres from the top of the blade.

After derailing, the front of the locomotive stopped at km 679.908,4 which is 79.3 metres from the site of derailing at point no. 49.

Point no. 49 at Sežana station is single right-hand, inside, curved, 49E1-500-1:12, R1 = 380 m, R2 = 215 m, h = 70. The blade on which the flange of the first left wheel of the locomotive climbed in the direction of travelling had the engraved year of manufacture of 1973.

Directly before point no. 49, the track curves left if viewed from start to the end of the track. The highest permitted speed of train no. 93724 regulated by the timetable in the area of points in the 'B' side of Sežana station is 35 km/h.

Train no. 93724 was composed of locomotive no. 363-031 and 20 empty carriages of the Uagps series.

Until the start of eliminating consequences of the accident and repair of damages to the point, track no. 3 and "the valley" are closed for transport from point no. 49 from the direction of Villa Opicina.

Replacement transportation of passengers by bus for train nos. 1808 and 1807 will be organised on the line Sežana–Villa Opicina–Sežana.

Cause:

It was determined during the investigation that the direct cause for the derailment of the locomotive of train no. 93724 at point no. 49 of Sežana station on 20 September 2018 at 13:58 was the exceptionally poor condition of the right diverging blade which was severely worn out in the length of 2.5 metres from the top of the blade.

Indirect cause could be attributed to the poor stability of the point being used since 1973. Despite regular maintenance (mechanical regulation, replacement of worn-out elements), the stability of the point degrades over the years due to burdening.

Indirect cause could also lie in the travelling dynamics of the train along the section of the track that makes an 'S' curve directly before the point and that means that the resistance of the track is increased and more traction is required to overcome it.

Recommendations

Due to the risk of repeated accident, it is

recommended to SŽ – Infrastruktura, d.o.o., to:

- establish a register of hazardous points and a plan of examining such points, which must be adjusted to the time of exploitation of points and the weight of good transported over these points. The points being used longer and those that are more heavily burdened must be examined at more frequent intervals;
- produce limit values of wear for individual point elements with an emphasis on the wear of diverging blades;

recommended to SŽ – VIT, d.o.o. (towing provider), to:

- dedicate more attention to the dynamics of driving series 363 locomotives in the area of points when training train drivers. The properties of series 363 locomotives are exceptionally unfavourable when driving over points with a small radius and curve cant due to their typical mounting of axles into bogies and high centre of gravity.

Scraping of IC (intercity) passenger train no. 18 travelling on the right track against a machine/drill while drilling, which was loaded in a carriage on a closed left track between Laško and Celje stations at km 524.125 on 23 November 2018 at 14:32

On 23 November 2018 at 14:32, IC (intercity) passenger train no. 18 scraped with its left side against the drilling machine equipped with caterpillar tracks loaded onto two-axle flat bogie wagon Laaps no. 23 79 430 8029-9 between Laško and Celje stations. At the time of the accident, the left track between Rimske Toplice–Laško–Celje stations was closedas per decree no. 210/18 on closure of the track and voltage disconnection of the catenary due to track renovation and reconstruction.

During the closure of the left track, the traffic between Rimske Toplice–Laško–Celje stations took place along the right track, which was rearranged into a single-track line. Trains thus ran on the incorrect right track in the Zidani Most–Maribor direction. The working timetable for single-track traffic was made as of 19 July 2018. Train crossing intervals were directed and shifted by the train dispatcher of Maribor traffic operations.

All train runs were prohibited during the closure on the closed left track between Rimske Toplice–Laško–Celje stations. The prohibition did not apply to the needs of contractors, Kolektor Koling d.o.o., CGP Novo Mesto, SŽ-ŽGP d.d., Ljubljana and SGD Celje and their subcontractors.

The drilling took place on 23 November 2018 between Laško and Celje stations in the area of the left track from km 522.800 to Celje station along the outer left side of the track with a large self-propelled drilling machine equipped with steel caterpillar tracks, MC 600 Comacchio, loaded onto a two-axle flat bogie wagon Laaps. For the needs of moving between the pylons, the wagon was connected to DMG 99 79 9 436 001-1. The purpose of the drilling was to install earthing elements of load-bearing pylons of the catenary. The drilling machine was turning on the wagon. During the drilling, the machine with caterpillar tracks was positioned perpendicular to the wagon, and when the wagon was moving between the pylons of the catenary, the

drilling machine and caterpillar tracks were parallel to the wagon. The drilling machine was also drilling when trains were running on the neighbouring track. Its dimensions were not believed to intervene with the clearance profile of the neighbouring track. The turning of the machine from the position for drilling into the position for moving in the direction towards the next pylon of the catenary had to be carried out when no train was running on the neighbouring track.

At 14:32, IC passenger train no. 18 ran past the working machine and scraped its left side in the direction of travelling against an element on the drilling machine intended for connecting another machine or a trailer. IC passenger train no. 18 that ran in the Ljubljana–Maribor direction scraped against the working machine (drilling machine on caterpillar tracks) of the contractor, Geokop inženiring, which was loaded onto the wagon of the contractor, Tegrad, at km 524.125.

During the sliding of the element for connecting working machines along the left side of EMG 312 – 119/120, 317-110, six side thermopan glass windows in the passenger section of the train and left front mirror of the control cab were broken. The passenger exit door and sheets on the side of the train set were also damaged.

The passengers were transported to Celje station in buses. The damaged EMG was removed from the track at 15:52 and was unfit for further use. Between 14:32 and 15:52, the track between Laško and Celje stations was closed to traffic.

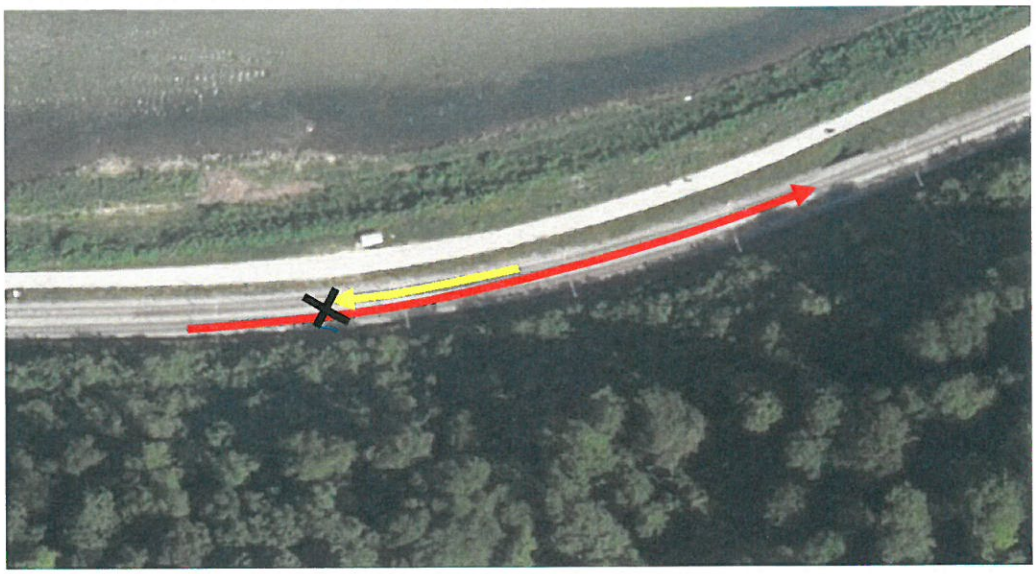


Photo 2: The red arrow shows the direction of movement of train no. 18, and the yellow the direction of travelling the motor railway vehicle. The black cross shows the site of scraping.

Causes:

It was established during the investigation that the direct cause of scraping IC train no. 18 against the element for connecting machines to the drilling machine on steel caterpillar tracks, Comacchio MC 600, on 23 November 2018 at 14:32, was the extension of the drilling machine of the subcontractor, Geokop inženiring, which was loaded onto the wagon of the contractor, Tegrad, during drilling on the outer side of the closed left track into the normal clearance profile of the right track.

During the works performed on the left track, the drill was occasionally in the gauge of the neighbouring right track where the transport of trains took place between Laško and Celje stations in both directions. At the time when the drilling machine was in the gauge of the neighbouring track, the basic safety provisions stating that the traffic on the neighbouring track must be stopped unconditionally in such cases were not observed.

Indirect cause may lie in the inappropriately secured work site at the time of drilling. To ensure safer work of workers and machines along the working track, the normal clearance profile of the transport track would have to be marked in the area of works by installing a warning tape on corner profiles that are attached under the foot of the nearby track of the working track as prescribed in point 19 of the Safety plan study.

Recommendations

Due to the risk of future accidents, it is advised to the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o., to:

- actively participate in the drafting of the safety plan, which would have to made according to individual phases of the investment renovation of the track or line (e.g. phase of construction, phase of installation and phase of finishing works) due to the specifics of the work's technological processes and machinery;
- supervise safety when working on the closed track and secure delimitations between the working and closed tracks.

When implementing investment work during the renovation of an individual track on a double- or multi-track line when traffic is underway on the neighbouring track or tracks, it is necessary to minutely define individual safety elements as per work phases in order to avoid the risk to the greatest degree possible when managing train traffic. The safety management system must be harmonised with the safety plan.

Collision of passenger train ICS (InterCity Slovenija) no. 20 with a worker on track no. 2 at Kresnice station on 26 November 2018 at 15:30

On 26 November 2018 at 15:30, passenger train ICS (InterCity Slovenija) no. 20 hit a worker who stepped into the clearance profile of track no. 2 on which a train was travelling, which hit the worker's left side with its left front side at km v 541.945 when carrying out finishing works on the renovation of track no. 3 at Kresnice station.

The closure of track no. 3 was implemented on 26 November 2018 at Kresnice station, which ended at 15:00. A group of workers of the contractor, ŽGP, continued to finish works on track no. 3 of Kresnice station. The workers were levelling gravel between tracks nos. 2 and 3, which had been dumped in a heap. A shunting passage had to be arranged between tracks nos. 2 and 3. The workers levelled the gravel with shovels as well as a wooden hand-made device in the form of a plank onto which a handle was attached. The group's watchman was watching out for their safety and was warning them about incoming trains both verbally and with a whistle. Since the works took place opposite the traffic office, the watchman received information about incoming trains from the signaller verbally, while he also monitored the exit signals of the relay signalling and safety device of Kresnice station.

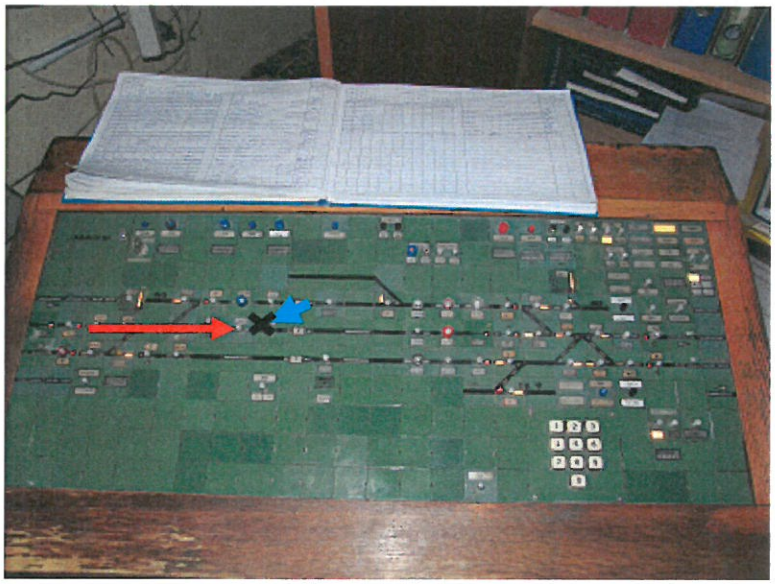


Photo 3: The red arrow on the control panel of the relay signalling and safety device of Kresnice station shows the route of passenger train ICS no. 20, the blue arrow shows the worker's movement towards the clearance profile of track no. 2, and the black cross marks the site of collision between the train and the worker.

The signaller of Kresnice station informed one of the two watchmen, who was at the traffic office at the time, that train no. 20 would pass by Kresnice station on track no. 2 at 15:30. The watchman immediately forwarded the received information verbally to the other watchman, who was on the island platform in the immediate vicinity of the working group. The watchman watching over the working group on the island platform informed the workers who were levelling the piled gravel between tracks nos. 2 and 3 about the passing of train no. 20 on track no. 2 of Kresnice station. All workers in the group moved towards the left rail of track no. 2 if looking from Ljubljana–Zidani Most direction, outside the clearance profile of track no.2. When train no. 20 was approaching Kresnice station and the workers on station track no. 2, the worker involved in the accident, who initially also moved to a safe place outside of the clearance profile of track no. 2 after the watchman forwarded the message, began unexpectedly moving backward towards track no. 2. When moving towards track no. 2, the worker was holding the handle of the hand-made device for levelling gravel. The working group's watchman on the island platform was warning the workers about the approaching train by blowing the whistle. When other workers noticed that their colleague was nearing the hazardous area while moving backwards, they started warning him by shouting that the train was coming. The driver of train no. 20 also warned the workers about the approaching train by sounding the train whistle. The worker failed to observe the warnings and continued to approach the hazardous area while moving backwards. Train no. 20, which was going past Kresnice station, hit the worker with the left front side while the latter was between tracks nos. 2 and 3 in the area of the clearance profile of track no. 2. After the collision, the worker was thrown 11.4 metres from the point of impact in the direction in which the train was travelling. The worker fell after the collision on track no. 3 and showed no signs of life.

Causes:

It was established during the investigation that the direct cause of the collision of passenger train ICS no. 20 with the worker who performed finishing works of the investment maintenance of track no. 3 at Kresnice station in a supervised group on 26 November 2018 at 15:30 was the worker's entry into the hazardous area of the neighbouring track despite warnings from the working group's watchman.

The indirect cause of the accident was the omission of the work-site protection as prescribed in point 2.7. Protection method – work in the railway area of the Safety plan study.

It is also probable that one of the indirect causes for the collision of train no. 20 and the worker who was approaching the hazardous area while moving backwards in the clearance profile of track no. 2 between track nos. 2 and 3 of Kresnice station lies in the worker's confusion due to the noise caused by the company, Industrija apna Kresnice, which is situated in the immediate vicinity of the site of accident.

Recommendations

Due to the risk of future accidents, it is recommended to:

1. the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o., to:
   - actively participate in the drafting of the study, Safety plan for implementing works on the investment infrastructure maintenance;
   - the Safety plan should be drafted as per the main phases of investment maintenance, e.g. phase of constructing superstructure and substructure, phase of installation and phase of finishing works);
2. the investment works contractor, ŽGP d.d., which was carrying out works on track no. 3 of Kresnice station:
   - actively participate in the drafting of the study, Safety plan for implementing works on the investment maintenance of public railway infrastructure.

Collision of local passenger train no. 3281 with a goods road motor vehicle at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 on 25 May 2019 at 7:43

On 25 May 2019 at 7:43, local passenger train no. 3281 collided at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 with a goods road motor vehicle/chiller lorry. Passenger train no. 3281 travelled from the starting station of Ljubljana to the final station of Novo mesto on a single-track non-electrified line no. 80 (Metlika–Ljubljana). The goods road motor vehicle approached the level crossing while driving in the right lane of Jurčkova cesta road from Dolenjska cesta road in the direction of the Rudnik shopping centre.

At the moment when the half barriers started descending, the goods road motor vehicle was on the railway track of the level crossing, which can be determined from traces on the lower edge of the right half barrier if viewed from the travelling direction of the vehicle.

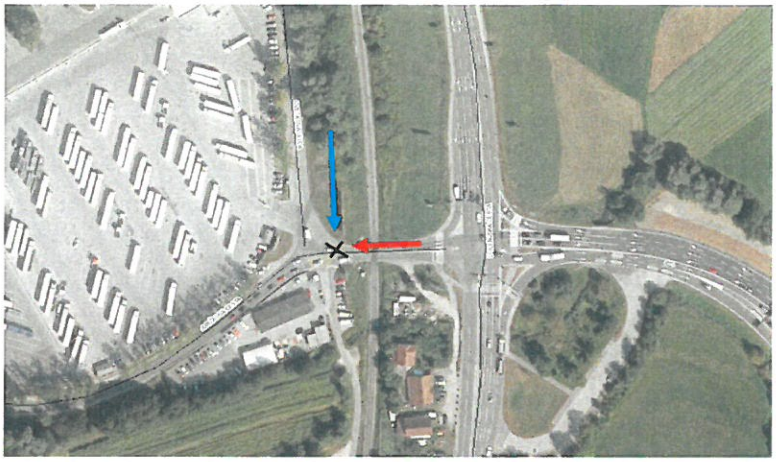


Photo 4: The red arrow shows the route of the goods road motor vehicle on Jurčkova cesta road from Dolenjska cesta road in the direction of the Rudnik shopping centre, the blue arrow shows the travelling direction of passenger train no. 3281, which drove from Ljubljana to Novo mesto, and the black cross marks the site of collision.

When examining the site of the event directly after the accident, several fresh marks from the impact of the half barrier against a solid object (chipped paint) were visible on the lower edge of the half barrier. The marks occurred when the half barrier was sliding along the right upper edge of the cooler unit of the goods road motor vehicle when the half barrier was descending. After the collision, the train pushed the vehicle in front of it until it stopped. During the pushing of the goods road motor vehicle, the train derailed with the first bogie, i.e. left wheels on the inner side of the left track and right wheels on the outer side of the left track onto the ballast if viewed from the travelling direction of the train. The place of derailment was at km 146.418,36 according to the traces on the track. The train pilot stopped at km 146.350,4. From the point of collision with the goods road motor vehicle to the point of derailment, the train travelled 39 metres and additional 67.6 metres until it stopped. The total length of travelling from the collision until stopping was 106.6 metres.

Causes:

The direct cause of collision between local passenger train no. 3281 and the goods road motor vehicle located on the railway track at the level crossing of a road and railway at the moment when the train switched on the device for protecting the level crossing was the positioning of the goods road motor vehicle on the hazardous area of the track. When the half barriers were descending, the goods road motor vehicle was unable to move from the hazardous area of the track in time due to condensed road traffic.

The indirect cause lies in the stopping of goods road motor vehicles at the entrance to the car park of Viator&Vektor, which resulted in the road traffic congestion at the crossroads and consequently at the level crossing.

Another indirect cause is also low visibility of the track due to trees and bushes growing along the track, which obstructed the view.

Consequences:

Consequences of the collision of local passenger train no. 3281 at the level crossing of a road and railway track protected by half barriers between Ljubljana Rakovnik and Škofljica stations on 25 May 2019 at 7:43 include:

- minor injuries sustained by two train passengers, the conductor, the train driver and the driver of the goods road motor vehicle;
- damaged pilot of control unit DMG 715-105;
- damaged first derailed bogie of control unit DMG 715-105;
- damaged left and right side of control unit DMG 715-105;
- damaged track in the length of 108 metres (track fastening material and sleepers);
- damaged bridge construction;
- damaged device for protecting the level crossing (half-barrier drive and half barrier), and
- completely destroyed goods road motor vehicle.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to:

1. the car park manager, Viator&Vektor (parking), Metalka Commerce, d.d.:
   - to relocate the entrance on the southern side of the car park along the railway line from Cvetkova ulica street in the direction of Kumarjeva ulica street;
2. the railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:
   - to remove trees and bushes between Cvetkova ulica street and the railway line.

When analysing road traffic at the level crossing and the existing infrastructure, it was established that as per the technical characteristics of the level crossing and the road infrastructure in the immediate vicinity of the level crossing the entrance to the car park of Viator&Vektor poses a significant risk for road users when crossing the railway line in the case of congestion at the crossroads of Cvetkova ulica street and Jurčkova cesta road, which is caused by goods road motor vehicles when turning into the car park.

Derailment of international cargo train no. 47882 at point no. 1 of Hrastovlje station on 25 June 2019 at 14:40

During the arrival of international cargo train no. 47913 of the railway undertaking, Adria Transport, d.o.o., on 25 June 2019 at 11:42 on track no. 2 of Hrastovlje station, right point blade no. 1 broke. The blade broke 7.16 metres from the top between both railway switch thresholds.

Train no. 47913 travelled from the direction of Divača to Koper freight station. The train was supposed to cross opposite train no. 42024 at Hrastovlje station. After train no. 47913 entered track no. 2 at Hrastovlje station at 11:42, trains nos. 53211, 48402, 48441, 97066, 47901, 97068, 45089, 47912 and 53210 drove through point no. 1 in a straight line until 14:39, since trains only used track no. 1 during this time period.

When trains run on track no. 1 at Hrastovlje station, they travel on the left blade on point no. 1, and when they run on track no. 2, they travel on this point on the right blade.

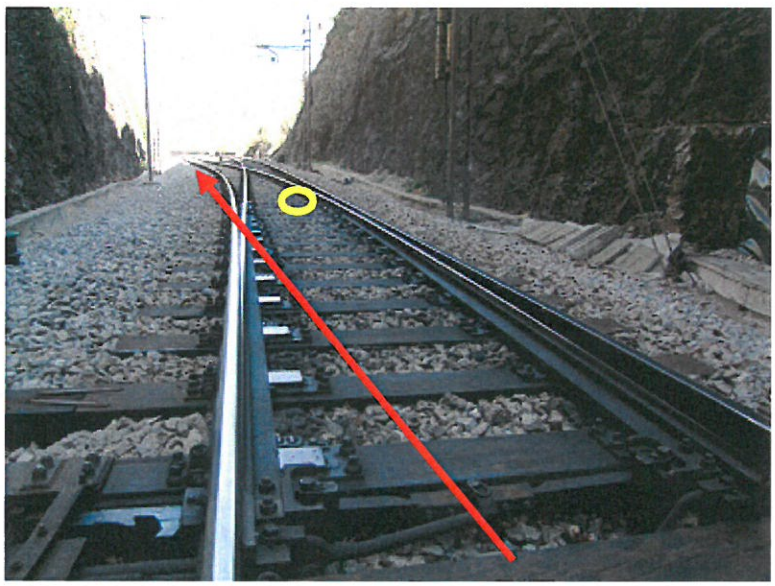


Photo 5: The red arrow shows the travelling direction of train no. 47913 over point no. 1, while the yellow circle shows the break point of the right blade. The blade broke between sleepers 11 and 12.

Train no. 47882 of the railway undertaking, Slovenske železnice – Tovorni promet, d.o.o., coming from the direction of Koper freight station entered track no. 2 of Hrastovlje station due to the crossing with the opposite train no. 53210. After it completed the crossing, train no. 47882 began driving from track no. 2 in the direction of Divača at 14:37. When the train deviated onto the right broken blade of

point no. 1, the broken section of the blade was moving away from the section of the blade welded to the frog at the break point due to physical laws during the rolling of the wheels of the first five carriages on the track. When the first bogie of the fifth carriage went over the break point, the broken part of the blade started turning to the side, which knocked the blade from the bearing on the outer left side of the track, resulting in the derailment of the first bogie of the sixth carriage and then the following five carriages.

While the carriages were derailing at point no. 1, the coupling of the fifth carriage broke between the fifth and sixth carriages. After decoupling, the rubber hoses of the main reservoir pipe came undone, causing the main reservoir pipe to empty, resulting in forced breaking of the entire rolling stock and subsequent stopping in the Dol tunnel with the front of the train at km 13.758.

Carriages 6, 7, 8, 9, 10 and 11 derailed in train no. 40882 if viewed from the front to the end of the train.

Causes:

The direct cause of the accident of train no. 40882 on 25 June 2019 at 14:40 lies in the moving along right broken point blade no. 1 in deviation when leaving Hrastovlje station on track no. 2 towards Divača station.

The reason for the breaking of the right blade when train no. 47913 travelled towards the blade in deviation when entering track no. 2 on 25 June 2019 at 11:44 was insufficient rigidity of the blade's support (sleepers), which caused greater subsidence of the blade resulting in the break. Since stability of the ballast and substructure was not ensured at point no. 1, subsidence was too great at certain sections of the blade, causing the occurrence of micro-fractures in the blade, which advanced to the point of instantaneous break.

Consequences:

The result of the right blade breaking was the derailment of six carriages/tank wagons of train no. 40882, on one of which the tank shell cracked when sliding along the circumference of the tunnel. Some 7,611 litres of flammable liquid (aviation fuel/kerosene) were discharged into the ground of the tunnel. The escaped liquid posed a significant environmental hazard because the area of the accident is located in the area of drinking water catchment for the Primorska coastal region.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:

- draft a list of points as per their risk exposure and adjust accordingly the monitoring cycle which must be dependent on the age of the point and its burdening (if the point is older and more burdened, the inspections must be more frequent);
- the cycle of point maintenance must be adjusted to their age and burdening (if the point is older and more burdened, maintenance cycles must be more frequent), and the regulation and replacement of worn parts, e.g. sleepers, sliding plates, track fastening material, etc., must be implemented more frequently;
- the circumference of the tunnel must be treated so that the surface is smooth with no sharp edges or protruding rocks.

Collision of local passenger train no. 3220 with a semi-trailer at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 on 25 July 2019 at 10:32

On 25 July 2019 at 10:32, local passenger train no. 3220 collided at a level crossing protected with half barriers between Ljubljana Rakovnik and Škofljica stations at km 146.457 with a semi-trailer/chiller lorry. Passenger train no. 3220 travelled from the starting station of Novo mesto to the final station of Ljubljana on a single-track non-electrified line no. 80 (Metlika–Ljubljana). The semi-trailer approached the level crossing while driving in the right lane of Jurčkova cesta road. The semi-trailer was travelling from the Rudnik shopping centre in the direction of Dolenjska cesta road.

According to the driver of train no. 3220 involved in the accident and the driver of the semi-trailer, the semi-trailer was on the railway track of the level crossing at the moment when the half barriers started descending.

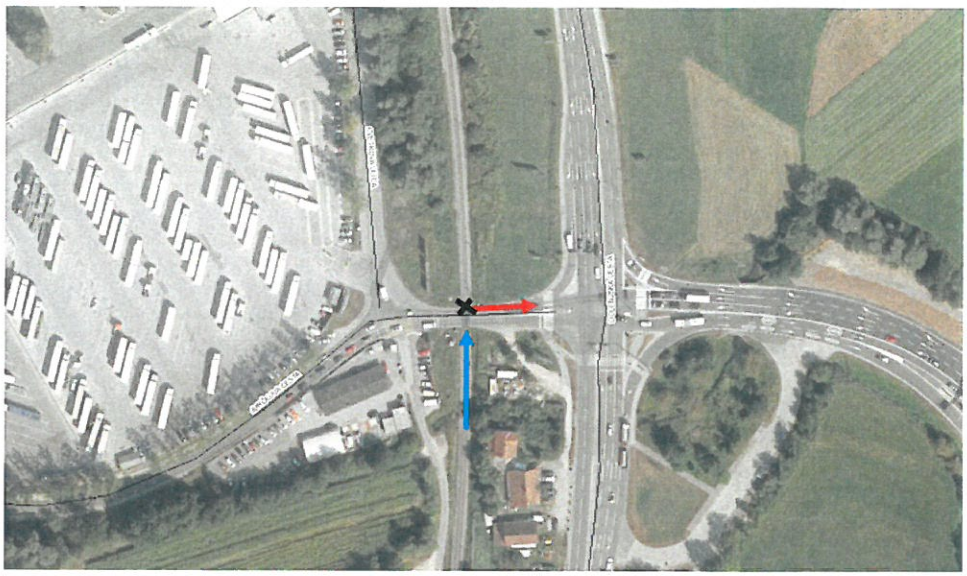


Photo 6: The red arrow shows the route of the semi-trailer on Jurčkova cesta road from the Rudnik shopping centre in the direction of Dolenjska cesta road, the blue arrow shows the travelling direction of passenger train no. 3220, which drove from Novo mesto to Ljubljana, and the black cross marks the site of collision at the level crossing.

After train no. 3220 collided with the rear section of the semi-trailer, it pushed the latter out of the track's clearance profile. While the semi-trailer was being pushed from the gauge, the drive of the right semi barrier broke at the level crossing and mounted a personal road motor vehicle, which was stationary correctly in the lane on the opposite side. The train pilot stopped at km 146.562. The distance of the train's movement from collision until stopping was 108 metres.

Causes:

The direct cause of collision between local passenger train no. 3220 and the rear end of the semi-trailer located on the railway track at the level crossing of a road and railway at the moment when the train switched on the device for protecting the level crossing was the positioning of the semi-trailer in the hazardous area of the track. When the half barriers were descending, the goods road motor vehicle was unable to move in time from the hazardous area of the track because the road traffic was stationary.

The indirect cause of the accident lies in the density of road and railway infrastructure in a relatively small area. Road congestion occurs as road traffic is regulated by traffic lights at the crossroads of Jurčkova cesta road and Dolenjska cesta road, the access to the southern Ljubljana bypass and the dynamics and density of road traffic in the area of the level crossing, which frequently results in incorrect assessment of the drivers' available space at the crossing.

Another indirect cause is also low visibility of the track due to trees and bushes growing along the track, which obstructed the view.

Consequences:

Consequences of the collision of local passenger train no. 3220 with the rear end of a semi-trailer at the level crossing of a road and railway track protected by half barriers between Ljubljana Rakovnik and Škofljica stations on 25 July 2019 at 10:32 include:

- minor injuries sustained by the train driver and three passengers on local passenger train no. 3220;
- damaged pilot of the drive unit DMG 713-124;
- damaged device for protecting the level crossing (half-barrier drive, half barrier and a traffic sign with flashing lights);
- broken wooden pylon of railway telecommunications network cable;
- completely destroyed semi-trailer;
- approximately half of the goods in the semi-trailer were destroyed (large cuts of fresh meat), and
- damaged personal road motor vehicle, Peugeot 207.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to the Municipality of Ljubljana and the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:

1. construct a new level crossing of road and railway infrastructure at another location, which will ensure safer access for road users to the Rudnik shopping centre from the direction of Dolenjska cesta road;
2. remove the existing level crossing because it represents a significant risk for road users when crossing the railway line.

The analyses of the dynamics of road and rail traffic at the level crossing and the siting of the existing road and railway infrastructure at the location revealed that the level crossing represents a significant risk for road users as per the technical characteristics of railway infrastructure and the existing facilities along the line, in the area of the level crossing and the road infrastructure in the narrow area of the level crossing. Due to infrastructure concentration and density of road traffic, congestion frequently occurs when crossing the railway line at the crossroads of Cvetkova ulica street and Jurčkova cesta caused by goods road motor vehicles while entering and exiting the area of the shopping centre. An increased risk also represents the entrance to the car park of Viator&Vektor, which was constructed in a completely

inappropriate location.

Derailment of international passenger train no. 247 at point no. 1 of Rimske Toplice station at km 509.350 on 6 August 2019 at 10:02

When international passenger train no. 247 drove from the correct left track in the Zidani Most–Rimske Toplice interstation section to track no. 3 of Rimske Toplice station at point no. 1 at km 509.350,4 on 6 August 2019 at 10:02, its first carriage Ddmee no. 51 55 949 1101-5 climbed with flanges of left wheels of the second bogie onto the groove between the left blade and left basic rail. Both axles derailed when both their wheels drove into an empty space between the blades and basic rails of point no. 1 of Rimske Toplice station, i.e. into the groove between the left blade and left basic rail after climbing of left wheels' flanges.

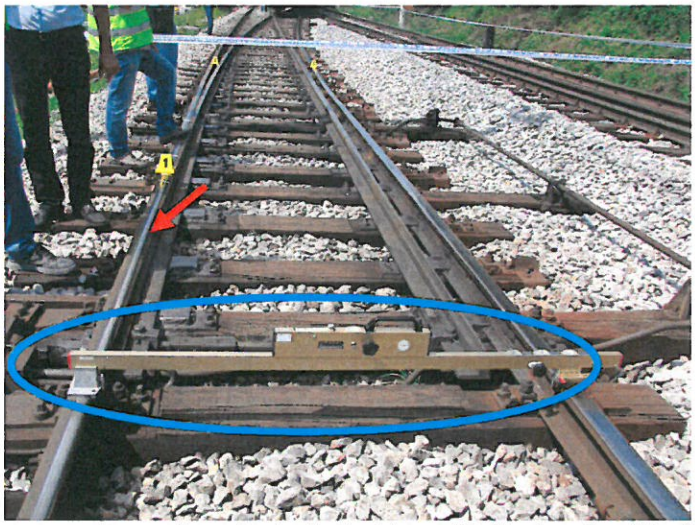


Photo 7: The red arrow shows the start of climbing of left wheels of both axles of the first carriage's second bogie and the blue ellipse shows the measuring device for performing measurements on point no. 1 when inspecting the site of the accident.

International passenger train no. 247 was travelling on the route Ljubljana–Budapest-Déli via Zidani Most, Pragersko, Ormož, Hodoš national border crossing, Zalaegerszeg, Boba, Veszprém, Székesfehérvár, Kelenföld.

Train no. 247 was scheduled to stop at Rimske Toplice station on track no. 3 for the entry and exit of passengers.

At the time of the accident, the closure of left line track L-30 and tracks nos. 1 and 201 at Rimske Toplice station was introduced as per the order of Maribor traffic operations no. 1209849 between Rimske Toplice–Laško stations. The closure was implemented due to the works on the project, "Upgrade of the Zidani Most–Celje

railway line". During the closure, the train transport between Rimske Toplice–Laško stations only took place on right line track D-30 in both directions and according to an adjusted timetable. Certain trains did not drive during the closure in the section of the track between Zidani Most and Celje stations. The transport of passengers travelling by trains that did not run during the closure between Zidani Most and Celje was organised by replacement bus transport. To improve the flow of passengers, train no. 247 was ordered stops at intermediate stations with a special timetable during the closure of line track L-30 between Rimske Toplice–Laško stations.

Two international goods trains came from the direction of Zidani Most before train no. 247. Train no. 47400 went past Rimske Toplice station at 9:44, and train no. 42000 at 9:50. Train no. 247 entered track no. 3 of Rimske Toplice station at 10:02.

After derailment of both axles of the second bogie of the first carriage Ddmee no. 51 55 949 1101-5, the first bogie of the second carriage, no. 51 55 207 0051-6, also derailed while the train still ran and subsequently stopped at points nos. 3 and 4. Due to the influence of forces during the dragging of the first derailed carriage, the train automatically uncoupled at the coupling of the engine and the first carriage. The shackle of the coupler of the first carriage mounted onto the towing hook of the engine became automatically undone due to thrusts occurring when the derailed wheels of the bogies were bouncing off the tracks. The train uncoupled, which resulted in the drop of air pressure in the main reservoir pipe and that consequently activated the braking system of the rolling stock and stopped it.

The pilot stopped at km 509.566,6, which is 217.1 metres from the traces of mounting of flanges of left wheels of both axles of the second bogie of the first carriage into the groove between the left blade and left basic rail of point no. 1.

Causes:

The direct cause for mounting of the left wheels of both axles of the second bogie of carriage Ddmee no. 51 55 949 1101-5 into the groove between the left blade and basic rail of point no. 1 at Rimske Toplice station 1.5 metres from the top of the blade in the direction of travelling of train no. 247 while entering track no. 3 of Rimske Toplice station lies in the expanded material of the basic right railhead into left and right and the deformed angle of the railhead upper surface, which gradually adjusted to the conical shape of the rolling stock wheels.

The indirect cause for climbing of the left wheels onto the left blade, 1.5 metres from the top of the blade of point no. 1 is the position of the point that was installed at an unfavourable location. The point was installed in an area where the line transitions

from the right curve into a straight line. Since it was installed in the right curve, the left side of the point was canted and the centre of gravity of the rolling stock concentrates on the lower right track when travelling over the point, which is particularly reflected when deviating. The wheels are rubbing and pressing down on the lower right track when the rolling stock runs over it. The railhead eventually expands into the left and right after constant rubbing and the angle of the railhead surface also gradually changes as it adjusts to the conical shape of the wheels, which increases friction between the wheels and the track.

Consequences:

The consequence of climbing of the left wheels of both axles of the second bogie of carriage Ddmee no. 51 55 949 1101-5 at point no. 1 of Rimske Toplice station is the derailment of two carriages of train no. 247, damage to points nos. 1, 3 and 4, deformation of the superstructure of point connection of points nos. 1, 3 and 4, damaged main departure signal IS-31, destroyed track magnet and shunting signal of departure signal IS-31.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:

- urgent maintenance works, which will reduce the risk when the rolling stock is moving, must be implemented before more intensive running in a curve over the points whose replacement is anticipated due to wear;
- deformations and wear of basic tracks must be established and replaced promptly when monitoring point elements, especially in the parts of points located in curves.

Derailment of international passenger train no. 41914 at point no. 1 of Rimske Toplice station at km 509.358 on 14 August 2019 at 17:20

Locomotive 91 79 1 363-013-8 derailed on 14 August 2019 at 17:20 when international goods train no. 41914 moved from the correct left track in the Zidani Most–Rimske Toplice interstation section to track no. 2 of Rimske Toplice station at point no. 1 at km 509.358,5. The flanges of all three left wheels of the first bogie of the locomotive climbed into the groove between the left blade and the left basic rail. All three axles derailed when all six wheels drove into an empty space between the blades and basic rails of point no. 1 of Rimske Toplice station, i.e. into the groove between the left blade and left basic rail after climbing of the left wheels' flanges.

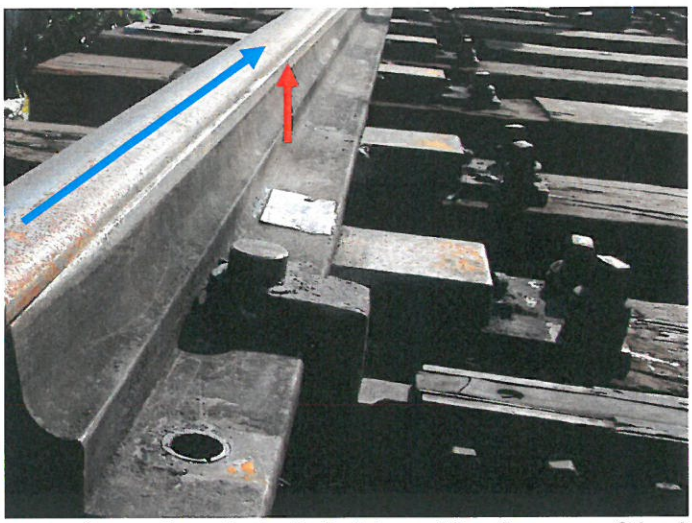


Photo 8: The red arrow shows the start of climbing of the flanges of the left wheels onto the left blade railhead of point no. 1 between the second and third sleepers, and the blue arrow points in the direction of movement of train no. 41914.

International goods train no. 41914 was driving from Koper freight station to Dunajská Streda (Slovakia) via Zidani Most, Pragersko, Ormož, Hodoš national border crossing, Zalaegerszeg (Hungary), Komaróm (Hungary), Komárno (Slovakia). Train no. 41914 went past Rimske Toplice station on track no. 2 due to the closure of line track L-30 between Rimske Toplice–Laško stations.

At the time of the accident, the closure of left line track L-30 and tracks nos. 1 and 201 at Rimske Toplice station was introduced as per the order of Maribor traffic operations no. 1209849 between Rimske Toplice–Laško stations. The closure was implemented due to the works on the project, "Upgrade of the Zidani Most–Celje railway line". During the closure, the train transport between Rimske Toplice–Laško stations only took place on right line track D-30 in both directions and according to an adjusted timetable. The timetable for passenger transport was minimised during the closure in this section. Certain trains were not moved during the closure in the section of the track between Zidani Most and Celje stations.

Goods train no. 52102 came from the direction of Zidani Most before train no. 41914. Train no. 52102 left Zidani Most station at 17:01 and went past Rimske toplice station at 17:13. Train no. 41914 ran after train no. 52102 according to a spacing automatic block system. Train no. 41914 went past Zidani Most station at 17:06. After train no. 41914 went past distance automatic block signal P-132, which is also the before-main signal of Rimske Toplice station, it arrived at signal sign no. 10: "Be prepared to

stop". When train no. 52102 past Rimske Toplice station at 17:13, the signaller first set on the control panel of the relay signalling and safety device the entry route for train no. 41914 to track no. 2 and then the exit route from track no. 2 in the direction of right line track D-30 towards Laško station. Upon the arrival of the train, locomotive no. 363-013 derailed at point no. 1 at 17:20.

After the derailment of all three axles of the first bogie of locomotive E-Lok no. 91 79 1 363-013-8, the second bogie of the locomotive derailed before the train stopped after passing point no. 3. Immediately after the feeling jerky horizontal and vertical movements of the locomotive, the driver switched on the fast breaking of the train.

The pilot stopped at km 509.434, which is 83.6 metres from the traces of mounting of flanges of left wheels of all three axles of the first bogie of the locomotive onto the left blade railhead of point no. 1 at Rimske Toplice station.

Causes:

The direct cause for the mounting of the left wheels of all three axles of the first bogie of locomotive no. 91 1 79 363013-8 with wheel flanges onto the left blade railhead of point no. 1 at Rimske Toplice station, which then slipped into the groove between the left blade and basic rail, 1.5 metres from the top of the blade in the direction of travelling of train no. 41914 when entering track no. 2 of Rimske Toplice station lies in the expanded material of the basic right railhead into the left and right and the deformed angle of the railhead, which gradually adjusted to the conical shape of the rolling stock wheels' tread surface.

The indirect cause for the climbing of the left wheels onto the left blade, 1.5 metres from the top of the blade of point no. 1 is the position of the point, which was installed at an unfavourable location. The point was installed in area where the line transitions from the right curve into a straight line. Since it was installed in the right curve, the left side of the point was canted, and the centre of gravity of rolling stock concentrates on the lower right track when travelling over the point from the direction of Zidani Most, which is principally reflected when deviating. The wheels are rubbing and pressing down the head of the lower right track when the rolling stock runs over it in deviation. The railhead eventually expands into the left and right after constant rubbing, and the angle of railhead tread surface also gradually changes as it adjusts to the conical shape of the wheels, which increases friction between the wheels and the track.

Consequences:

The consequence of the climbing of the left wheels of all three axles of the first bogie of locomotive E-Lok no. 91 79 1 363-013-8 at point no. 1 of Rimske Toplice station is the derailment of the locomotive of international goods train no. 41914, damage to the coupling and buffing device of first carriage Sggns no. 33 54 4576632-2 (right buffer at the front of the carriage and coupling device), damage to points nos. 1 and 3, deformation of the superstructure of point connection of points nos. 1 and 3.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to the public railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:

- urgent maintenance works, which will reduce the risk when the rolling stock is moving, must be implemented before more intensive running in a curve over the points whose replacement is anticipated due to wear;
- it is recommended that procedures on risk monitoring and supervision are made for each individual point element;
- deformations and wear of basic tracks must be established when monitoring point elements, especially in the area of points that are most exposed to risk (areas in curves).

Derailment of international cargo train no. 40851 at point connection of points nos. 8 and 9 of Breg station at km 494.664 on 6 November 2019 at 00:58

When international goods train no. 40851 was leaving track no. 2 of Breg station on 6 November 2019 at 00:58, the second axle of the first bogie of the sixteenth carriage derailed at the point connection of points nos. 8 and 9. The bogie's axle of carriage Sggmrs no. 37 80 495 2537-1 derailed because the left wheel climbed onto the railhead while running on the point connection, which was ascertained from the traces on the left track 4.2 metres before the frog of point no. 9 at km 494.661 and on the right track 1.0 metre before the rail slide track of the frog of point no. 9.

Photo 9: The red arrow shows the traces of the start of the climbing of the left wheel before the frog of point no. 9 and the blue circle shows initial traces of the left wheel derailment.

Container train no. 40851 with indication "PAS-KOP 125" (PAS – KOP, shorter for Paskov and Koper) was travelling from the starting station of Vratimov – Paskov Terminal 56-35034-8 to the final station of the Port of Koper 79-44351-5 according to a timetable. The train left Vratimov – Paskov Terminal station on 4 November 2020 at 13:30. The train travelled to the Port of Koper Luka via international border crossings Lanžhot–Kúty (Czech Republic–Slovakia), Rusovce–Rajka (Slovakia–Hungary), Gyekenyes–Koprivnica (Hungary–Croatia), Savski Marof–Dobova (Croatia–Slovenia). Along the entire route, the train made no stops to change the composition. At Breg station, train no. 40851 made an unusual stop due to the notification about an exceptional run on the incorrect left track between Breg–Zidani Most stations, which was ordered because of the replacement of a damaged insulator on the catenary system pole at track no. 2 of Zidani Most station.

Electric rolling stock was unable to run on this track due to the puncture of the electric insulator of the right track's catenary between Breg–Zidani Most stations. The breakdown strength became unstable on one of the insulators of the bearing elements of the catenary system pole, causing the insulator to puncture. A punctured insulator must be replaced because it becomes conductive and loses its primary function. Unstable breakdown strength is usually noticeable in rainy conditions and when there is high humidity in the air.

Therefore, train no. 40851 had to leave track no. 2 on the "B" side of Breg station towards the incorrect left track in the direction of Zidani Most station. The train was deviating when running over points nos. 8 and 9.

After derailing before the frog of point no. 9 of Breg station, the train drove with the derailed axle of carriage Sggmrs no. 37 80 495 2537-1 until it stopped at Zidani Most station. The pilot stopped on track no. 203 at km 501.417 and the end of the train was at km 500.900 at the stoppage.

Causes:

The direct cause of the climbing of the left wheel of the second axle of the first bogie of carriage Sggmrs no. 37 80 495 2537-1 onto the left railhead of the point connection of points nos. 8 and 9 in the direction of movement of train no. 40851 when leaving track no. 2 of Breg station lies in the deformation of horizontal geometry along the entire length of the connecting track, which is the result of compression of the track connection due to thrusting of points nos. 8 and 9 from opposite directions. The indirect cause of derailment was the poor condition and wear of the connecting track. The manufacturer, month and year of manufacture, and the type of track were engraved on the tracks. The left track stated "ZENICA IX 62-M-49" and the right track stated "ZENICA IV 63-M-49", which means that the tracks were over 55 years old at the time of the accident and they also had side wear on the railhead.

Consequences:

The consequences of the derailment of the second axle of the first bogie of the sixteenth carriage, Sggmrs no. 37 80 495 2537-1, of train no. 40851 include damaged wooden sleepers, track fastening material, base plates between tracks and sleepers, screws for attaching base plates from the site of derailment at point no. 9 of Breg station at km 494.664,53 until stoppage of the derailed carriage with the pilot in the area of track no. 203 of Zidani Most station at km 501.029, damaged derailed bogie of carriage Sggmrs no. 37 80 495 2537-1, mono-blocks of all four wheels of the first bogie of carriage Sggmrs no. 37 80 495 2537-1, towing hook and the hose of the main reservoir pipe directly in front of the cock on the end of the fifteenth carriage, Sggrs no. 37 80 495 1206-6, if viewed in the direction of movement.

Recommendations:

To avoid similar accidents in the future, the following recommendations are issued to:

1. the railway infrastructure manager, SŽ – Infrastruktura, d.o.o.:
   - implement investment maintenance works on the connecting track of points nos. 8 and 9 at Breg station;
   - draft a list of critical areas on public railway infrastructure with regard to safety where there is a risk of the derailment of rolling stock, including a risk assessment, a monitoring programme and an investment maintenance cycle;

2. the consignor:
   - observe the provisions of the guidelines for loading goods into interchangeable containers. The goods in the containers of the derailed carriage were not protected accordingly against longitudinal and transverse movements. PVC foil was placed between the loading surface of the container (floor) and the loaded wooden crates, which increased the sliding of the goods along the container's floor.

3.5 Explanation and introduction to, or background of, investigations

Until the issue of the 2019 Annual Report, the investigation body in rail transport failed to complete investigation procedures for three accidents that occurred in 2019. The deadline for the completion of the investigation prescribed in Article 6 of Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 has not yet expired.

Investigations instigated in 2019, although not yet completed					
Date of accident	**Type of accident**	**Place of accident**	**Legal basis**	**Reason investigation was not completed or was suspended**	**Who, why, when (decision)**
24 September 2019	Collision of passenger train no. 3216 with a goods road motor vehicle	Level crossing, between Škofljica and Ljubljana Rakovnik stations at km 143+033	Article 20 of the ZZelP	The project will be completed in 2020	24 September 2020
10 November 2018	Collision of passenger train no. 2408 with a cyclist	Level crossing, between Ljubljana Šiška and Ljubljana Vižmarje at km 567+774	Article 20 of the ZZelP	The project will be completed in 2020	10 November 2020

19 November 2018	Goods train no. 53213 hit a person	Ljubljana station on track no. 26 at km 565+364	Article 20 of the ZZelP	The project will be completed in 2020	19 November 2020

3.6 *Accidents and events investigated in the last five years (2015–2019)*

[A table of railway accidents investigated between 2015 and 2019, i.e.: serious accidents, other accidents, incidents and safety studies, with data from 2015 to 2019 as per types of accidents, collisions of trains, collisions with obstacles, derailments, accidents of people and rolling stock while driving, fires on rolling stock, hazardous substances and other] (Item 3.1 should be supplemented with trends established in accident investigations.)

Accidents investigated		2015	2016	2017	2018	2019	Total
Serious accidents Paragraph one of Article 20 of the Railway Safety Directive	Collision						
	Derailment		2			1	3
	Level crossing						
	People and rolling stock while driving						
	Fires on rolling stock						
	Other						
	Hazardous						
Other accidents Paragraph two of Article 20 of the Railway Safety Directive	Collision	1		1	1		3
	Derailment			3	2	4	9
	Level crossing	2	4	3	1	4	14
	People and rolling stock while driving				1	1	2
	Fires on rolling stock						
	Other	1		1	3		5
	Hazardous						
TOTAL		4	6	8	8	10	36

In 2015, the investigation body investigated four events, i.e. serious accidents, accidents or incidents, six in 2016, seven in 2017, eight in 2018 and ten in 2019.

Two accidents occurred at the same site in 2019. Two passenger trains collided on two occasions with two goods road motor vehicles at a level crossing protected by half barriers between Škofljica and Ljubljana Rakovnik stations. Two almost identical accidents also occurred at point no. 1 of Rimske Toplice station.

When investigating collisions of two passenger trains with two goods road motor vehicles at a level crossing protected by half barriers between Škofljica and Ljubljana Rakovnik stations, it was established that the risk for road and rail users was too substantial at this crossing due to the density of road and railway infrastructure facilities in a relatively small area and the density of road traffic. The level crossing would have to be relocated from this area to a more suitable location, or an overpass or an underpass should be built.

Since individual examples of accidents do not repeat frequently, there is no need for the drafting of more detailed studies on railway transport safety between 2010 and 2019.

4 RECOMMENDATIONS

Below is the table of realisation of the recommendations issued in the past 10 years.

Recommendations issued		Situation of recommendation implementation					
		Completed		In the process of implementation (or are being drafted)		Will not be completed (rejected)	
YEAR	no.	no.	%	no.	%	no.	%
2010	3	3	100				
2011	6	5	83.3			1	16.7
2012	12	10	83.3			2	16.7
2013	5	4	80			1	20
2014	8	5	62.5			3	37.5
2015	4	4	100				
2016	5	3	60	2	40		
2017	16	13	81.3	3	18.77		
2018	17	15		2			
2019	18	15	83.3	2	11.1	1	0.6
TOTAL	94	77	81.9	9	9.6	8	8.5

In 2019, the railway accident investigation body issued eighteen recommendations referring to:

- the establishment of a register of hazardous points and a plan of examining such points, which must be adjusted to the time of exploitation of points and the weight of goods transported over these points. The points being used longer and those that are more heavily burdened must be examined at more frequent intervals;

- the preparation of limit values of wear for individual point elements with an emphasis on the wear of diverging blades;
- the training process of train drivers who are advised to learn about the dynamics of driving series 363 locomotives over the area of points;
- active participation in the drafting of the study, Safety plan for implementing works on the investment infrastructure maintenance;
- the content of the safety plan, which should be drafted as per the main phases of investment maintenance, e.g. phase of constructing superstructure and substructure, phase of installation and phase of finishing works;
- active participation in the drafting of the safety plan, which would have to be made according to individual phases of the investment renovation of the track or line (e.g. phase of construction, phase of installation and phase of finishing works) due to the specifics of the work's technological processes and construction machinery involved;
- supervision of safety when working on the closed track and securing delimitations between the working and closed tracks;
- preparation of a list of points as per their risk exposure and suitable adjustment of the monitoring cycle, which must be dependent on the age of the point and its burdening;
- the point maintenance cycle, which should be adjusted to the age and burdening of the point;
- technical characteristics of the circumference of the tunnel should have smooth surfaces with no sharp edges or protruding rocks;
- the implementation of investment maintenance in the section of the track where the horizontal geometry collapsed;
- the preparation of a list of critical areas of public railway infrastructure with regard to safety where there is risk of the

derailment of rolling stock, including a risk assessment, a monitoring programme and an investment maintenance cycle;

- the observance of provisions of guidelines for loading and protecting goods in interchangeable containers, for which it is recommended that it is protected in such a way to prevent any movement during transport manipulation;
- the rearrangement of the entry to a car park for goods road motor vehicles situated next to a railway line;
- the removal of vegetation along the track, which obstructs the view of the level crossing;
- the construction of a new level crossing between road and rail infrastructure at another location where the safety of road and rail users will be ensured;
- the removal of the existing level crossing, which represents great risk for road users when crossing the railway line.

REPUBLIKA SLOVENIJA * MINISTRSTVO ZA INFRASTRUKTURO * 15 LJUBLJANA

Investigator-in-charge of railway accidents and incidents:
mag. Daniel Lenart, Secretary