STATE COMMISSION ON RAILWAY ACCIDENTS INVESTIGATION
Ministry of Interior and Administration

REPORT No. PKBWK 07/ 2022

on the investigation of a railway accident
that occurred on February 03, 2022, at 06:14 on the route Warlubie - Laskowice Pomorskie,
on track no. 2, category B level crossing at km 437.386
railway line No. 131 Chorzów Batory - Tczew
area of the Infrastructure Manager PKP PLK S.A. Railway Line Department in Bydgoszcz

WARSAW, December 14, 2022.

https://www.gov.pl/web/mswia/panstwowa-komisja-badania-wypadkow-kolejowych

This Report has been prepared under the provisions of *Commission Implementing Regulation (EU) 2020/572 of April 24, 2020, on the reporting structure to be used for railway accidents and occurrences investigation report*
(Official Journal of the European Union No. 132 of April 27, 2020)

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I. SUMMARY

Type of Event: Accident.

Description: An occurrence at a rail-road crossing (hereinafter referred to as a "level crossing" according to the Act on Road Traffic) of category B, involving the invasion of a passenger train of RU PKP Intercity S.A. into a bus standing in the rolling stock gauge between closed half barriers.

Date of Event: 03.02.2022 06:14 am.

Place of Event: Level crossing in track No. 2, located on route Warlubie - Laskowice Pomorskie of railway line No. 131 Chorzow Batory - Tczew at km 437.386, crossing identification number 131 437 386, geographical location 53º34'44 "N,18º36'54 "E.

Implications of the occurrence: As a result of the occurrence, the bus driver died on the spot. The bus was destroyed and the EU07A-002 locomotive and two train cars were damaged.

Causal factor:

(means any act, omission, event or condition or combination thereof that, if corrected, eliminated or avoided, would most likely have prevented the event)

Bus entering the crossing during emission of signals by traffic signals prohibiting passing that signal.

Contributing factors:

(means any act, omission, event or condition that affects the occurrence of an event by increasing its probability, accelerating the consequences over time, or increasing the severity of the consequences, but the elimination of which would not have prevented the event)

1) The inability of trucks and buses to exit the crossing with the half barriers closed without damaging infrastructure elements and traffic safety devices at the crossing, resulting from the following facilities, i.e.;
   - Concrete fencing and a built-in S-4 traffic signal in the road gauge at the exit section of the crossing,
   - A growing tree at a distance of 11 meters from the rail head and in front of the crossing,
   - Road in a curve, sharp turn of the road to the left immediately after the crossing.
2) Failure of the bus driver to make a determined attempt to exit with breaking the half barriers.

Systemic factors: Did not occur

Recommendations and their addressees:

1) Infrastructure manager PKP PLK Railway Line Department in Bydgoszcz will re-evaluate the significance of the change considering local conditions in connection with the implementation of post-accident recommendations.
2) The infrastructure manager PKP PLK Railway Line Department in Bydgoszcz will implement the findings included in the Note from the meeting of the Team for the assessment of the significance of the change in accordance with the procedure SMS-PR-03 *"Management of change" for the assessment of the significance of the change for the technical change consisting in the reconstruction of level crossings from category A to B on the line No. 131 Chorzów Batory - Tczew located at km 344.021; 437.386; 440.762* dated 15.04.2015, in particular, with regard to TVU monitors at the control panel of the Warlubie station.
3) The road manager will develop a new traffic organization project in the area of the cat. B level crossing, considering the topographical conditions of the intersection of the railway line and the road, in such a way that priority of passage through the crossing will be given to vehicles coming from the direction of the village of Bąkowski Młyn.
4) Infrastructure managers during public campaigns to improve safety at rail-road crossings will emphasize the formation of correct behavior of crossing users when a

road vehicle is between the barriers, including, among other things, the need to immediately exit the vehicle by braking the barriers or to leave the vehicle when it is damaged at the crossing.

5) Authorized infrastructure managers, in the event of a change in the category of a level crossing, reconstruction or construction of a new crossing or pedestrian crossing, will make it mandatory to assess the significance of the change, taking into account existing local conditions.

Fig. 1 - The aftermath of the occurrence (PKBWK's own material)

Fig. 2 - The aftermath of the occurrence (PKBWK's own material)

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II. INVESTIGATION AND ITS CONTEXT

1. Decision to initiate investigation

The Chairman of the State Commission on Railway Accidents Investigation (hereinafter "PKBWK" or "Commission"), Mr. Tadeusz Ryś, issued decision No. PKBWK.4631.2.2022, dated February 16, 2022, to initiate investigation to clarify the causes and circumstances of the accident at the level crossing, category B, at km 437.386. Taking into account this fact and the provisions of Article 28e (4) of the Law of March 28, 2003, on railway transport (consolidated text of Journal of Laws of 2021, item 1984, as amended), hereinafter referred to as the "Railway Transport Act", the accident was reported to the European Union Railway Agency within the prescribed period and registered in the database under the number PL-10193.

2. Grounds for the decision to initiate investigation

Based on an analysis of the circumstances, given the nature of the occurrence, which would have been a serious accident under slightly changed conditions, the Chairman of the GDPC decided that the Commission's Investigation Team should proceed under Article 28e (2) of the Railway Transport Act.

3. Scope and limitations of the investigation, including its justification, as well as an explanation of any delays that are considered a risk or other impact on the conduct of the investigation or the conclusions of the investigation

Investigation to determine the causes of the occurrence were conducted under Article 28h (1) of the Railway Transportation Act, which, in accordance with the provision of Article 28f (3), does not decide about guilt or liability.
Given the nature of the event, among other things, an analysis was made:

- crossing documentation, internal regulations of the infrastructure manager and the Railway Undertaking related to the investigated occurrence,
- Safety Management System (SMS) of the infrastructure manager and the carrier,
- Maintenance system documentation (DSU) of the railway vehicle.

During the course of the investigation, there were no restrictions that would adversely affect the investigation.

4. Aggregated description of the technical capabilities of the functions in the team of persons conducting investigation

The Chairman of the Commission appointed a three-member Investigation Team from among the permanent members of the Commission, with qualifications and competence within the scope of the investigation.

5. Description of the communication and consultation process conducted with persons or entities involved in the occurrence, during the investigation and in connection with the information presented

Pursuant to Article 28h (2) (5) of the Railway Transport Law, the Chairman of the PKBWK obligated designated persons from among the members of the railway commission to cooperate with the Investigation Team (letter PKBWK no. 4631.2.1.2022 dated 16.02.2022.).

According to the letter No. PKBWK 4631.2.2.2022 dated 25.02.2022, in PKP PLK S.A. Railway Lines Department in Bydgoszcz on 03.03.2022, the chairman of the railway commission handed over the collected documentation to the PKBWK Investigation Team in a protocol.
The chairman of the PKBWK requested by letter No. PKBWK.4631.2.3.2022 dated February 9, 2022, to the President of the Management Board of PKP Intercity S.A. in Warsaw for the release of the foreground image of the locomotive EU07A-002 and procedure P-301 for sharing data recorded by the monitoring system. The RU PKP Intercity S.A. provided relevant materials for the needs of the Investigation Team.

6. Description of the level of cooperation proposed by the actors involved

During the ongoing investigation of the circumstances and causes of the occurrence, the cooperation of with representatives of entities related to the circumstances of the occurrence did not raise any objections from the Investigation Team.

7. Description of the methods and techniques used in the investigation and the methods of analysis used to establish the facts and make the findings referred to in the report

Throughout the process aimed at clarifying the causes and circumstances of the occurrence, the investigation team considered the provisions of national regulations, the infrastructure manager's internal regulations and technical documentation. In addition, it drew on its own knowledge and experience and from the documentation gathered by the Investigation Team and the railway commission.
As part of the event investigation, the Investigation Team performed the following activities, among others:

- Inspection of the scene and its consequences on the day of the accident, including inspection of the crossing, access roads, railway line,
- Preparation of Fig.graphic and video documentation on the day of the accident and at later dates,
- Analysis of the documentation provided by the Railway Undertaking, railway manager, road manager and road vehicle owner,
- Participation in the hearing of the driver of train No. IC 5600/1,
- Analysis of the data of the recorder of the driving parameters of the railway vehicle and the image of the foreground (locomotive EU07A-002).

The following is a selection of the legislation, regulations and internal instructions used during the investigation:

European Union regulations:

1) Directive 2016/798/EC of the European Parliament and of the Council of May 11, 2016, on railway safety (Official Journal of the EU L 138 of May 26, 2016, p. 102, as amended).
2) Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27, 2016, on the protection of natural persons with regard to the processing of personal data and on the free flow of such data and repealing Directive 95/46/EC (General Data Protection Regulation (Official Journal of the EU L119 of 04.05.2016. p.1. as amended)) and the related Act of May 10, 2018 on the Protection of Personal Data (Journal of Laws No. 1000).
3) Commission Regulation (EU) No. 1158/2010 of December 9, 2010, on a common safety assessment method for compliance with the requirements for obtaining railway safety certificates.
4) Commission Regulation (EU) No. 1169/2010 of December 10, 2010, on a common safety assessment method for compliance with the requirements for obtaining railway safety authorization.

5) Commission Implementing Regulation (EU) 2020/572 of April 24, 2020, concerning the reporting structure to be used for the reporting of investigations of accidents and railway occurrences (Official Journal of the European Union No. 132 of April 27, 2020).

National regulations:

1) Railway Transport Act of March 28, 2003 (i.e. Journal of Laws 2021, item 1984, as amended).
2) Act of July 7, 1994, Construction Law (i.e. Journal of Laws of 2020, item 1333, as amended).
3) Law of June 20, 1997 Law on Road Traffic (i.e., Journal of Laws 2021, item 450, as amended).
4) Act of March 21, 1985, on public roads (i.e., Journal of Laws of 2021, item 1376, as amended).
5) Regulation of the Minister of Infrastructure and Development of October 20, 2015 on technical conditions to be met by intersections of railway lines and railway sidings with roads and their location (Journal of Laws 2015 item 1744, as amended).
6) Regulation of the Minister of Infrastructure dated January 11, 2021, on employees employed in positions directly related to the operation and safety of railway traffic and the operation of certain types of railway vehicles (Journal of Laws. of 2021, item 101).
7) Regulation of the Minister of Infrastructure dated July 18, 2005 on general conditions of railway traffic and signaling (i.e., Journal of Laws of 2015, item 360, as amended).
8) Regulation of the Ministers of Infrastructure and Internal Affairs and Administration of October 31, 2019, on traffic signs and signals (i.e. Dz. 2019 item 2310,as amended).
9) Regulation of the Minister of Transport and Maritime Affairs of March 2, 1999, on the technical conditions to be met by public roads and their location (i.e. Journal of Laws of 2016, item 124, as amended).

Internal instructions of the carrier PKP Intercity S.A.

1) Instruction for the driver of a traction vehicle (Bt-1) I 304.
2) Instruction for conductor teams within the scope of passenger train service operated by "PKP Intercity" S.A. (Br-21) BFO I 001.
3) Instruction on health and safety of electric and diesel traction vehicle traction teams Bbhp-1.
4) Instruction on professional preparation, examinations, and periodic instruction of employees of "PKP Intercity" S.A. (IC-B) I 300.
5) Instruction on professional preparation of employees of "PKP Intercity" S.A. (BA-5) I 301.

Internal instructions of the infrastructure manager PKP PLK S.A.

1) Ir - 8 Instruction on the handling of serious accidents, accidents and occurrences in rail transport.
2) Ir - 1 Instruction on train operation.
3) Ie - 4 (WTB-E10) Technical guidelines for the construction of railway traffic control devices.
4) Id - 1 Technical conditions for pavement maintenance on railway lines.
5) Ik - 2 Railway safety inspection instructions.
6) Id - 7 Instruction on supervision of railway lines.
7) Ie-111 Requirements for closed-circuit television systems used at Category B level crossings.

8. Description of difficulties and specific challenges encountered during investigation

The members of the Investigation Team did not encounter difficulties or problems that could affect the investigation, timeliness or conclusions.

9. Any interactions with the judicial authorities

The chairman of the PKBWK requested by letter No. PKBWK.4631.2.03.2022, dated April 05, 2022, to the Regional Prosecutor's Office in Swiecie to gain access to the collected documents relevant to the determination of the circumstances and causes of the occurrence. These documents were made available to the extent specified in the said letter.

10. Other information relevant to the ongoing investigation

No other relevant information.

III. DESCRIPTION OF THE OCCURRENCE

1. Event and background information

1.1. Description of the type of occurrence

An occurrence at a level crossing involving passenger train IC 5600/1 of the Railway Undertaking PKP Intercity S.A., comprised of locomotive EU07A-002 and seven wagons, and a Mercedes INTEGRO bus run by PKS Grudziądz. The occurrence involved the train hitting right rear part of the bus, which stand on the crossing between closed half barriers, trying to leave the crossing. After the impact, the bus was thrown to the right side of track No. 2, in direction of the train to a distance of about 100 meters from the axis of the crossing.

1.2. Date, exact time, and location of the occurrence

The occurrence occurred on 03.02.2022 at 06:14, at a category B level crossing, track No. 2, located on the route Warlubie - Laskowice Pomorskie, at km 437.386 of railway line No. 131 Chorzów Batory - Tczew.

1.3. Description of the site of the occurrence, including meteorological conditions and geographic conditions at the time of the occurrence, as well as any work being carried out at or near the scene of the occurrence

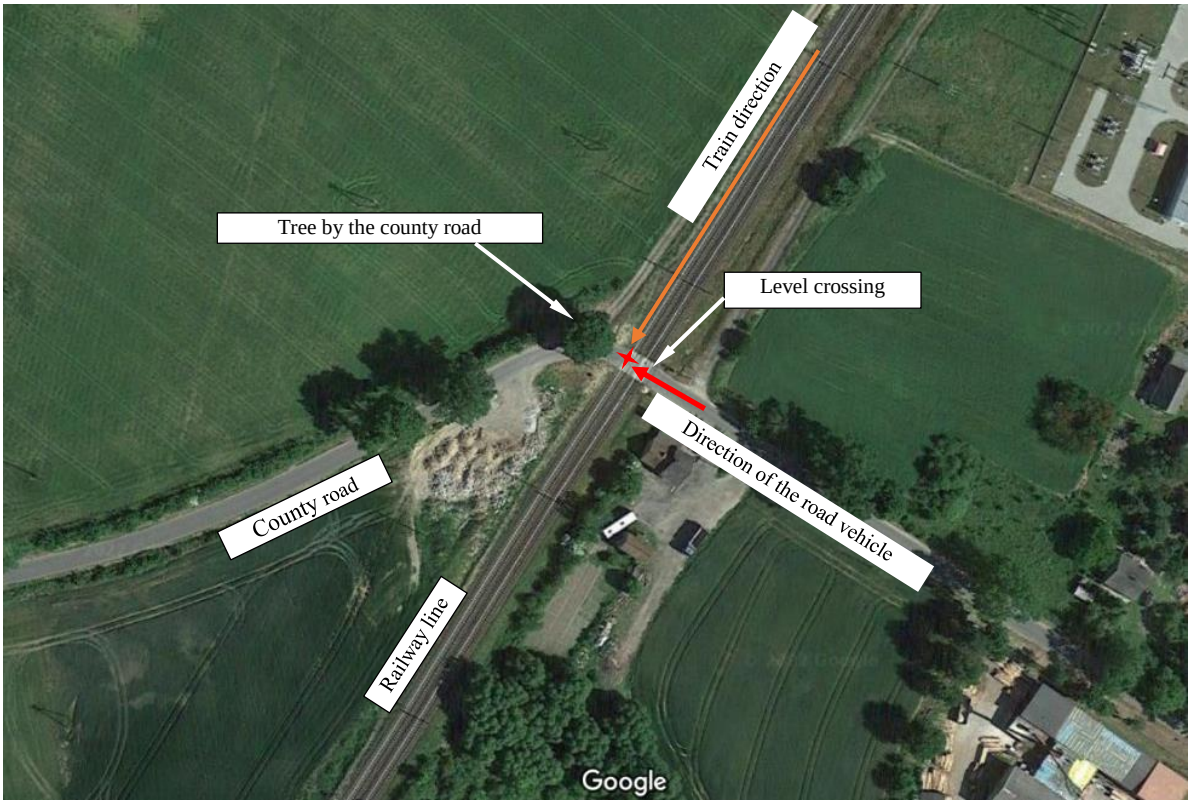
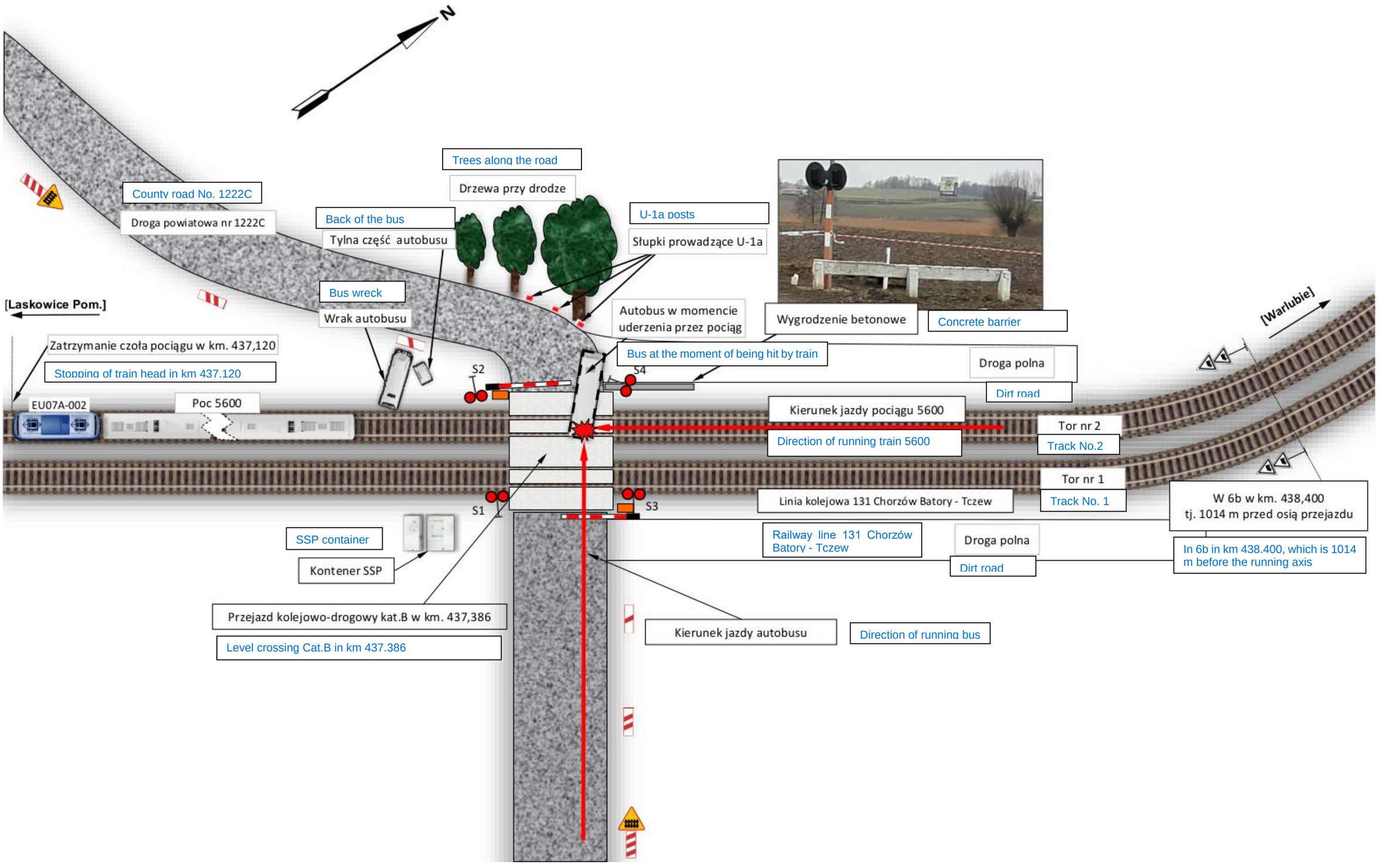


Fig. 3 - General view of the site (source: Google Earth)

The crossing where the accident occurred, is located on district road No. 1222C Bąkowski Młyn - Bąkowo, made of bituminous pavement with a dirt shoulder. The width of the roadway between traffic signals S1 and S3 is 5.10 m, while between traffic signals S2 and S4 is 4.70 m (Figure 1). The permissible speed of road vehicles on the road in the area of the level crossing according to the crossing metric is 50 km/h. The district road is intersected with the railway track at an angle of 85°. The area of the level crossing with the road is in an undeveloped area. County road No. 1222C from the village of Bąkowo on both sides is marked with warning signs A-9 and indicator posts on the right side G-1a, G-1b, G-1c. In front of the crossing, on both sides of the access road there are traffic signals of the

automatic crossing system. The distances of the traffic signals from the outermost rail of track 1 are: S1 - 6.5 m, S3 - 6.7 m, while from the outermost rail of track No. 2 they are: S2 - 6.5 m, S4 - 6.1 m. The crossing is equipped with semi-control barriers that close the entrance to the crossing from both directions of travel on county road No. 1222C. Visibility of signals given by traffic signals correct.
At the S4 traffic signal at 5.50 meters from the outermost rail of track No. 2, parallel to the track axis, a concrete fence is built, preventing safe exit from the crossing. In the direction of the village of Bąkowski Młyn (the direction of the bus), there is a tree behind the crossing at 11 meters from the extreme rail of track No. 2, in front of which the road turns sharply to the left (Figure 1).
The tree made it difficult for the bus to turn gently to the left to avoid damaging the turnpike devices and for the bus to stay in its lane while turning without occupying the opposite lane.
The geographical coordinates of the crossing are 53º34'44 "N 18º36'54 "E. The occurrence occurred during dark season without precipitation or fog, with an ambient temperature of -2ºC.
No work was carried out in the area of the crossing affecting the occurrence.

Figure 1 - Sketch of the accident (PKBWK material)



1.4. Deaths, injuries, and property damage

a) Passengers, employees or contractors, level crossing users, intruders, other people on the platform, other people not on the platform

The accident resulted in the death of one person (the bus driver). None of the passengers and the train crew IC 5600/1 were injured.

b) Cargo, luggage, and other property

As a result of the accident, a road vehicle (bus) was destroyed. There was no damage to the luggage of the train passengers.

c) Rolling stock, infrastructure, and environment

Rolling stock

The train was not derailed. The front end of locomotive EU07A-002 - cab A was damaged, i.e. windshields, bumpers, scrapers power and brake lines, windows. In addition, the side plating of the locomotive was damaged, along with brake cylinders and shock absorbers, and the side window of cab B was broken. As a result of the application of sudden braking of the train, flat spots on the wheels in two wagons (the restaurant wagon and the last one in the train) appeared. As a result of the impact of the spare wheel from the road vehicle, the ventilation duct on the chassis of the second wagon in the train set was damaged.

Fig. 4 - View of the railway vehicle after the accident

Infrastructure

The thrown road vehicle destroyed the junction box for the axle counter of the automatic crossing system, the N2 grade-crossing gate bars and the S4 signal canopy. Behind the crossing at a length of approx. 20 meters, track No. 2 was deformed.

Environment

There was no environmental contamination because of the occurrence.

1.5. Description of other effects, including the impact of the event on the regular activities of the entities involved

The consequences of the occurrence necessitated the suspension of train traffic on track No. 2 on the route Warlubie - Laskowice Pomorskie. On 03.02.2022 track No. 2 was closed to train traffic from 06:14 to 15:16, 24 passenger trains were delayed for 365 minutes and six freight trains for 506 minutes.

1.6. Identification of the individuals, their functions, and the entities involved, including any ties to contractors or other relevant parties

The following people were directly involved in the occurrence:

- Driver of the IC 5600/1 train - employee of RU PKP Intercity S.A. ,
- Second driver of the IC 5600/1 train - employee of RU PKP Intercity S.A. ,
- Driver of the road vehicle (bus) - employee of PKS in Grudziądz,
- Children caretaker - employee of the Warlubie municipality being in the bus.

1.7. Description and identifiers of trains and their composition, including associated rolling stock and registration numbers

Train No. IC5600/1 was composed of locomotive EU07A-002 and seven passenger wagons. Locomotive EU07A-002 had a Certificate of Technical Efficiency of the Railway Vehicle No. BPT1j-01/2019, for which a Permission to Operate the type of Railway Vehicle No. T/2013/0119 was issued. The certificate is valid from 04.01.2019 to 03.01.2024, or for a mileage of 750,000 km calculated from 000350 km. Mileage at the time of the occurrence 448,921 km. The locomotive had the ID PL- PKP IC 91 51 5 160 001-1.

EVN numbers of the wagons in the train set:

- 50 51 2078 809-4
- 50 51 2078 801-1
- 50 51 8478 102-7
- 51 51 8870 225-9
- 61 51 1970 215-2
- 50 51 2078 790-6
- 51 51 2071 074-1

Train data IC 5600/1- from the brake test card:

- train length..... ..... 190 m
- total train weight..... 419 tons
- required percentage of braking mass.... ... 148%
- actual percentage of braking weight.... ... 160%
- braking mass required..... 621 tons
- actual braking weight..... 674 tons.

1.8. Description of relevant parts of infrastructure and signaling - track type, switch, dependency device, signal, train protection systems

Track

Rail type.....	-	60E1 (UIC60) - year of construction 2010
Sleepers.....	-	prestressed concrete of PS94 type
Attachment type.....	-	spring type Sb3
Type of ballast.....	-	gravel thickness 30 cm
Highest permissible speed of trains on the route....	-	160 km/h

Level crossing:

- A crossing constituting a one-level intersection of the railway line No. 131 Chorzów Batory - Tczew with the district road No. 1222C Bąkowski Młyn - Bąkowo, equipped with half barriers and traffic signals,
- Individual ride identification number (yellow sticker): 131 437 386,
- Axis of the passage - km 437,386,
- Angle of intersection of the road with the railway - 85°,
- Crossing surface constructed with 4 sets (2 sets per track) of CBP-type crossing plates,
- Road surface on access roads - bituminous,
- Gradeline of the access road:
  - Right side (direction of entry of a road vehicle to the crossing) - 0.6% over a length of 150 m,
  - Left side 0.0% over a length of 100 m,
- Crossing traffic product - 29095; last, measurements were taken on October 19-20, 2021,
- Overall length of the passage - 14.5 m,
- Width of the road crown at the crossing - 6.0 m,
- Roadway width of the road at the crossing - 5.0 m,
- Width of the roadway on the access road left side - 6.0 m,
- Width of the roadway on the access road right side - 4.2 m,
- Maximum speed of road vehicles when passing the crossing - 50 km/h,
- Illuminated crossing - two light poles.

Automatic crossing system (SSP):

- Type of automatic crossing system equipment - RASP-4Ft,
- Type of signaling devices -SD-K2, 4 pieces,
- Electronic sound generator - 2 pieces,
- Type of crossing warning track - Top 99, 2 pieces, built on the side of the Laskowice Pom. station,
- Type of remote control device - mounted at Warlubie station,
- Type of grade-crossing gate drive - RHR 95,
- Type of grade-crossing bar - DES pieces 2,
- Built-in devices for speeds of 160 km/h,
- Traffic protection devices at the crossing linked to the traffic control devices of Warlubie station.

Signage of the crossing on the day of the occurrence:

Signage of the district road from the Bakowo village to the crossing.

On the county road, there is an A-9 warning sign and G-1a, G-1b, and G-1c indicator posts. In front of the crossing, on the right side from the direction of Bąkowo, there is an SSP traffic light (S1), and on the left side there is an SSP traffic light (S3) facing the county road. The signals transmitted by this traffic light can be seen from the county road from 60 meters.

From the side of the track set indicators W6b:

- In the direction of increasing kilometers of the railway line placed at km 436.350, i.e. 1036 meters from the axis of the crossing,
- In the direction of decreasing kilometers of the railway line placed at km 438,400, i.e. 1014 meters from the axis of the crossing.

1.9. Any other information relevant to the description of the event and background information

The Investigation Team did not identify any other relevant information in the context of the occurrence description.

2. Fact-based account of events

2.1 Chain of contiguous events that led to the occurrence, including: actions taken by the persons involved; operation of rolling stock and technical installations; operation of the operating system.

On February 03, 2022, at approximately 06:10 a.m., a bus left Warlubie, which, according to the planned route, was to pick up children from Lipinki and take them to school in Warlubie. In the bus, in addition to the driver, there was a caretaker of the children. The route of the bus was along district road No. 1222C toward the village of Rulewo, where there is a category B level crossing. The automatic crossing system (ssp) of this crossing was in a state of warning due to a freight train running on track No. 1 in direction of Warlubie station. Due to the closed grade-crossing gate and the activated traffic light, the bus stopped in front of the crossing. After the freight train passed the crossing, the system began to open the grade-crossing gate. Before it was fully opened and the Warlubie signals given by the traffic signals were turned off, an approaching IC 5600/1 passenger train on track 2 from the station caused the warning state of the automatic crossing system to be maintained and the grade-crossing gate closed again. The lights on the traffic signals continuously transmitted signals prohibiting entry the crossing, and the grade-crossing gate immediately after opening, began to close. The bus driver, not paying attention to the signal forbidding entry emitted by the traffic signals (S1 and S3 visible to him), entered the crossing while the grade-crossing gate was closing. The bus driver reached the gate-crossing gate on the other side of the crossing and stopped the bus. During the stop, he instructed the children's caretaker to get off the bus and raise the grade-crossing gate manually.

Fig. 5 - Bus stopping

Fig. 6 - Moment of impact

The caretaker, after several unsuccessful attempts to raise the grade-crossing gate, noticed that a train was approaching from Warlubie station. He immediately instructed the driver to leave the crossing. The bus driver slowly moved to exit the crossing and bypass the grade-crossing gate without damaging it.
The driver of train IC5600/1, after passing Warlubie station and exiting the curve, noticed a standing bus at the crossing. He implemented emergency braking of the train and gave the audible signal "Attention". The train hit the rear of the bus traveling at a speed of about 90 km/h.
The time from when the bus stopped at the crossing until the occurrence was 45 seconds.

Fig. 7 - View of the bus at the crossing from the cab of the railway vehicle

As a result of the impact, the bus turned 90 degrees and sideways hit the locomotive and was thrown to the right side, looking in the direction of the train, about 100 meters from the crossing.

2.2. The sequence of events from the occurrence of the occurrence to the completion of the emergency services, including: measures taken to protect and secure the occurrence site; efforts of rescue and emergency services

Immediately after the accident, the caretaker called the emergency number 112 and notified the Emergency Notification Center of the accident by heading toward the crashed bus. Near the crashed bus, he found the driver lying down, who gave no signs of life. After medical services arrived at the scene of the accident at 06:30, the doctor declared the bus driver dead. The police patrol arrived at the scene of the accident at 06:30, while at 07:45, employees of the Criminal Police Department in Swiecie arrived. The rescue operations involved units of the Volunteer Fire Brigade from Warlubie (arrival at 06:27) and Wielkie Komorsk (arrival at 06:32), the Military Fire Brigade from Grupa (arrival at 06:42) and the Rescue and Fire Fighting Unit from Swiecie (arrival at 06:43). A prosecutor also arrived at the scene to supervise police work. Passengers of train No. IC 5600/1 (53 persons), with the assistance of the fire department, walked on the platform to train No. 57108 between Gdynia Główna and Zbąszynek and continued their journey. After the completion of police operations, the prosecutor at 10:15 am allowed the train to run to Laskowice Pomorskie station.
After the train left the route, the technical services of the infrastructure manager went to work to repair the damage caused by the occurrence. After repairing the damaged infrastructure elements, normal train traffic was restored on 03.02.2022 at 17:30.

IV. OCCURRENCE ANALYSIS

1. Roles and responsibilities

1.1. Railway Undertakings or infrastructure managers

Infrastructure manager PKP PLK S.A. Railway Line Department in Bydgoszcz

Among other things, the infrastructure manager is responsible for the proper maintenance of the railway line, including crossings. The infrastructure manager's duties are defined, among other things, by the provision of Article 62 of the Law of July 07, 1994 - Construction Law. This provision obliges managers to conduct annual inspections and five-year inspections of construction facilities (including crossings, together with crossing safety devices). The infrastructure manager's internal instruction Id-1 in §31 imposes an obligation to conduct a diagnostic survey of crossings (including railway and road surfaces, visibility conditions, lighting). In addition, Instruction Ie-7 (E-14) includes the scope, time periods, methods of testing regarding traffic control devices (including crossing safety devices). Timelines for inspections of construction facilities included in the instructions in accordance with Article 62 of the Law of July 07, 1994 - Construction Law.

In 2015, the crossing located at kilometer 437.386 on railway line No. 131 was included in the program "*Improvement of safety and elimination of operational hazards at selected level crossings in the Kujawsko-Pomorskie Province.*" The task under this program consisted of changing three level crossings from category A to category B, along with the installation of new traffic safety devices at the crossings on railway line No. 131.The applicable Safety Management System at PKP PLK S.A. requires, before deciding on changes related to traffic safety, conducting an assessment of the significance of the replacement. On April 15, 2015, a meeting of the Change Significance Assessment Team was held in Bydgoszcz in accordance with procedure SMS-PR-03 "Change Management".

The change significance assessment team at the meeting evaluated the draft technical change in the field of srk equipment and telecommunication recording in the change significance assessment memo:

Railway traffic control devices [srk]:

- Container for ssp equipment,
- Control devices ssp,
- Impact devices,
- Power supply equipment for crossing signals, equipped with systems that sustain the operation of the system for at least 8 hours after a loss of primary power supply using maintenance-free batteries,
- Road traffic signals and road traffic signals with acoustic signals,
- Grade-crossing gate drives with half barriers,
- ToP crossing warning discs,
- UZK remote control equipment for ssp will be located at a distance of 1179 m from the crossing, the signal box at Warlubie station km 438.565,
- SHP devices,
- Indicator W11p,
- Burglar and fire alarm system, fire station communications.

Telecommunication:

- TVU devices for observation of the crossing and recording of events at the crossing with the ability to identify the registration number of the road vehicle (data storage 7 days),
- TVU monitors at the Warlubie station's control panel at 1179 meters from the crossing.

The team for assessing the significance of the change considered the change in crossing category from A to B category with the above-mentioned technical equipment to be a change that affects safety, but insignificant.

After analyzing the collected documentation, the Investigation Team found that in the Terms of Reference (ToR) of 2012, the project for the telecommunication branch did not include the installation of TVU monitors at the Warlubie station's disposition switchgear, allowing observation of the crossing.
The memo from the meeting of the Change Significance Assessment Team of April 15, 2015, requires "the development of crossing preview monitors in the Warlubie station's control room at a distance of 1179 meters from the crossing."
The same Note from the Meeting of the Team for the Assessment of the Significance of the Change of Crossing Categories from Category A to Category B at the crossing at kilometer 440.762 of railway line No. 131, included a requirement for the installation of crossing-view monitors at the Warlubie station's signal box at 2197 meters from the crossing. In the Terms of Reference (ToR) of 2012, the project also did not provide for the installation of crossing preview monitors at the Warlubie station's signal box.
As can be seen from the above, the Change Significance Assessment Team evaluated a different technical configuration than envisioned in the ToR and the project.
Based on the memo, the Change Significance Assessment Team prepared a *Report* on April 15, 2015, *from the assessment of the significance of the change*, which did not take into account the criteria included in the memo, in which the Team assessed the change as insignificant, since the development of crossing preview monitors at the Warlubie station's control room was included.
The process of assessing the significance of the conversion of the transit category from A to B did not consider the elements relevant to the criteria for considering the change as an insignificant change.
The requirement for the development of these monitors was not considered at the design and implementation stage of the project.
In the opinion of the Investigation Team, the circumstances of the evident risks arising from the local conditions of the passage and the non-compliance with the ToR, the Investigation Team considered as an irregularity the failure to meet the requirements of procedure SMS-PR-03 Change Management version 1 of January 27, 2015.

PKP PLK S.A. Railway Lines Department in Bydgoszcz presented protocols of annual and five-year reviews (inspections) of the crossings in terms of the surface and in terms of traffic protection devices at the crossing. An analysis of the protocols of the five-year, annual, and ad hoc inspections carried out in 2020 and 2021 on the maintenance of the facility for checking the technical condition of the traffic control equipment and its suitability for use, as well as the diagnostic examination of the traffic control equipment, was carried out. The diagnostician, after inspecting the equipment, found no abnormalities and determined its technical condition to be good. Therefore, there was no need to issue recommendations and the facility was allowed to continue operation without issuing recommendations requiring corrective action.

Railway Undertaking PKP INTERCITY S.A.

The carrier designated a railway vehicle with a certificate of authorization for operation of a type of railway vehicle and a certificate of technical efficiency of the vehicle to carry out the transport task. The designated train crew operating the train had all the authorizations and qualifications required by the regulations. The train was operated based on a timetable.

The obligations of carriers in the area of safe driving are specified in the infrastructure manager's instruction Ir-1 - on train operation, Ie-1(E-1) - instruction on signaling, and the carrier's internal instruction Bt-1 - instruction for the driver of the traction vehicle. Based on the analysis of the collected material, the Investigation Team did not find any irregularities in the conduct of the train crew during the operation of the train as well as after the occurrence.

1.2. Maintenance entities, maintenance workshops or any other maintenance providers

The Railway Undertaking PKP INTERCITY S.A. supplying the rolling stock is responsible for its efficiency, technical condition, and compliance with the vehicle maintenance process. The locomotive driving the train has a railway vehicle type certificate and a current certificate of technical efficiency. The carrier presented documentation of the last technical inspections of railway vehicles performed. The investigation team found no irregularities in the maintenance and operation of the rolling stock. The technical condition of the railway vehicle did not affect the occurrence.

1.3. Rolling stock manufacturers or other suppliers of railway products

Based on the collected research material, the Investigation Team did not identify factors influencing rolling stock manufacturers and suppliers of railway products to the occurrence.

1.4. National safety authorities or the European Union Railway Agency

The President of the Railway Transport Authority (UTK) supervises rail traffic safety. The Investigation Team, based on the collected research material, did not identify factors influencing the national safety authority on the occurrence. From 2019 to the date of the accident, the President of the Office of Rail Transport (UTK) conducted 23 inspections at the Bydgoszcz Railway Works. As part of these inspections, 60 level crossings were covered. No inspections were carried out at the crossing in question.

1.5. Notified bodies, designated bodies, or risk assessment authorities

The Investigation Team, based on the collected research material, did not identify factors influencing notified bodies and risk assessment authorities on the occurrence of the occurrence.

1.6. Certification bodies of entities responsible for maintenance listed in section 1.2

The certification body of the Railway Undertaking PKP Intercity S.A. as the entity responsible for maintenance under the safety management system (SMS) is the President of the Office of Rail Transport. The Investigation Team, based on the collected research material, did not identify factors influencing the Railway Undertaking's certification body on the occurrence of the occurrence.

1.7. Any other person or entity that has a connection to the occurrence, as possibly documented in one of the relevant security management systems, or referred to in the register or the relevant legal framework

Pursuant to §81 of the Decree of the Minister of Infrastructure and Development dated October 20, 2015, *on technical conditions to be met by intersections of railway lines and railway sidings with roads and their location* (i.e., Journal of Laws 2015, item 1744, as amended), the duties of proper marking and maintenance of the access road to the crossing belong to the administrator of district road No. 1222C.
Marking of the crossing correct.

2. Rolling stock and technical installations

Powered railway vehicle
Electric locomotive EU07A-002 is equipped by the manufacturer with TELOC 1500 electronic system for recording driving parameters.
The Investigation Team analyzed selected driving parameters recorded in the system immediately before the occurrence. The parameters of the train's driving on the 1 km route and during the 1 minute before the occurrence to the moment of stopping after the occurrence are shown in the following graph with description.
The following charts show the following driving parameters of the IC 5600/1 train:

1) Ciś._w_przew._Gl (bar) - pressure in the main line,
2) Speed - speed in km/h,
3) SW- sending an audible signal,
4) Ham_Nag_Man - activation of emergency braking,
5) Przyc_Czujności - use of the vigilance button,
6) Kab._B_aktywna - control from cab B.

Fig. 2 shows the driving characteristics of train No. IC 5600/1 as a function of time.
Fig. 3 shows the driving characteristics of train No. IC 5600/1as a function of distance.

The times recorded in the locomotive were not synchronized with the infrastructure manager's equipment.
Description:
- From 06:16:06 (km 22 322.2322) to 06:16:21 (km 22 322.6322) the train passes through Warlubie station at a speed of up to 120 km/h,

- After passing Warlubie station, the train speed increases to 120.4 km/h,
- At 06:16:26 (km 22,322.8322), the driver noticed an obstacle at the crossing, applied the braking travel setter and the air pressure in the main line dropped,
- From 06:16:27 to 06:16:31 - emitting the sound signal "Attention",
- From 06:16:28 to 06:16:35 - a drop in speed from 120.4 km/h to 90.8 km/h,
- 06:16:35 - at a speed of 90.8 km / h, he ran into an obstacle and the pressure in the main line dropped to 1.03 bar,
- 06:16:52 - stopping the train after 17 seconds and covering about 239 m.

Figure 2 - Graph of driving parameters of locomotive EU07A-002 as a function of time (PKBWK material)

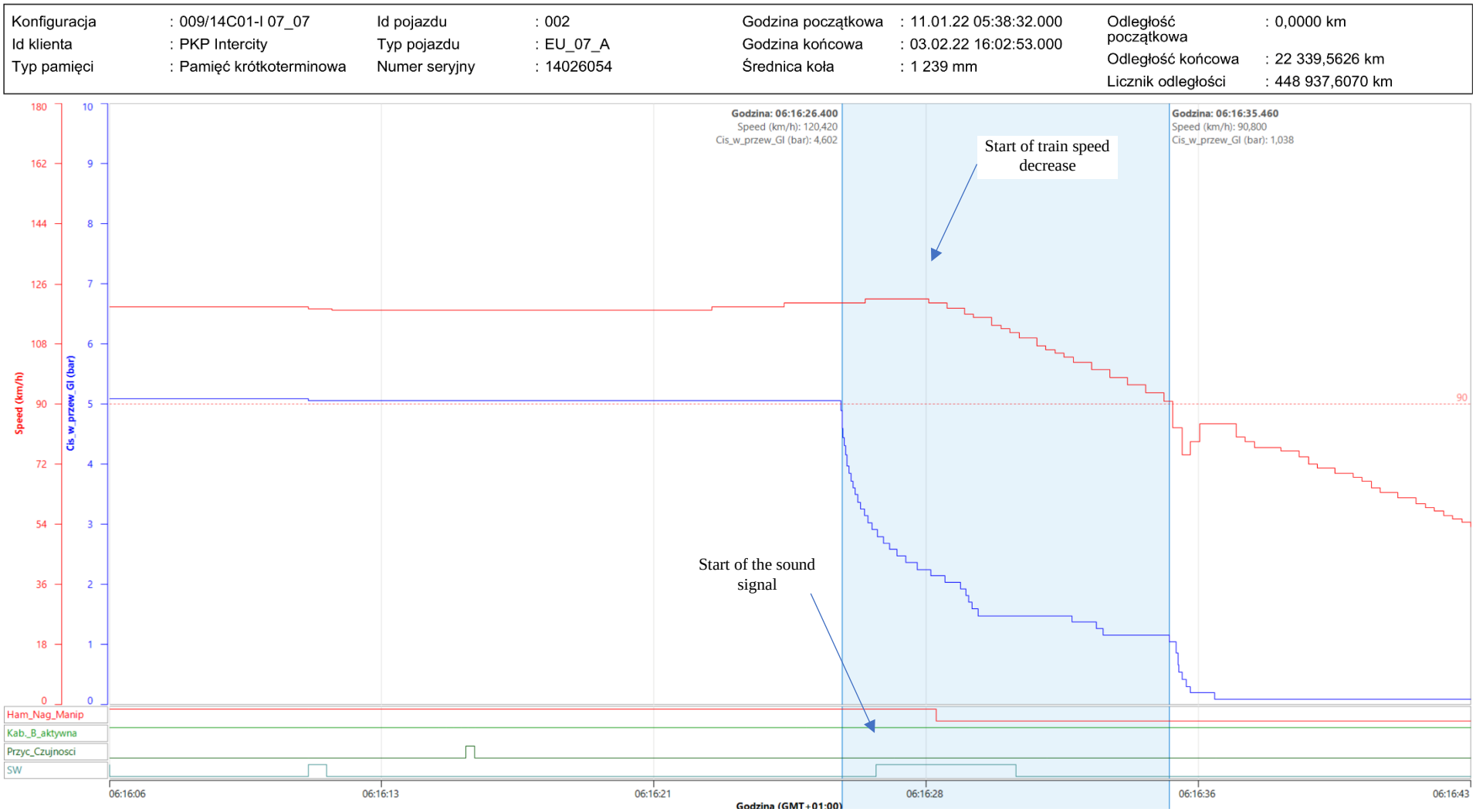
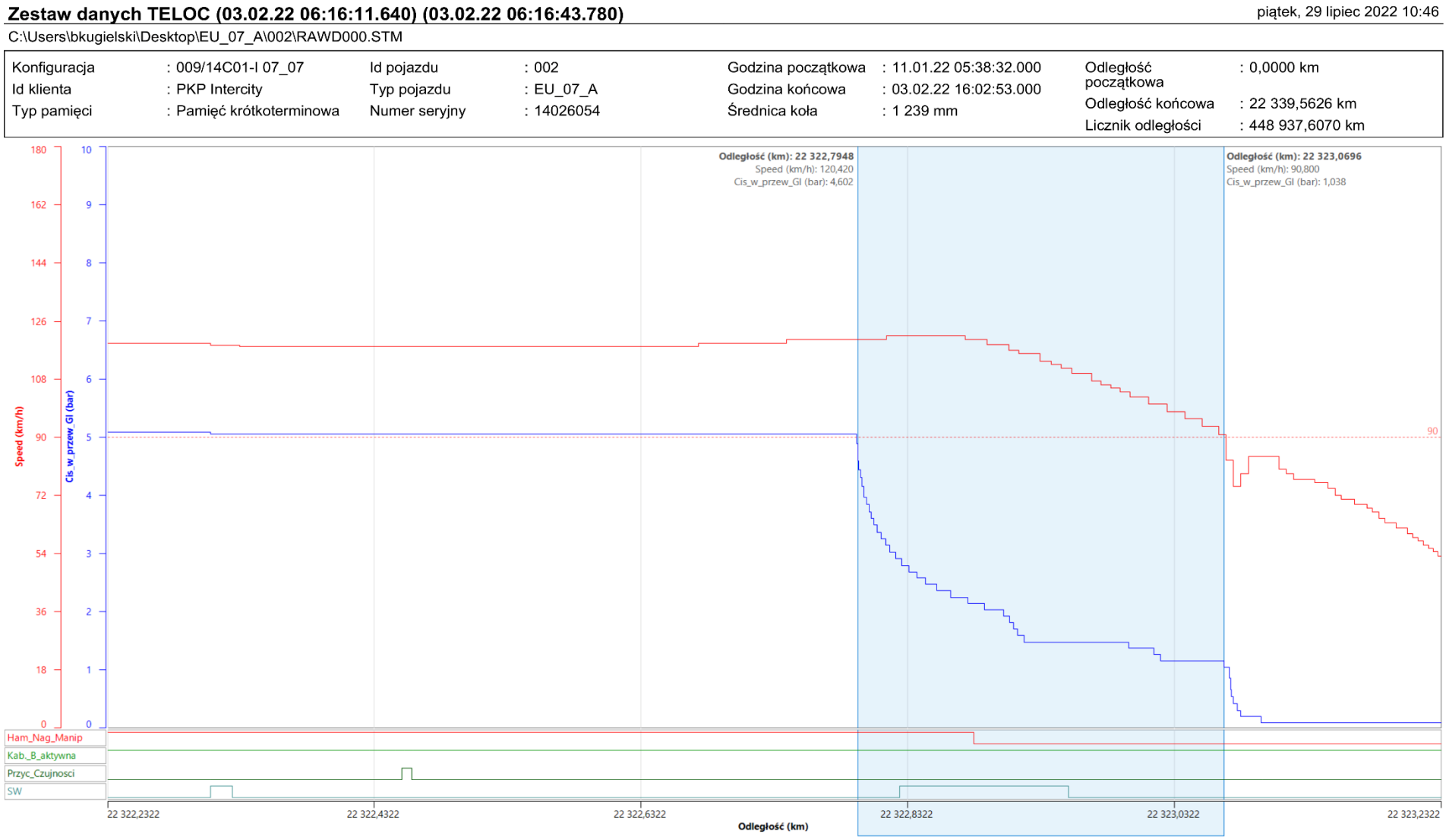


Figure 3 -Drawing of driving parameters of locomotive EU07A-002 as a function of distance (PKBWK material)



Automatic crossing system

In 2015, the category of the crossing in question was changed from category A (crossing operated from a distance by a traffic officer of Warlubie station, 4 grade-crossing gate bars closing the entire road) to category B. RASP-4Ft type automatic crossing system equipment and SD-K2 traffic lights for category B were installed. The system is equipped with TOP crossing warning discs informing drivers of trains approaching the crossing from the Laskowice Pomorskie station about the efficiency of the equipment, while for trains coming from the Warlubie station the equipment is linked to the traffic control devices of this station. Two grade-crossing gate drives of the RHR-95 type have been installed, as well as 4 traffic signals SD-K2, including two with acoustic signaling. The crossing was equipped with a monitoring system consisting of 4 cameras (two for each direction of road vehicles). On the day of the accident, the equipment was operating properly. The maintenance process carried out correctly, in time periods in accordance with approved schedules. The Investigation Team raises no objections to the operation and maintenance of the automatic crossing system.

3. Human factors

3.1 Human and individual characteristics

The driver of the road vehicle was performing the first course on the day of the occurrence. According to the explanations provided by his employer, the bus course was planned and prepared. The driver was providing a service under a contract of mandate. His good health, the absence of contraindications to driving, confirmed by an occupational physician, allowed him to perform this service. According to the protocol of inspection and postmortem examination, it follows that the driver of the road vehicle was not found to have alcohol in his blood as well as no psychoactive compounds.

The driver of the bus entered the crossing despite the operating traffic light and sound signals on the traffic signals prohibiting entry. After entering the crossing, the half barriers were closing on both sides of the crossing. He stopped the bus in front of the closed half barriers and could not leave the crossing without damaging the vehicle and elements of the infrastructure used to secure traffic at the crossing (the grade-crossing gate bar, the S4 traffic signal and the concrete fence). From the analysis of the material collected by the Investigation Team, it appears that this situation may have caused stress to the driver. This factor may have led to the driver's failure to take immediate action to exit the level crossing or exit the vehicle.

The bus driver's failure to make a determined attempt to exit causing damage to the vehicle and infrastructure elements, was considered by the Investigation Team as a contributing factor.

According to Article 49(1)(1) of the Traffic Law, stopping a vehicle at a crossing is prohibited.

In addition, the investigation into the cause of the occurrence confirmed the correct course of action of the driver, who, upon noticing an obstacle at the crossing, immediately implemented sudden braking of the train with simultaneous giving of the "Attention" signal. An examination of the train driver did not reveal the presence of alcohol in his blood as well as psychoactive compounds.

3.2 Job-related factors

Electric locomotive EU07A-002 had the appropriate approval for operation on the PKP PLK S.A. network and was technically sound. The working time of the train crew in accordance with the applicable standards. The driver of train No. IC5600/1 had 12 hours of rest before starting work. The driver had the required training in the operation of EU07A-series traction vehicles and other training related to the work position.

The road vehicle was in good working order and had a current technical examination allowing it to be operated safely. The driver of the road vehicle had the appropriate authorization to drive this type of vehicle.

3.3 Organizational factors and tasks

From the material collected by the Investigation Team, it appears that the rail and road carriers provided the service personnel involved in the occurrence with the statutorily required rest time. These employees had all the required regulatory and instructional authorizations and authorizations related to the related to the activities performed on the job. The employer equipped them with the necessary instructions and regulations to ensure safe work performance. The Investigation Team raises no objections to factors related to organizational tasks.

3.4 Environmental factors

Fig. 8 - View of the crossing from the direction of the bus (PKBWK's own material).

The above Figure shows a view of the crossing in question from the position of the driver of a road vehicle. The essence of the design of Category B level crossings equipped with two half barriers is to protect road users from entering the crossing (inrun half barrier closing the right lane of the road) and to allow safe exit from the crossing (an unclosed exit lane of the road from the crossing) in the event that a road vehicle is on the crossing after the grade-crossing gates start to close. Factors that significantly limit the functionality of the crossing in question are the narrow road, the concrete fence, the sharp left turn of the road behind the crossing and the tree growing on the side of the road 11 meters from the extreme rail. It was difficult and even impossible for trucks and buses to leave the crossing without damaging elements of the railway infrastructure and the road vehicle.

During the on-site visit to the crossing, the Investigation Team observed the way trucks crossed the crossing (Fig. 9 and 10). As can be seen from the location of the road behind the crossing (the width of the road lane is 4.2 m, the growing tree in front and the sharp curve to the left), the drivers of road vehicles, especially trucks and buses, occupy the opposite lane when passing through the crossing with the grade-crossing gates open in the direction of the village of Bąkowy Młyn. Vehicles driving in the opposite direction are exposed to collision. To avoid collision situations, the organization of traffic in the area of the crossing should be changed in such a way that vehicles traveling from the direction of the village of Bąkowy Młyn have priority to pass through the crossing.

In addition, a recommendation has been made by the Chairman of the PKBWK to remove the tree growing on the left side of the crossing going from the village of Baikki Mill.

Fig. 9 -Truck crossing with open grade-crossing gates (PKBWK's own material)

Fig. 10 -Route of a truck with open grade=crossing gates (PKBWK's own material)

3.5 Any other factors relevant to investigation

The Law on Road Traffic is the basic regulation for users of public roads referred to as the "Highway Code," i.e. the provisions of the Act of June 20, 1997. – Law on Road Traffic (i.e., Journal of Laws 2021, item 450, as amended).

Special provisions, relating to level crossings and pertaining to drivers of road vehicles, are contained in Article 28 of this law and state that:
"1.The driver of a vehicle, when approaching a level crossing and when passing through a crossing, is obliged to exercise extreme caution. Before entering the tracks, he is obliged to make sure that a rail vehicle is not approaching and take appropriate precautions, especially if the air clarity is reduced due to fog or other reasons.
2. The driver shall be obliged to drive the vehicle at such a speed that he can stop it in a safe place when a rail vehicle is approaching or when a safety device or signal given prohibits entry to the crossing."
In addition, the Regulation of the Ministers of Infrastructure and Internal Affairs and Administration of July 31, 2002 on traffic signs and signals (Journal of Laws 2019, item 2310, as amended), which states in § 98(5) that:
"A *flashing red signal or two alternating flashing red signals means that you are prohibited from passing a traffic signal or other device that transmits these signals.*"
and § 78(5) states that:
"1.Sign G-3 St. Andrew's cross in front of a single-track level crossing - designates a place to stop in connection with the movement of a train or other rail vehicle at a level crossing without barriers or without half barriers,..."
The failure of the driver of the road vehicle to comply with the aforementioned regulations when approaching and passing the crossing, the Investigation Team considered, as a causal factor for the occurrence. The speed of the road vehicle immediately prior to entering the crossing was low due to the opening of the semi-traffic barriers of the automatic crossing system immediately before the bus entered the crossing. The road vehicle was technically sound.

4. Feedback and control mechanisms, including risk and safety management and monitoring processes

The Investigation Team did not identify systemic factors influencing the occurrence.
Feedback and control mechanisms, including risk management and security, and monitoring processes had no impact on the occurrence.

5. Previous events of a similar nature

The investigation team, as part of its investigation, analyzed a selection of accidents that occurred under similar circumstances at crossings that occurred between 2016 and 2021.
A brief description of the events and their consequences.

1) On 03.04.2019 at 15:44 at the cat. B crossing, with the smoothly operating signaling with four half barrier gates (two inrun and two exit) at kilometer 152.183 on track no. 1 of railway line no. 271 Wrocław Główny - Poznań Główny, there was an invasion of train IC 45101 of RU PKP Intercity S.A. into an ambulance standing between closed grade-crossing gates. The driver of the ambulance, bypassing a passenger car standing in front of the closed inrun grade-crossing gate, entered the crossing while the exit grade-crossing gate was being closed. As he passed the crossing, the exit grade-crossing gate closed, preventing him from leaving the crossing. The driver of the ambulance positioned the quarters with his face toward the direction of the train. The oncoming train slammed into the ambulance standing at the level crossing. As a result of the occurrence, two people died on the spot, and the driver of the vehicle was taken to the hospital.

2) On 19.04.2016 at 07:10 a.m. at a category B crossing, with the signaling on track No. 1 at kilometer 32.612 of the railway line No. 356 Poznań Wschód - Bydgoszcz in working order, a train No. 79628 of RU Koleje Wielkopolskie Sp. z o.o. was invaded by a Volvo SR6 truck carrying construction timber standing at the crossing. The driver of the truck, while turning off the provincial road No. 196 onto the section of the municipal road leading to the crossing, disregarded the B-5 road sign (prohibition of truck entry), entered the crossing with the grade-crossing gate bars raised, not paying attention to the light signal on the signals. As he entered the crossing, the grade-crossing gate bar began to close and the truck

driver stopped the vehicle. A moment later, the train collided with the rear of the truck. As a result of the occurrence, one person was slightly injured. The car and rail bus SA132 - 003 were severely damaged.

V. CONCLUSIONS

1. Summary of analysis and conclusions about the causes of the occurrence

A factor that contributed to the occurrence was the failure of the driver of the road vehicle to exercise extreme caution when passing through the crossing. The driver of the road vehicle failed to obey the signals given by the traffic signals (two alternately flashing red lights). The behavior of the driver of the road vehicle in entering the crossing despite the traffic signals on the signals being turned on, the Investigation Team considered, as a causal factor in the occurrence of the occurrence.

Among the factors contributing to the occurrence, the team considered environmental factors to include:

- Concrete fencing and a built-in S-4 traffic signal limited the width of the exit to 2 meters,
- Growing tree at 11 meters from the rail head and in front of the crossing,
- Sharp turn of the road to the left immediately after the crossing,

From the analysis of the material collected by the Investigation Team, it appears that this situation may have caused stress to the driver. This factor may have led to the driver's failure to take immediate action to exit the level crossing or exit the vehicle. The bus driver's failure to make a determined attempt to exit causing damage to the vehicle and infrastructure elements was considered by the Investigation Team as a contributing factor.

2 Measures taken since the occurrence

The chairman of the PKBWK, having regard to the existing state of reduced security based on the provisions of Article 28l paragraph 1a of the Railway Transport Act of March 28, 2003 (i.e. Dz. U. 2021. Item 1984) on 21.04.2022 by letter addressed to the Director of PKP PLK S.A. Railway Line Department in Bydgoszcz, the Head of the Świecko District and the Head of Warlubie Municipality issued the following recommendations in order to increase safety in rail transport with regard to the crossing in question:

1) Removal of unnecessary concrete elements at the crossing on the side of track 2;
2) Removal of the tree growing on the left side of the crossing going from the village of Bąkowski Mill;
3) Determining the boundary of plots of land belonging to PKP PLK S.A. within the area of the crossing to reposition traffic safety devices at the crossing.
4) Repositioning the masts of the level crossing monitoring cameras so that the images include the indications of signals on traffic signals.
5) Determine the necessary measures to widen the access roads to the crossing to allow collision-free movement of vehicles in both directions when commuting to and passing through it.

As of the closing date, the recommendations in 1), 2) and 4) had been implemented.

3. Additional notes

The team for assessing the significance of the change evaluated a different technical configuration than the ToR stipulated. Conducting an assessment of the significance of the conversion of the crossing category from A to B in a manner that did not take into account the circumstances of the obvious risks arising from the local conditions of the crossing and the non-compliance with the ToR, the Investigation Team considered a failure to comply with the requirements set forth in Procedure SMS-PR-03 Change Management.

VI. SAFETY RECOMMENDATIONS

1) Infrastructure manager PKP PLK Railway Line Department in Bydgoszcz will re-evaluate the significance of the change considering local conditions in connection with the implementation of post-accident recommendations.
2) The infrastructure manager PKP PLK Railway Line Department in Bydgoszcz will implement the findings included in the Note from the meeting of the Team for the assessment of the significance of the change in accordance with procedure SMS-PR-03 *"Management of change" for the assessment of the significance of the change for the technical change consisting in the reconstruction of level crossings from category A to B on the line No. 131 Chorzów Batory - Tczew located at kilometer 344.021; 437.386; 440.762* dated 15.04.2015, in particular regarding TVU monitors on the control panel of the Warlubie station.
3) The road manager will develop a new traffic organization project in the area of the cat. B level crossing, considering the topographical conditions of the intersection of the railway line and the road, in such a way that vehicles coming from the direction of the village of Bąkowski Młyn will have priority to cross the crossing.
4) Infrastructure managers during public campaigns to improve safety at rail-road crossings will emphasize the formation of correct behavior of crossing users when a road vehicle is between the horns, including, among other things, the need to immediately exit the vehicle with the horns broken or to leave the vehicle when it is damaged at the crossing.
5) Authorized infrastructure managers, in the event of a change in the category of a level crossing, reconstruction or construction of a new crossing or pedestrian crossing, will make it mandatory to assess the significance of the change, taking into account existing local conditions.

STATE COMMISSION ON RAILWAY ACCIDENTS INVESTIGATION
CHAIRMAN

.....
Tadeusz Ryś

List of entities appearing in the contents of Report **No. PKBWK 07/2022**

No.	Symbol (abbreviation)	Explanation
1	*2*	*3*
1.	EUAR	European Union Railway Agency
2.	GDPWK	State Commission on Railway Accidents Investigation
3.	UTK	Office of Rail Transport
4.	IZ	PKP PLK S.A. Railway Lines Department
5.	PKP INTERCITY S.A.	Railway Undertaking