



STATE COMMISSION ON RAILWAY ACCIDENTS INVESTIGATION
Ministry of Interior and Administration

REPORT No. PKBWK 0 1/2023

**on the investigation of the railway incident
that occurred on October 16, 2019 at 13:51
at Leszczyny station, at km 31.738
railway line no. 140 Katowice Ligota - Nędza**

area of the infrastructure manager PKP Polskie Linie Kolejowe S.A.

Railway Lines Department in Tarnowskie Góry

WARSAW, February 02, 2023.

<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 incidents investigation report* (Official Journal of the European Union No. 132 of April 27, 2020)

| | |
|---|-----------|
| I. SUMMARY | 4 |
| II. PROCEEDINGS AND ITS CONTEXT | 6 |
| 1. Decision to initiate proceedings | 6 |
| 2. Reasons for the decision to initiate proceedings | 6 |
| 3. The scope and limitations, including its justification, as well as an explanation of any delays that are considered a risk or other impact on the course of the proceedings or conclusions of the proceedings | 6 |
| 4. Aggregate description of the technical capabilities of the functions in the team of investigators | 6 |
| 5. A description of the communication and consultation process conducted with the persons or entities involved in the occurrence, during the investigation and in relation to the information presented | 6 |
| 6. Description of the level of cooperation proposed by the actors involved..... | 7 |
| 7. Description of the methods and techniques used in the investigation and methods of analysis used to establish the facts and make the findings referred to in the report | 7 |
| 8. Description of the difficulties and specific challenges encountered during the proceedings | 8 |
| 9. All interactions with the judiciary | 9 |
| 10. Other information relevant to the proceedings..... | 9 |
| III. DESCRIPTION OF THE OCCURRENCE | 11 |
| 1. Occurrence and basic information..... | 11 |
| 1.1. Description of the type of occurrence | 11 |
| 1.2. Date, exact time and location of the occurrence | 11 |
| 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 | 11 |
| 1.4. Deaths, injuries, and property damage | 13 |
| 1.5. Description of other effects, including the impact of the occurrence on the regular activities of the entities involved | 13 |
| 1.6. Identification of individuals, their functions, and entities involved, including any relationships with contractors or other relevant parties | 13 |
| 1.7. Description and identifiers of trains and their composition, including associated rolling stock and registration numbers..... | 13 |
| 1.8. Description of relevant parts of infrastructure and signaling - track type, switch, dependency device, signal, train protection systems..... | 13 |
| 1.9. Any other information relevant to the description of the occurrence and background information..... | 14 |
| 2. Fact-based description of events | 20 |
| 2.1. The chain of related events that led to the occurrence, including: the actions of the people involved; the operation of rolling stock and technical equipment; the operation of the operating system | 20 |
| 2.2. The sequence of events from the occurrence to the completion of emergency services, including: measures taken to protect and secure the scene; efforts of rescue and emergency services | 21 |
| IV. ANALYSIS OF THE OCCURRENCE | 22 |
| 1. Roles and responsibilities..... | 22 |
| 1.1. Railway companies or infrastructure managers | 22 |
| 1.2. Maintenance entities, maintenance workshops or any other maintenance providers | 23 |
| 1.3. Rolling stock manufacturers or other suppliers of railway products..... | 23 |
| 1.4. National safety authorities or the European Union Railway Agency..... | 23 |
| 1.5. Notified bodies, designated bodies or risk assessment authorities | 23 |
| 1.6. Certification bodies of the entities responsible for maintenance listed in Section 1.2. | 23 |
| 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 | 24 |
| 2. Rolling stock and technical installations | 24 |
| 3. Human factors | 27 |
| 3.1 Human and individual characteristics | 27 |

| | |
|---|-----------|
| 3.2 Job-related factors | 28 |
| 3.3 Organizational factors and tasks | 28 |
| 3.4 Environmental factors | 28 |
| 3.5 Any other factors relevant to proceedings | 28 |
| 4. Feedback and control mechanisms, including risk and safety management and monitoring processes | 28 |
| 4.1 Conditions of the relevant regulatory framework | 28 |
| 4.2 Processes, methods, content and results of risk assessment and monitoring activities carried out by any of the parties involved: railway undertakings, infrastructure managers, entities in charge of maintenance, maintenance workshops, other maintenance providers, manufacturers and other entities, as well as the reports of the independent assessment referred to in Article 6 of Implementing Regulation (EU) No. 402/2013 | 28 |
| 4.3 Safety management system of the railway companies involved and infrastructure managers, taking into account the basic elements set out in Article 9(3) of Directive (EU) 2016/798 and any EU implementing acts | 29 |
| 4.4 The management system of the entity(ies) responsible for maintenance and maintenance workshops, taking into account the functions set forth in Article 14 (3) of and Annex III to Directive (EU) 2016/798 and any subsequent implementing acts | 29 |
| 4.5 Results of supervision by national safety authorities in accordance with Article 17 of Directive (EU) 2016/798 | 29 |
| 4.6 Authorizations, certificates and assessment reports issued by the Agency, national safety authorities safety or other conformity assessment bodies | 29 |
| 4.7 Other system factors | 29 |
| 5. Previous occurrences of a similar nature | 30 |
| V. CONCLUSIONS | 31 |
| 1. Summary of analysis and conclusions about the causes of the occurrence | 31 |
| 2. Measures taken since the occurrence | 32 |
| 3. Additional notes | 32 |
| VI. SAFETY RECOMMENDATIONS | 33 |
| List of drawings | |
| Figure 1 - Sketch of the layout of the rooms and some equipment of the Lsz control room | 12 |
| Figure 2 - An example of the RX3i series universal base cassette | 17 |
| Figure 3 - Dimensions of the RX3i serial expansion cassette and layout in the enclosure | 24 |
| Figure 4 - Dimensions of the RX3i universal base cassette and layout in the enclosure | 25 |
| List of Photos | |
| Photo No. 1 - General view of the site. | 11 |
| Photo No. 2 - MOR-1.01 cable connections during internal acceptance | 15 |
| Photo No. 3 - Cable connections after the occurrence | 15 |
| Photo No. 4 - Terminal strip No. 7 in the MOR-1 cabinet (Photo No.: PKBWK) | 16 |
| Photo No. 5 - View of Module 4 - which first reported damage on the day of the occurrence (photo by PKBWK, taken on 05/10/2020 in the new MOR-1 cabinet) | 17 |
| Photo No. 6 - Installation of a fire extinguisher performed during a fire | 19 |
| Photo No. 7 - Open computer cabinet (Photo: railway commission) | 20 |
| Photo No. 8 - Arrangement of devices in the MOR-1 computer cabinet | 25 |
| Photo No. 9 - Connections in the computer cabinet of unknown origin that do not correspond to the solutions of the equipment manufacturer (the cabinet was dismantled after the fire and the wires of the connecting cables in the cabinet were cut) | 26 |
| Photo No. 10 - Incorrect connections on terminal block #7 with visible signs of overheating and melting. | 26 |
| Photo No. 11 - Fire buttons in the relay room | 32 |
| Photo No. 12 - The control panel in the room of the traffic officer on duty | 32 |

I. SUMMARY

Type of occurrence: Incident.

Description of occurrence: Fire in the cabinet with computers of the MOR-1 system in the relay room of the Lsz dispatching control room of Leszczyny station.

Date of occurrence: 16.10.2019, 13:51.

Site of occurrence: Railway line No. 140 Katowice Ligota - Nędza, Leszczyny station
at km 31.738, geographical location 50°08'29.4 "N 18°37'06.5 "E.

Implications of the occurrence: Destruction of the MOR-1 system equipment built into the computer cabinet.

Causal factors:

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

1. Excessive temperature rise of the components of module 4 in the expansion bay of PLC A due to an increase in voltage relative to the internal resistance of the module, which caused an excessive increase in power consumption and the value of the current flowing. Damage to the module due to prolonged power supply at a voltage higher than the maximum allowed by the manufacturer.
2. Unauthorized modification of the computer cabinet wiring, consisting in use of wiring connections in the MOR-1 system cabinet that do not comply with the manufacturer's solutions.
3. Failure of the thermostat to detect the increased temperature of the upper PLC cabinet due to excessive air circulation caused by leaving the door of this cabinet open for a long time.

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 occurrence)

1. Failure on the day of the occurrence to turn on the automatic extinguishing system on the control panel located in the traffic control room after the receiving committee left the relay room.
2. Late and unprofessional firefighting.
3. Installation of an emergency button for the fire extinguishing system in the traffic officer's room that is not provided for in the documentation.
4. Changes made by the contractor to the connections of the computer cabinet, despite the existence of the correct connections required for this facility, confirmed by the issuance of a Declaration of Conformity to Type No. 018/17/3/MOR-1.01/2019 issued on 03/10/2019 by the manufacturer.
5. Loss of stable connection on the terminal strip due to multiple wire connections on the strip.
6. Placing the computer cabinet thermostat at the level of the top PLC cassette, instead of at the highest point of the cabinet.
7. Arrangement of the RX3i cassettes in the computer cabinet, not in accordance with the requirements contained in the documentation of the manufacturer of PACSystems RX3i controllers, reducing the cross-section of gravity cooling channels.

Systemic factors:

(means any causal or contributing factor of an organizational, management, social or regulatory nature that may affect similar and related occurrences in the future, taking into account, in particular, the conditions of the regulatory framework, the design and application of the safety management system, personnel skills, procedures and maintenance)

1. There is no provision in the legislation requiring the participation of the manufacturer of computer systems of railway station equipment or its authorized representative in the process of internal acceptance of the equipment before it is put into operation.
2. Lack of regulation in the Technical and Operational Documentation (DTR) of the equipment manufacturer obliging to permanently close the door of the computer cabinet during operation.

Recommendations and their addressees:

- 1) Infrastructure managers shall introduce a requirement for the participation of the manufacturer of railway station equipment computer systems or its authorized representative in the process of internal acceptance of the equipment before commissioning.
- 2) Infrastructure managers shall include in the programs of periodic training of personnel for operation and maintenance of railway equipment the subject of operation of fire-fighting equipment, in particular fixed gas extinguishing equipment.
- 3) Infrastructure managers shall install an emergency extinguisher button in the rooms of the staff of srk equipment operation at stations equipped with an automatic extinguishing system.
- 4) PKP PLK S.A. shall supplement the records of the Hazard Register in terms of diagnosed risks of fire source of railway equipment.
- 5) PKP PLK S.A. shall change the location of fire switches in the Leszczyny switchyard relay room from the right side to the left side of the door leading out of the relay room, and will install a white "extinguisher interlock" button.
- 6) Zakłady Automatyki Kombud S.A. shall specify in the DTR of the equipment:
 - permissible time to leave the door of the computer cabinet open for the duration of the performed maintenance,
 - the maximum permissible ambient temperature of the cabinet in a closed room,
 - the limits of setting the thermostat of the computer cabinet fan.
- 7) Zakłady Automatyki Kombud S.A. shall make changes in the MOR-1 system regarding the sending of information to the traffic officer's service station about alarms with information about exceeding the operating temperature of PLCs.
- 8) Zakłady Automatyki Kombud S.A. shall change the location of the fan thermostat in the computer cabinets of the MOR-1 system, so that there is a possibility of receiving the increase in temperature values from the upper part of the cabinet.
- 9) Zakłady Automatyki Kombud S.A. shall install computer cabinet elements in the newly built MOR-1 system installations, which will ensure the arrangement of controllers with the minimum free space around the base cassette, in accordance with the requirements of the manufacturer of controllers.

II. PROCEEDINGS AND ITS CONTEXT

1. Decision to initiate proceedings

Tadeusz Ryś, Chairman of the State Commission on Railway Accidents Investigation (hereinafter referred to as the "PKBWK" or "Commission") has issued Resolution No. PKBWK.7.2020 of 01.10.2020 on the conduct of proceedings concerning the incident which occurred on 16.10.2019 at Leszczyny station.

In view of the above and in accordance with the provisions of Article 28e (4) of the Railway Transport Law of March 28, 2003 (hereinafter "the Railway Transport Law") the Commission, on October 1, 2020, notified the European Union Agency for Railways ("EUAR") of this fact through the information system "ERAIL" and the above occurrence was registered in the ERAIL database under the number PL-6348.

2. Reasons for the decision to initiate proceedings

The investigation into the causes of the occurrence was initiated by a railway commission chaired by the Deputy Chief of Automation and Telecommunications of Rybnik Exploitation Section of the Railway Lines Department in Tarnowskie Góry of PKP PLK S.A., appointed by Director's Decision No. 212/2019 dated 17/10/2019, which prepared a "Report on the inspection of the incident site."

Taking into account the request of the chairman of the railway commission (Letter No. ISE5A-5430-336/20 dated 09.09.2020) and after analyzing the work of the railway commission on the railway incident that occurred on October 16, 2019 at 13:51 at Leszczyny station, signal box "Lsz" at km 31.738 of the line No. 140 Katowice Ligota - Nędza, the Chairman of the State Commission on Railway Accidents Investigation Tadeusz Ryś decided to take over the investigation by the PKBWK Investigation Team (hereinafter referred to as the "Investigation Team").

The proceedings to determine the cause of the occurrence were conducted pursuant to Article 28h (1) of the Railway Transport Law, which, pursuant to Article 28f (3), does not determine guilt or liability.

3. The scope and limitations, including its justification, as well as an explanation of any delays that are considered a risk or other impact on the course of the proceedings or conclusions of the proceedings

The investigation was taken over from the railway commission one year after the incident. The Investigation Team used materials collected by the railway commission and inspected the site and dismantled equipment from the Leszczyny station, which had been deposited with the manufacturer.

The PKBWK Investigation Team did not encounter any limitations in the investigation of the incident, which would have negatively affected the method and procedures in the post.

4. Aggregate description of the technical capabilities of the functions in the team of investigators

The Chairman of the Commission appointed an Investigation Team from among the permanent members, with relevant competence and experience in the field of the investigation.

There was no need to appoint ad hoc members and experts or to commission external expertise.

5. A description of the communication and consultation process conducted with the persons or entities involved in the occurrence, during the investigation and in relation to the information presented

The chairman of the PKBWK, on the basis of Article 28h (2) (5) of the Railway Transport Act, obliged by letter No. PKBWK.4631.7.1.2020 dated 01/10/2020 an employee of PKP PLK S.A. Railway Lines Department in Tarnowskie Góry and PKP PLK S.A. Silesian Region Investment Realization Center in Wrocław to cooperate with the Commission's Investigation Team.

At the request of the Investigation Team, the Chairman of PKBWK sent letters to all interested parties related to the investigated incident. Letters were sent to the following entities: the railway infrastructure manager PKP PLK S.A., Zakłady Automatyki KOMBUD S.A., EL-IN Sp. z o. o. in Skierniewice, KZA Przedsiębiorstwo Automatyki i Telekomunikacji S.A. in Lublin, PKP Cargo S.A., PKP Energetyka S.A. The aforementioned entities closely cooperated with the Investigation Team, providing all documentation and

necessary materials. In addition, they made it possible to visit the companies involved in the production of the srk equipment used in the system that failed at Leszczyny station.

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

During the course of the investigation, the level of cooperation with representatives of entities related to the circumstances of the occurrence was standard, did not raise any concerns and did not negatively impact the findings of the Investigation Team.

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

Throughout the process of clarifying the causes and circumstances of the occurrence, the Investigation Team relied, among other things, on the provisions of national regulations, the internal regulations of the infrastructure manager, the internal regulations and technical documentation of equipment manufacturers and the contractor company.

The Investigation Team used documentation provided by the railway infrastructure manager, manufacturers and contractors, as well as documentation collected by the railway commission.

As part of the occurrence investigation, the Investigation Team performed the following activities, among others:

- Inspection of the site of occurrence at Leszczyny station, including the relay, control and power rooms,
- Visual inspection of the damaged apparatus cabinet with its accessories deposited and secured at the manufacturer's premises,
- On-site inspections at the manufacturers of the affected apparatus cabinet and switching equipment,
- Preparation of Photo No.graphic and video documentation on the days of the inspection,
- visual inspection of signaling equipment of the same type installed in the territory of the Infrastructure Manager at another station with similar technical solutions of equipment with computer mapping,
- analysis of the documentation provided by the railway infrastructure manager, the manufacturer of the computer equipment, the manufacturer of the cabinet and the contractor
- hearings of the infrastructure manager's staff, manufacturers and contractors.

The following is a selection of the laws, regulations and internal instructions used during the course of the investigation in effect on the date of the occurrence:

National regulations:

- 1) Railway Transport Act of March 28, 2003 (i.e., Journal of Laws of 2019, item 710, as amended).
- 2) Ordinance of the Minister of Infrastructure and Development of December 30, 2014 on employees working 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 2015, item 46).
- 3) Regulation of the Minister of Infrastructure of July 18, 2005 on general conditions of railway traffic and signaling (Journal of Laws of 2015, item 360, as amended).
- 4) Act of July 7, 1994 Construction Law (i.e. Journal of Laws of 2019, item 1186).
- 5) Regulation of the Minister of Infrastructure and Development of May 13, 2014, on the admission to operation of certain types of structures, equipment and railway vehicles (Journal of Laws, item 720).
- 6) Regulation of the Minister of Infrastructure and Development of September 25, 2015, on the conditions and procedure for issuing, renewing, amending and revoking safety approvals, safety certificates and security certificates (Journal of Laws item 1548).
- 7) Regulation No. 3 of the Minister of Internal Affairs and Administration dated January 31, 2020, on the Regulations of the State Commission on Railway Accidents Investigation (Official Journal of the Ministry of Internal Affairs and Administration, item 2).

Internal instructions of the infrastructure manager:

- 1) Technical guidelines for the construction of railway traffic control devices Ie-4 (WTB-E10).
- 2) Instruction on the principles of operation and performance of works on railway traffic control equipment Ie-5 (E-11).
- 3) Instruction for technical acceptance and commissioning of railway traffic control systems Ie-6 (WOT-E12).
- 4) Instructions for operation of computerized railway traffic control systems in PKP Polskie Linie Kolejowe S.A. Ie-20.
- 5) Guidelines for the preparation of station instructions for the operation of computerized railway traffic control devices Ie-20a.
- 6) Conditions for safe installation and operation of railway traffic control systems on lines managed by PKP Polskie Linie Kolejowe S.A.. Ie-100a.
- 7) Technical requirements for the provision of protection against overvoltage and from lightning from rail traffic control equipment, communications and dSAT Ie-120.
- 8) Ir-8 Instruction on the handling of serious accidents, accidents and incidents in rail transportation.
- 9) Ik-2 Railway safety inspection manual.
- 10) Technical Standards for Detailed Technical Conditions for Modernization or Construction of Railway Lines to $V_{max} \leq 200$ km/h (for conventional rolling stock)/250 km/h (for tilting body rolling stock) TOM XIII Buildings.
- 11) TECHNICAL STANDARDS Detailed technical conditions for modernization or construction of railway lines for speeds $V_{max} \leq 200$ km/h (for conventional rolling stock)/250 km/h (for tilting body rolling stock) TOM IV ELECTRIC TRAFFIC/ POWER SUPPLY FACILITIES.
- 12) TECHNICAL STANDARDS Detailed technical conditions for the upgrading or new construction of railway lines for speeds $V_{max} \leq 200$ km/h (for conventional rolling stock)/250 km/h (for tilting body rolling stock) TOM V NON-TRACTION POWER SUPPLY.

KZA Lublin documentation:

- 1) ISO Certificate No.: 2638/03/2019/J/C.
- 2) Quality Book of the Integrated Quality Management System at KZA Przedsiębiorstwo Automatyki i Telekomunikacji S.A.
- 3) Technical documentation of ST, STS, SE cabinets.

KOMBUD Automation Plant S.A. documentation:

- 1) ISO Certificate No.: 0198 100 00823.
- 2) Technical and Operational Documentation DTR-2008/MOR-1.01 Monitor mapping system type MOR-1, variant MOR-1.01.
- 3) User's manual MSO MOR-1.01, Leszczyny station.
- 4) PACSystems RX3i System Description GFK-2314B-PL.

8. Description of the difficulties and specific challenges encountered during the proceedings

The investigation was taken away from the railway commission at the request of the chairman of the railway commission after one year from the date of its occurrence. The PKBWK Investigation Team was not present at the site inspection. The Investigation Team examined the causes and circumstances of the occurrence on the basis of the material provided by the railway commission and the manufacturer of the equipment. After taking over the investigation, the Investigation Team conducted a detailed inspection of the scene and then inspected the burnt cabinet at the equipment manufacturer. It also inspected the manufacturing process and analyzed the cabinet manufacturer's documentation.

The investigation, which took a year to complete, included interviews with the infrastructure manager's staff, the manufacturer, and contractors. The Investigation Team found that, over time, the information provided by the hearings was incomplete and inconsistent and presented a different reality. On more than one occasion, the hearings contained information that did not confirm the facts.

9. All interactions with the judiciary

In the incident under review, there was no need to cooperate with the judicial authorities.

10. Other information relevant to the proceedings

In the 2 hours prior to the occurrence, the following trains were operating on the trains adjacent to Leszczyny station:

Route Leszczyny - Czerwionka

From Czerwionka:

- 44705 dep. 12:15, arr. 12:21
- 444649 dep.12:49, arr. 13:03 (stalled wagon on the train)
- 13005 dep.13:09, arr. 13:21
- 43809 dep.13:48, arr. 14:42

To Czerwionka:

- 44756 dep.11:47, arr. 11:54
- 44856 dep.13:28, arr. 13:35

Route Leszczyny - Rybnik

From Rybnik:

- 44756 dep.11:42, arr. 11:45
- 454030 dep.11:51, arr. 11:55
- 43856 dep.12:36, arr. 12:40

To Rybnik:

- 444271 dep.11:55, arr. 11:58
- 44705 dep.12:22, arr. 12:25
- 14005 dep.13:26, arr. 13:30 on the left track

Route Leszczyny - Szczygłowie

From Szczygłowie:

- 444271 dep.11:44, arr. 11:54
- 443347 dep.12:40, arr. 12:54
- 144023 dep.12:57, arr. 19:04

To Szczygłowie:

- 454030 dep.11:57, arr. 12:04

On train No. 444649 (PKP CARGO) between Łaziska Średnie and Rybnik Towarowy, the traffic controller of Leszczyny station, while observing, noticed a braked wagon No. 31 51 5375173-2. The train was stopped at the station to disable the damaged wagon.

The wagon with deactivated sticker was put back on track 5.

The Investigation Team found no connection between the train traffic and the occurrence (fire in the relay room).

In the course of the investigation, the Investigation Team found out that the Chairman of the railway commission investigating the causes of the incident at Leszczyny station had previously been the chairman of the acceptance commission for srk equipment. In addition, a member of the railway commission also participated in the work of the equipment acceptance committee.

In accordance with the provisions of § 11. of the Instruction on the handling of serious accidents, accidents and incidents in railway transport Ir-8:

"A member of the railway commission participating in the proceedings may not be an employee who has a direct connection with the accident or incident or who is related to a person who has a connection to the occurrence; this exclusion also includes personnel directly responsible for the maintenance of the infrastructure in the area where the occurrence took place."

According to the Investigation Team, this had the effect of prolonging the investigation process due to conflicts of interest.

The Investigation Team concludes that the disassembly of the cabinet with its connections was done in violation of the rules of evidence preservation. The dismantled cabinet was taken over by the manufacturer from the railway commission without preparing a transfer document. This violates the provisions of § 17 (1) and (2) para. 6 Ir-8 Manual.

III. DESCRIPTION OF THE OCCURRENCE

1. Occurrence and basic information

1.1. Description of the type of occurrence

Type of occurrence: apparatus cabinet fire in the relay room.

Group: railway incident.

1.2. Date, exact time and location of the occurrence

The incident occurred on October 16, 2019 at 13:51 at Leszczyny station, at km 31.738 of line No. 140 Katowice Ligota - Nędza. The incident consisted of a fire in the equipment cabinet with computers in the relay room of the "Lsz" control room.

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

The container yard is located at 31.738 km of railway line No. 140 at a distance of 5.5 m from the outermost rail of switch No. 17. The layout of the yard is shown in Figure 1 below.

On the day of the occurrence, i.e. 16.10.2009, work was being carried out at Leszczyny station in connection with the reconstruction of the railway traffic control equipment within the framework of the investment task: "Streamlining of the main export routes from Upper Silesia", consisting in the connection of newly built internal and external devices to relay devices with MOR-1 computer mapping. On that day, the railway traffic in the station was running on alternate signals, the turnouts were secured in the basic position with turnouts locks, in addition to the turnouts No. 13 and 18, which were put into operation earlier. The occurrence took place in daylight, at a temperature of +15°C.

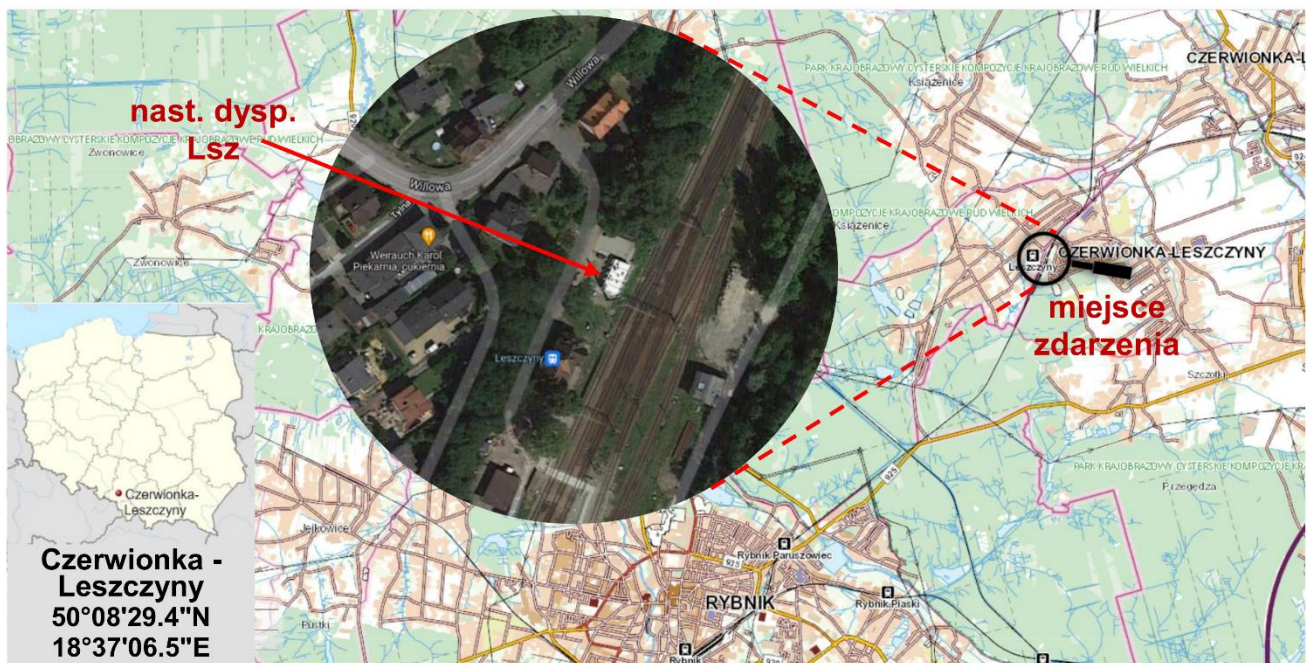


Photo No. 1 - General view of the site.

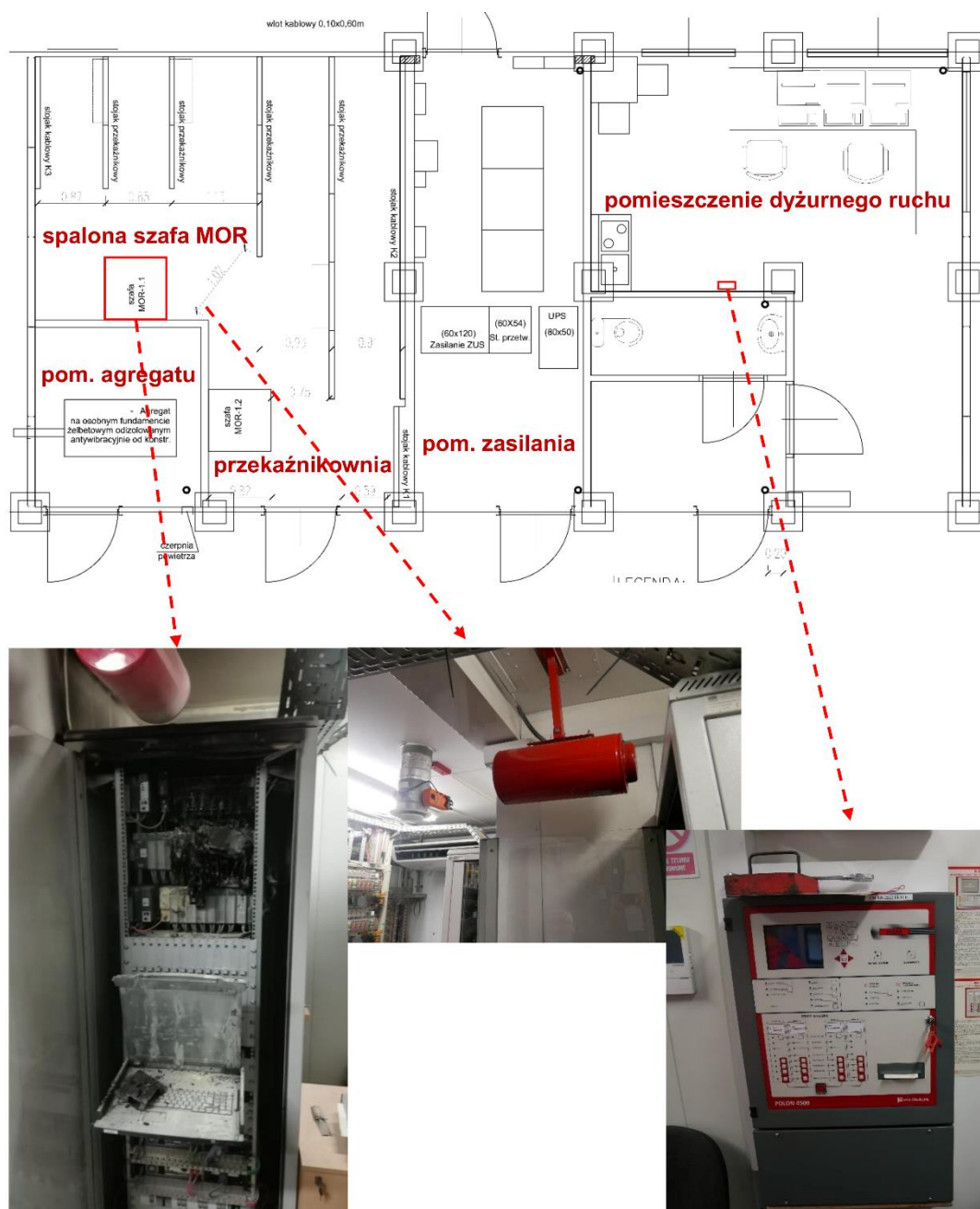


Figure 1 - Sketch of the layout of the rooms and some equipment of the Lsz control room

1.4. Deaths, injuries, and property damage

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

There were no injuries to either person as a result of the occurrence.

b) cargo, luggage and other property

Not applicable.

c) rolling stock, infrastructure and environment

As a result of the fire and firefighting, the computer cabinet of the MOR-1 system was significantly damaged. It was found that all I/O modules in PLC cassette A1 were completely destroyed as a direct result of the fire that occurred in one of the modules of PLC cassette A2.

In the PLC A2 expansion cassette, the I/O modules from slot 4 upwards were destroyed. There is no visible damage outside the PLC A1 and PLC A2 cassettes.

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

The occurrence caused an interruption of train traffic at Leszczyny station on 16/10/2019 from 13:54 to 14:41. As a result of the occurrence, trains were delayed:

- 1856 passenger trains in total for 97773 minutes,
- 100 freight trains in total for 4957 minutes.

Replacement bus service has been introduced on 16.10.2019. - 25.11.2019 for two pairs of passenger trains.

1.6. Identification of individuals, their functions, and entities involved, including any relationships with contractors or other relevant parties

The Investigation Team identified the following individuals directly related to the occurrence:

- Leszczyny station maintenance staff - employees of PKP PLK S.A. Railway Lines Department in Tarnowskie Góry, Rybnik Exploitation Section,
- The team of people who carried out the acceptance of the srk equipment, which included:
 - On the part of the Ordering Party - employees of CRI Silesia Region,
 - On the part of the user - employees of PKP PLK S.A. Railway Lines Department in Tarnowskie Góry,
 - On the part of the Contractor - employees of EL-IN Sp. z o. o.

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

Not applicable.

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

Leszczyny station is equipped with E-type relay equipment (made using small srk relays of the ERE and JRF types) with a monitor station mapping system of the MOR-1.01 type.

The station is equipped with switch drives of the EEA-5 type, 12 units, a counter system for ascertaining unoccupied control and SHP automatic train braking.

After the occurrence, all signaling devices in the station were out of control, no image on the monitor of the computerized MOR-1 signalman's panel (after the power was turned off during the firefighting operation). In the field, all semaphores and shields dark, no control of switch drives.

Relay room door closed (no key lock), relay room key not sealed.

Upon inspection of the computer cabinet, the railway commission and the equipment manufacturer's representative found the complete destruction of all I/O (input/output) modules in PLC cassette A1 as a direct result of a fire that occurred in one of the modules in PLC cassette A2. The cable bundles connected

to the modules burned along with the cable tray. PLC A1 did not show any signs of destruction, but the front panel of the power supply of the controller was found deformed. Inside the PLC A2 expansion cassette, the I/O modules from slot 4 upwards were destroyed. There was no visible damage outside the PLC A1 and PLC A2 cassettes. The station control computers remained fully operational. The MOR-1 cabinet was open at the time of the occurrence, as evidenced by an extended and open console.

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

Analysis of DVR records from the day of the occurrence

The following is a diagnostic report from PLC A:

```
$19/10/16 13:50:51 I/O TAB: 19/10/16 13:50:51.16
$19/10/16 13:50:51 rack=1 slot=4 blk=127 pt=32767 IObus=127
$19/10/16 13:50:51 grp=27 act=2 cat=8 type=7 desc=4 id=256
$19/10/16 13:50:51 -----
$19/10/16 13:51:11 -----
$19/10/16 13:51:11 I/O TAB: 19/10/16 13:51:11.849
$19/10/16 13:51:11 rack=1 slot=4 blk=127 pt=32767 IObus=127
$19/10/16 13:51:11 grp=27 act=2 cat=8 type=7 desc=5 id=257
$19/10/16 13:51:11 -----
!19/10/16 13:51:15 ERR: I/O module missing
!19/10/16 13:51:15 No module <1:4,127> (19/10/16 13:51:15)
$19/10/16 13:51:15 -----
$19/10/16 13:51:15 I/O TAB: 19/10/16 13:51:15.839
$19/10/16 13:51:15 rack=1 slot=4 blk=127 pt=32767 IObus=127
$19/10/16 13:51:15 grp=3 act=3 cat=14 type=0 desc=0 id=258
$19/10/16 13:51:15 -----
~19/10/16 13:51:15 Av status. SP a/b: 0020:0000
!19/10/16 13:51:23 ERR: LOS RCK
~19/10/16 13:51:23 Av status. SP a/b: 0030:0000
!19/10/16 13:51:23 No module <1:1,127> (19/10/16 13:51:23)
Diagnostic report from PLC B:
~19/10/16 13:51:15 Av status. SP b/a: 0000:0020
!19/10/16 13:51:17 SPa ERR: LOS_IOM
~19/10/16 13:51:23 Av status. SP b/a: 0000:0030
!19/10/16 13:51:24 SPa ERR: LOS_RCK
*19/10/16 13:51:27 Tel SS2:150 126 100 23 (CMD.).
*19/10/16 13:51:27 Tel SS2:150 126 100 23 confirmed by 2SP.
```

STS-2 computer diagnostic report

```
2635116-10-201913 :51: 17ALRSLszStPol "SP: No communication with I/O module -
alarm continues from: 16-10-2019 13:51:17"
2635216-10-201913 :51: 26ALRSLszzwr1/3cd "Unexpected failure to control point position
- alarm continues from: 16-10-2019 13:51:26"
2635316-10-201913 :51: 26ALRSLszzwr1/3cd "Ripping - alert continues from: 16-10-2019
13:51:26"
2635416-10-201913 :51: 26ALRSLszzwr3ab/7cd "Unexpected failure to control point
position - alarm continues from: 16-10-2019 13:51:26"
```

The recorders show that the fire started at module 4 in the expansion slot of PLC A at 13:50:51. This was the IC694MDL660 input module. This module is a special command controller module, the input of which is connected to the contacts of the executive relays of the special command cards, which are directly

connected to terminal block 7 of the computer cabinet. The + 24V srk buffer supply voltage is distributed on the terminals of this strip and is connected to the input modules of the IC694MDL660 via the command relay modules.

Non-factory connections with wires of 1 mm² cross-section were found on this strip. These connections were not made during the production of the MOR-1.01 system. As a result of the modifications made to the cabinet connections and connections without the knowledge of Z.A. KOMBUD S.A. as the manufacturer of the system, the internal connections in the head No. 07 used for zeroing the axis counter sections were dismantled.

Non-factory bridges were installed in this place. In addition, the cable was installed on top of the 07 head, thus changing the internal connections of the MOR-1.01 cabinet.

The Investigation Team concludes that the factory wiring of the cabinet has been tampered with.

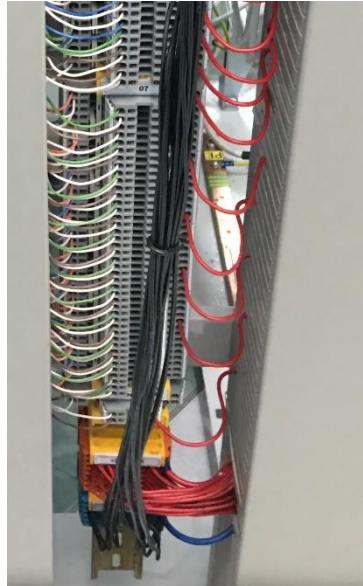


Photo No. 2 - MOR-1.01 cable connections during internal acceptance

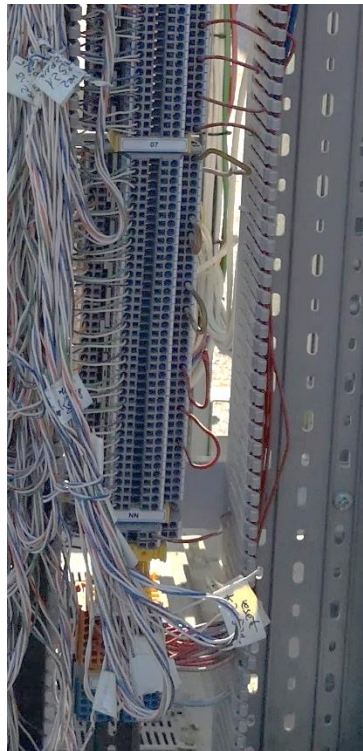


Photo No. 3 - Cable connections after the occurrence

The above-mentioned incorrect connection (contrary to the design) of the power supply to the input module (applying the positive voltage of Ukomp. instead of Usrk.) resulted in a doubling of the supply voltage due to the grounding of the opposite potentials of the two batteries, i.e. SRK battery and Komp. battery.

A doubling of the supply voltage increased the value of the current flow, resulting in a fourfold increase in the energy released and excessive heating of the module.

At a critical moment, the continuous opening of the cabinet worsened the thermostat's temperature detection, which led to the failure of the input module. The manufacturer allows a maximum input voltage of 30V.

The value of the current flowing in the circuit was high enough to destroy the module but did not force the overcurrent protection to trip.

Other connections were made according to the documentation with 0.8 mm² wires. Below are the connections of terminal block #7, which show traces of melting insulation of wires and terminal block inputs not caused by the cabinet fire. The terminal strips show signs of mechanical damage caused by the use of non-factory connections in the form of bridges, which have been repeatedly assembled and disassembled on the strip. The method of attaching wires to the strip, with wires repeatedly inserted and removed, did not ensure proper current flow in the cabinet's circuits, as evidenced by overheating of the wires and terminal strip receptacles not caused by the fire.

According to the Investigation Team, the use of wiring connections in the MOR-1 system cabinet contrary to the manufacturer's solutions and improper connections on the terminal blocks were causal factors in the occurrence.



Photo No. 4 - Terminal strip No. 7 in the MOR-1 cabinet (Photo No.: PKBWK)

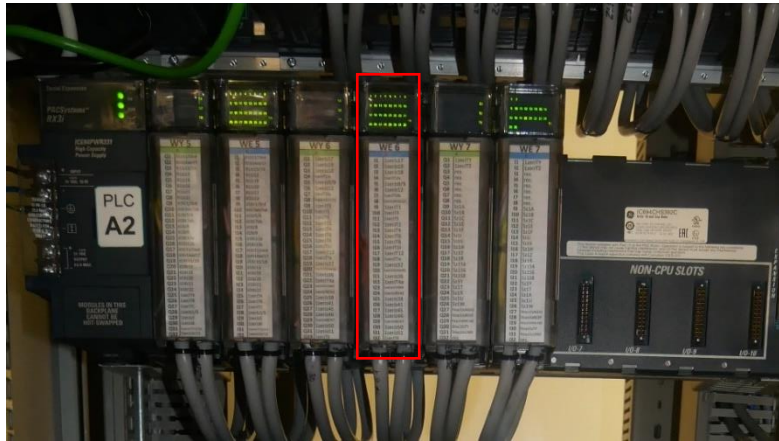


Photo No. 5 - View of Module 4 - which first reported damage on the day of the occurrence (photo by PKBWK, taken on 05/10/2020 in the new MOR-1 cabinet)

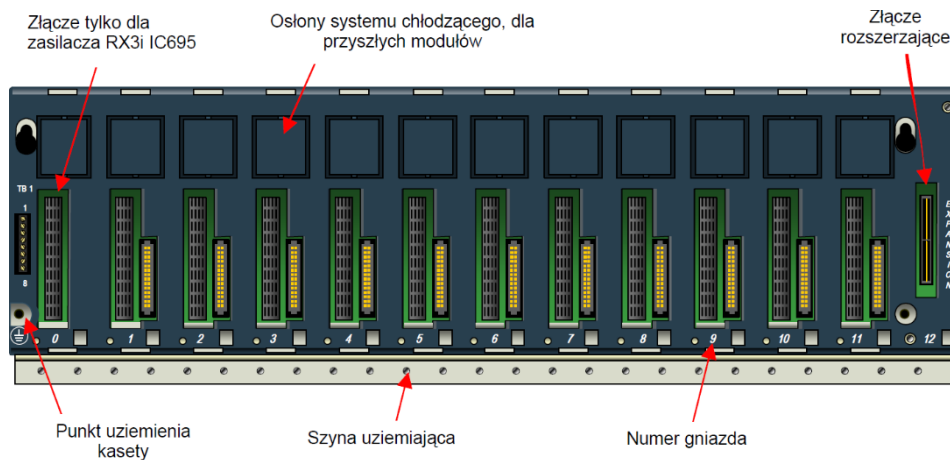


Figure 2 - An example of the RX3i series universal base cassette

Analysis of selected DVR records prior to the occurrence

The following are examples of the recorder's records showing that:

- from 01/10/2019 to the date of the occurrence, there were repeated failures of the axle counters, which sometimes resolved spontaneously without a reset command,
- From 01/10/2019 to the date of the occurrence, 507 such cases were recorded,
- As of 12/10/2019, i.e., from the date of commissioning of the service station at the switchyard, 26 such cases were recorded.

| | | | |
|--------------------|-----|---------------|---|
| 2601415-10-201916: | 03: | 58ALRSLszJz50 | "Axis counter failure - alarm continues from: 15-10-2019 16:03:58" |
| 2601515-10-201916: | 03: | 58ALRSLszJz50 | "Axis counter failure - alarm has ceased, lasted from: 15-10-2019 16:03:58" |
| 2731615-10-201921: | 37: | 15ALRSLszJz3 | "Axis counter failure - alarm has ceased, lasted from: 15-10-2019 21:11:56" |
| 2731715-10-201921: | 37: | 21ALRSLszJz3 | "Axis counter failure - alarm continues from: 15-10-2019 21:37:21" |
| 2731815-10-201921: | 37: | 21ALRSLszJz3 | "Axis counter failure - alarm has ceased, lasted from: 15-10-2019 21:37:21" |

2621516-10-201912 :47: 55ALRSLszJT8 "Axis counter failure - alarm continues
from: 16-10-2019 12:47:55"
2621616-10-201912 :47: 55ALRSLszJT8 "Axis counter failure - alarm has
ceased, lasted from: 16-10-2019 12:47:55"

In addition, from 01/10/2019 to the date of the occurrence, the system recorded 47 cases of controller failure. Example:

2520510-10-201911 :25: 05ALRSLszIO_SS "StWe: Fault in controller -
alarm continues from: 10-10-2019 11:25:05"

In summary, the cyclic occurrence of axis counter errors may have been caused by overheating of the MOR-1 system controller expansion modules.

Firefighting action

After analyzing the surveillance records, the Investigation Team determined the following course of rescue operations after the occurrence.

On the day of the occurrence, the acceptance committee left the relay room at 1:29 p.m. after completing their work without locking the door. In addition, the automatic fire suppression system was not activated, leaving the switchgear unattended. At 13:54, an alarm system was activated at the signal box, indicating a fire in the relay room. Ten seconds after the alarm sounded, the traffic officer on duty and the signalman ran out of the signal box, opened the relay room door, and looked inside. The traffic officer then returned to the signal box and the signalman closed the relay room door and went to inform the receiving committee of the occurrence. At 1:56 p.m., members of the commission arrived on the scene, the power room was opened and the power supply to the signaling equipment was cut off, and the relay room door was opened, from which white smoke came out, and from 1:57 p.m. thick dark smoke began to come out of the relay room. At that time, cars were being moved from the parking lot at the signal box. All of the rooms in the switchyard were abandoned by the employees. At 14:00 the generator room was opened. At the same time, the main power supply to the control room was switched off, and at 14:01 one of the members of the acceptance committee took out the fire extinguisher wrapped in foil from the signal box room. After unpacking it and screwing on the hose, he went to the relay room. This employee extinguished the fire in the computer cabinet and left the relay room at 14:02. The smoke from the relay room stopped at 14:09.

It took 13 minutes from the time the fire alarm was activated until the smoke stopped coming from the relay room, and 8 minutes until the fire extinguisher was used. No attempt was made to activate the automatic extinguishing system during the entire firefighting operation.

The fire department arriving on the scene was no longer required to extinguish the fire.

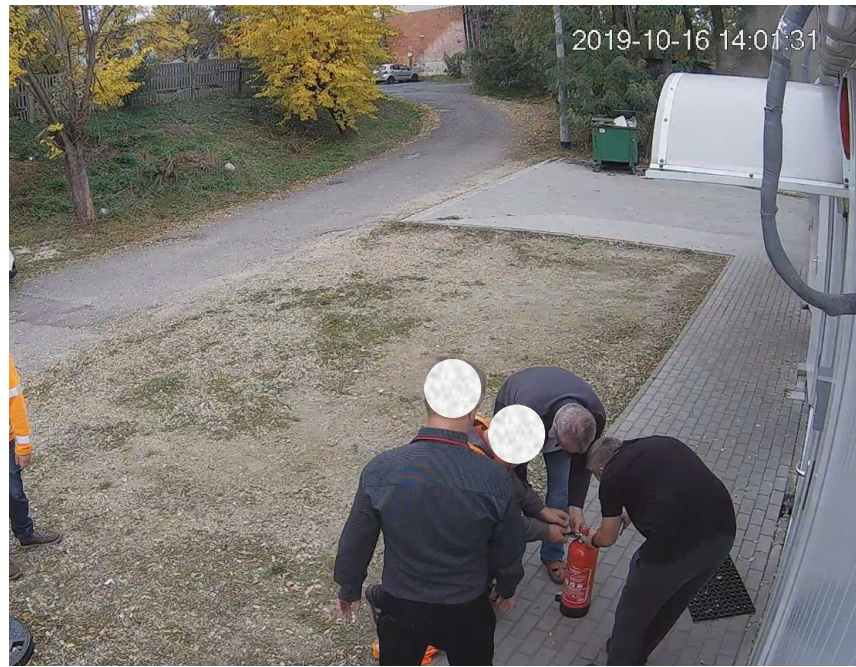


Photo No. 6 - Installation of a fire extinguisher performed during a fire

Acceptance process

On 20.06.2017 a contract was signed for the execution of works on the task "Reconstruction of railway traffic control equipment at Leszczyny station on railway line no. 140" within the project called: "Rationalization of the main export routes of Upper Silesia". The handover of the construction site took place on 26.06.2017. On 19.08.2017, the contractor (El-IN Sp. z o.o.) handed over the construction documentation of the SRK industry. Finally, the documentation was approved on 10.11.2017. - The executive design of the traffic control system industry was agreed with comments, and the documentation was accepted for implementation. From October 2017, the contractor proceeded with the installation of equipment on the new container signaling station, which was built in September 2017. The signaling equipment was installed on the existing track layout. On 09.03.2018, a technical acceptance commission was appointed to check the MOR-1 relay layer and the newly built external signaling equipment. The acceptance commission started its work on 13.03.2018. During the acceptance, the commission discovered a number of design and construction defects, which contributed to the prolongation of the acceptance process. After discovering the defects, the Commission repeatedly interrupted its work and resumed it after removing the identified defects, starting the process of checking dependencies from the beginning. Employees of the Exploitation Section in Rybnik, the diagnostic staff of IZ Tarnowskie Góry and the automation inspector of CRI Silesia Region participated in the work of the Acceptance Commission. The composition of the commission on the part of ISE also changed several times. On 11.10.2019 the transfer of the traffic officer to the new signal box and commissioning of the newly installed signaling equipment took place. Trains started to run on the main tracks of the reserved runways. The Commission successively launched the remaining runs.

From October 11 to October 16, 2019, the commission conducted a technical acceptance of the newly installed traffic control equipment at Leszczyny station. The Commission did not find any irregularities in the operation of the equipment until the occurrence took place.

2. Fact-based description of events

2.1. The chain of related events that led to the occurrence, including: the actions of the people involved; the operation of rolling stock and technical equipment; the operation of the operating system

On 16.10.2019, at 07:10 a.m., the receiving committee of signaling equipment started the switching and commissioning of signaling equipment at Leszczyny station. The fact of the beginning of the works and the necessity of opening the relay room and the machine room was recorded in the book E1758 at 07:10 a.m. On that day the train traffic at Leszczyny station was carried out on substitute signals. The work of the commission was finished at 13:30.

The commission left the relay room, leaving the computer cabinet open, and went to another building in the station to write a report on the acceptance work. The door to the relay room was left unlocked with no surveillance against public access. The automatic fire extinguishing system for the relay room at the control station was also not turned on. The records of the MOR-1 system recorders show that the place where the fire started was module 4 in the expansion cassette of PLC A at 13:50:51, as stated in para. 1.9 of the report.

At 1:51 p.m., the MOR-1 system's computer desktop showed a loss of position control of all switches in the station and signaling of broken switches, the system registered a "no communication with I/O module" alarm. At 1:54 p.m., the system reported a lack of communication with the station control system (STS), and an alarm was activated at the interlocking signaling a fire in the relay station.

After the fire, all I/O modules in PLC cassette A1 were completely destroyed due to the direct impact of the fire that occurred in one of the modules in PLC cassette A2. The cable bundles connected to the modules burned along with the cable tray. PLC A1 showed no signs of damage. However, the front panel of the power supply of this PLC was found to be deformed. In the PLC A2 expansion tray, the I/O modules from slot 4 upward were destroyed.



Photo No. 7 - Open computer cabinet (Photo: railway commission)

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

After the fire alarm sounded in the relay room, the traffic officer on duty and the switchman came out of the control room, opened the relay room door, noticed smoke in the relay room, but found no open flames. The dispatcher then returned to the signal box, while the switchman closed the relay room door. and went to inform the receiving committee of the occurrence. The committee arrived on the scene and noticed a fire in the computer cabinet, which was extinguished by one of the members of the receiving committee with a hand extinguisher. The detailed course of the rescue operation is presented on the basis of the surveillance records in the paragraph above.

IV. ANALYSIS OF THE OCCURRENCE

1. Roles and responsibilities

1.1. Railway companies or infrastructure managers

Modernization works at Leszczyny railway station included reconstruction of the railway traffic control system at Leszczyny railway station on railway line no. 140 as part of the investment task: "Rationalization of the main export routes from Upper Silesia".

The designer and executor of the works was Przedsiębiorstwo EL-IN Sp. z o.o. The reconstruction of the signaling equipment included the installation of E-type relay devices with ERE and JRF small relays and the MOR-1 monitoring system at Leszczyny station. The supplier of the MOR-1 devices was ZAKŁADY AUTOMATYKI KOMBUD S.A. The MOR-1 devices were installed in a data communication cabinet manufactured by KZA Przedsiębiorstwo Automatyki i Telekomunikacji S.A.

The investor was PKP PLK S.A., represented by the Silesian Region Investment Realization Center in Wrocław, and the user was the Railway Lines Department in Tarnowskie Góry.

As part of the Infrastructure Manager's Safety Management System there is a procedure SMS-PW-10 entitled "Construction, Modernization and Renewal of Railway Infrastructure". The purpose of the procedure is to determine how investments in construction, modernization or renewal of railway infrastructure (through its construction, reconstruction or renovation as defined by the Construction Law) shall be safely implemented from the moment of commencement of works at the construction site until acceptance of the works by the investor.

Another procedure operating within the framework of the Infrastructure Manager's Safety Management System is Procedure SMS-PW-11 entitled "Cooperation with Contractors of Designers of Investment Works". The purpose of the procedure is to establish the principles of cooperation with the contractors of investment works during the execution of works and to regulate the principles of acceptance of these works. The scope of application of the procedure includes all organizational units of the Company, in particular the Investment Realization Center ("CRI"), CRI branches, and Railway Works, whose scope of activity includes the tasks of preparation, implementation, and commissioning of investment projects.

Technical acceptance is based, inter alia, on the "Guidelines for technical acceptance and commissioning of railway traffic control equipment" Ie-6 and the "Terms and rules for acceptance of construction works on railway lines" - Annex to Resolution No. 938/2017 of the Management Board of PKP Polskie Linie Kolejowe S.A. dated September 13, 2017, hereinafter referred to as "Terms of Acceptance".

The Internal Instruction "Terms of Acceptance" provides, inter alia, for the performance of acceptance of individual parts of the executed works, the so-called "partial acceptance" (including disappearing or concealed works). These inspections are carried out, inter alia, when:

- The Contractor seeks payment for partial completion of the Work and the Contract provides for such a method of settlement,
- The Contractor is proceeding to the next stage of the Work and there is a need to determine the quality and quantity of the Work which is either falling or being covered,
- There is a need to assess the quality of the assembled component or equipment,
- There is a need for acceptance before a phase of the work is handed over to another contractor..

It is the responsibility of the engineer/supervisor to organize and carry out the partial acceptance.

In the case of work that is hidden and subject to concealment, the participation of a person designated by the Railway Company (a specialist in the industry) is mandatory.

In particular, the Contractor is obliged to check the quality of the elements, materials and equipment installed, as well as the

and equipment, as well as the ongoing control of the correctness of the work carried out.

In particular, the engineer/supervisor is required to:

- Inspect the work performed by the Contractor;
- Inspect and verify the quality of installed components, materials and equipment;
- Perform tests under its own quality control system;
- Participate in technical tests and verify the results of these tests;

- Verify and approve as-built documentation;
- Verify and review the assembly report;
- Issue statements on confirmation of work;
- Participate in all acceptance procedures.

The basic condition for the acceptance of the completed works is confirmation of the use of materials, elements, equipment and technologies provided for in the design, introduced to the market in a manner suitable for them and approved for use on PKP Polskie Linie Kolejowe S.A. lines:

- test results obtained by the Engineer within the framework of his own quality control system;
- results of inspections and tests carried out during the construction works;
- results of visual and random tests carried out during acceptance.

On 11/12/2019, a commission technical acceptance of the newly installed traffic control equipment at Leszczyny station was started. In the period between the beginning of the acceptance and the occurrence on 16/10/2019, no irregularities in the operation of the equipment were detected.

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

Based on the research material collected, the Investigation Team did not find any association between maintenance facilities, maintenance shops, or other maintenance providers and the occurrence investigated.

1.3. Rolling stock manufacturers or other suppliers of railway products

Based on the collected research material, the Investigation Team concluded that suppliers of railway products are related to the investigated occurrence:

- KZA Przedsiębiorstwo Automatyki i Telekomunikacji S.A.
- ZAKŁADY AUTOMATYKI KOMBUD S.A.
- Przedsiębiorstwo EL-IN Sp. z o.o..

1.4. National safety authorities or the European Union Railway Agency

The President of the Railway Transport Authority is a central governmental administrative body that is the national safety authority and the national regulator of rail transport within the meaning of the European Union regulations on safety, interoperability, and regulation of rail transport, competent in matters:

- 1) regulation of rail transport,
- 2) licensing of rail transport,
- 3) technical supervision of the operation and maintenance of railway infrastructure and rolling stock,
- 4) railway traffic safety,
- 5) interoperability and technical consistency of rail transport,
- 6) driving licenses and certificates.

On the basis of the collected material, the Investigation Team did not find any connection between the security authority with the factors influencing the occurrence.

1.5. Notified bodies, designated bodies or risk assessment authorities

The Investigation Team, based on the collected research material, found no connection of the notified and designated risk assessment bodies to the investigated occurrence.

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

The Investigation Team did not find any link between the certification bodies of the entities responsible for maintenance and the occurrence investigated, based on the research material collected.

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

Not applicable.

2. Rolling stock and technical installations

Technical installations - MOR-1 equipment

According to the data contained in the DTR of the MOR-1 system, the interface system for the MOR-1.01 system uses GE FANUC AUTOMATION microcomputer hardware (for configurations with dependent relay devices): two PLCs of the for configurations with dependent relay devices): two PLCs from the 90-30 series or the PACSystems RX3i family, a set of MDL digital input and output modules.

According to the description of the GE Fanuc Automation RX3i PACSystems RX3i controllers in the User's Manual, the *Layout Guidance* chapter contains information on the layout of the various components of the system in cabinets and enclosures. The provisions of this chapter are as follows:

"The enclosure must be able to properly distribute the heat generated by the components inside so that none of them overheat. The amount of heat dissipated is also a factor in determining the need for cooling systems such as fans or air conditioners in the enclosure. The minimum clearance around the RX3i base cartridge for cooling purposes should be 102 mm. Additional clearance may be required depending on the amount of heat generated by the equipment during operation. Appendix C describes how to calculate power dissipation through RX3i modules and field devices mounted in the enclosure."

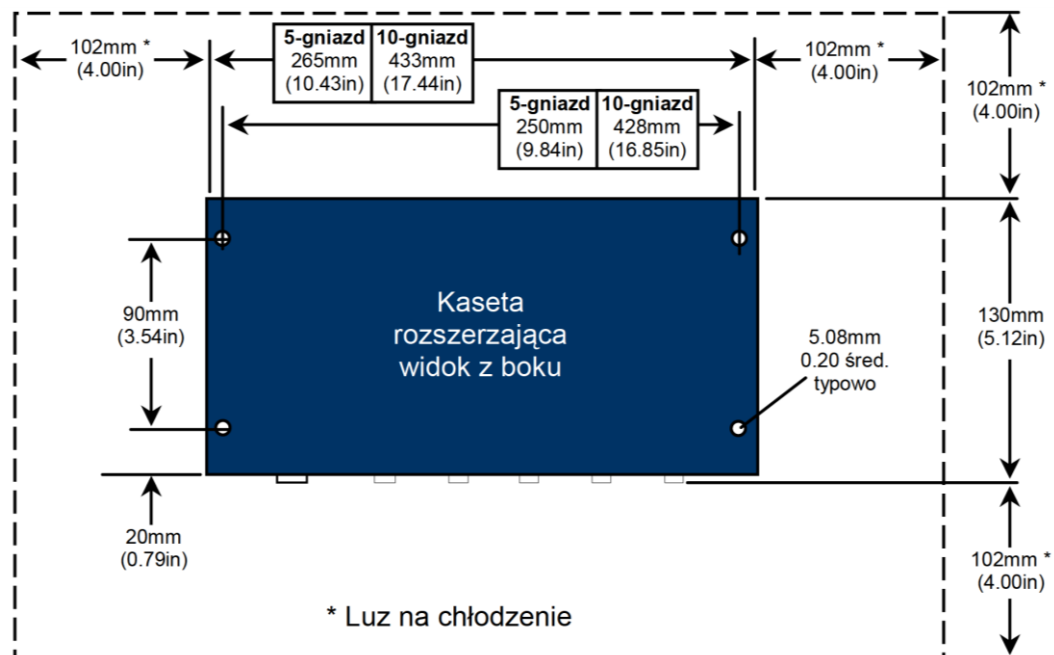


Figure 3 - Dimensions of the RX3i serial expansion cassette and layout in the enclosure

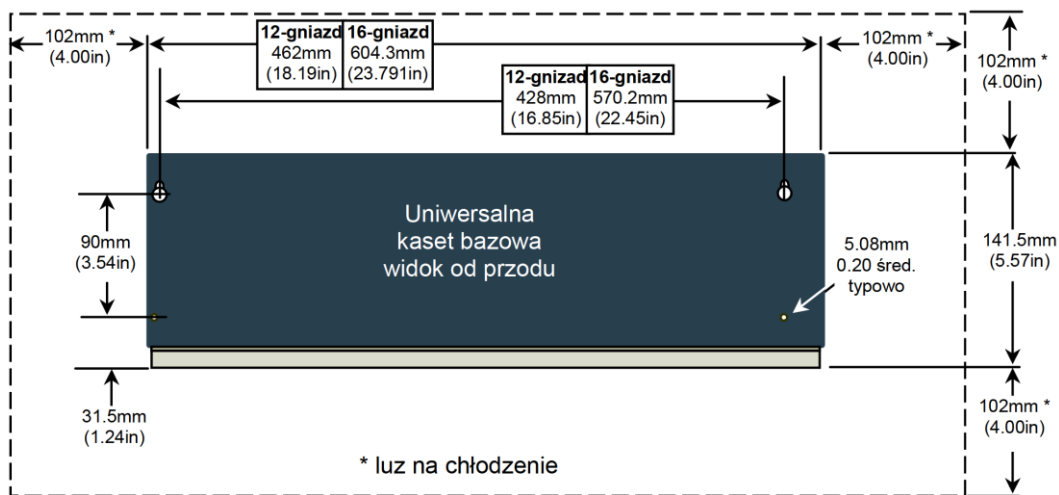


Figure 4 - Dimensions of the RX3i universal base cassette and layout in the enclosure



Photo No. 8 - Arrangement of devices in the MOR-1 computer cabinet

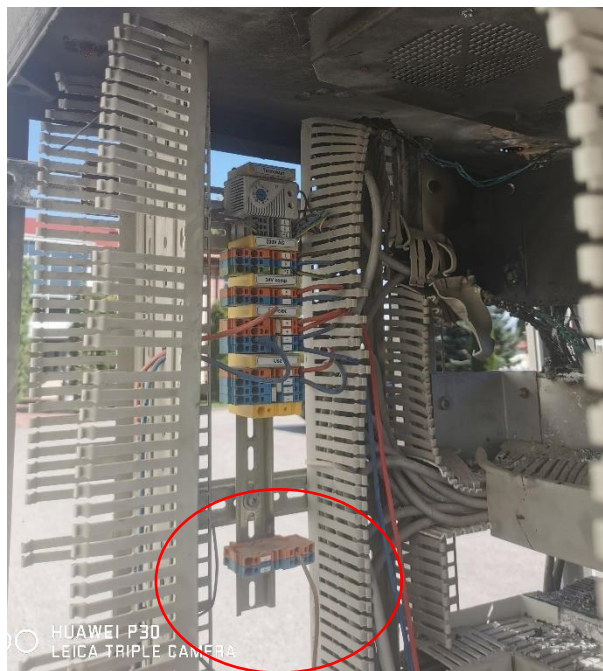


Photo No. 9 - Connections in the computer cabinet of unknown origin that do not correspond to the solutions of the equipment manufacturer (the cabinet was dismantled after the fire and the wires of the connecting cables in the cabinet were cut).

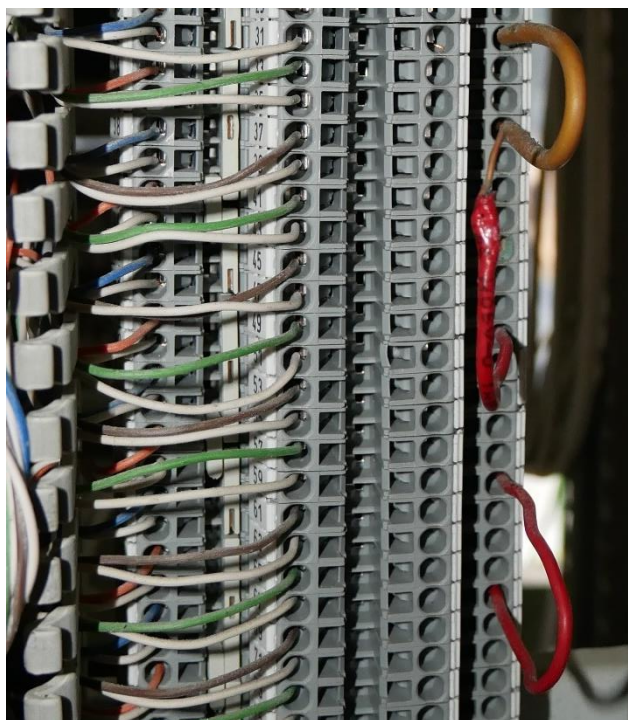


Photo No. 10 - Incorrect connections on terminal block #7 with visible signs of overheating and melting.

According to the Investigation Team, permanent heating at the connection point caused by improper terminal block connections and permanent heating at the top of the computer cabinet caused by a lack of proper cooling contributed significantly to the occurrence.

The Technical and Operational Documentation DTR-2008/ MOR-1.01 of the monitor mapping system type MOR-1 variety MOR-1.01 specifies the following design recommendations and guidelines for the installation of equipment:

- MOR-1.01 system devices are designed for installation in typical 19" (440 mm) wide RACK-type equipment cabinets. One cabinet is designed for controllers and executive relay modules (and cable strips for connecting executive relay modules with devices of the basic dependency layer). The other cabinet is for computers: Station Controller (SS) and Operator Station (SO). For small sites, it is possible to place all system devices in one cabinet. Due to the length of cable connections, it is most advantageous to locate the cabinets of the MOR-1.01 system in the relay room, but in case of lack of space, they can also be located in another room (e.g. the room of the traffic officer on duty). Versa Point modules should be arranged to provide the shortest possible connections to relays (or other elements of the basic dependency layer) that are the source of messages (e.g., on relay racks). Internal panel connections (i.e., connections of controllers to executive relay cards) are included in the system's factory documentation. Connections from the command controller (SP) cabinet to the base layer devices should be made with cables with a conductor cross-section of 0.8 mm². WAGO type terminals mounted on TH rails should be used for connection strips.
- The MOR-1.01 devices may be installed by authorized persons designated by the manufacturer and by the investor's competent services. The basis for the installation is the documentation prepared by the manufacturer and approved by the investor. Cable connections should be made on the basis of the cable connection list and cable connection tables. Terminal blocks of MOR-1.01 devices are available to the installer. After installation, all connections should be checked for correctness. Commissioning of the system should be carried out by the manufacturer's service".

Factors identified as contributing to the occurrence by the Investigation Team:

- Changes made by the contractor to the connections of the computer cabinet, despite having the correct connections required for this equipment, confirmed by the issuance of the Declaration of Conformity No. 018/17/3/MOR-1.01/2019 issued by the manufacturer on 03/10/2019.
- Loss of stable connection on the terminal strip due to multiple wire connections on the strip.
- Locating the computer cabinet thermostat at the height of the top PLC cassette instead of at the highest point of the cabinet.
- Arrangement of the RX3i cassettes in the computer cabinet that does not comply with the requirements of the PACSystem RX3i controller manufacturer's documentation, reducing the cross section of the gravity cooling channels.

According to the DTR of the system, "The devices of the MOR-1.01 system are resistant to electromagnetic interference and electrostatic discharges, overvoltage from external power sources and the effects of electric traction in accordance with the applicable standards (PN-EN 50121:2002 (U) series). The devices of the MOR-1.01 system meet the safety requirements applicable to power electronic devices with voltage up to 1kV".

Taking into account the above and the provisions of the DTR, as well as the analysis of the available evidence in the case, the Investigation Team does not conclude that the cause of the computer cabinet fire was due to overvoltages from external sources (outside the system).

3. Human factors

3.1 Human and individual characteristics

Not applicable.

3.2 Job-related factors

According to the Investigation Team, the following working conditions and ergonomic conditions of the on-duty traffic officer's workplace had an impact on the incident:

- The installation of an emergency button for the fire extinguishing system in the traffic duty room, which was not foreseen in the documentation.
- Late and unprofessional action to extinguish the fire.

3.3 Organizational factors and tasks

Not applicable.

3.4 Environmental factors

The Investigation Team did not identify environmental factors influencing the occurrence.

3.5 Any other factors relevant to proceedings

Not applicable.

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

4.1 Conditions of the relevant regulatory framework

As part of the proceedings in question, the Commission's Investigation Team conducted an analysis of the "Hazard Register", which is one of the most important elements of the Safety Management System of the Infrastructure Manager, PKP Polskie Linie Kolejowe S.A. The analysis concerned version 10.0 as of August 8, 2009.

Chapter 2 deals with risks related to traffic control devices and communication. These are risks caused by various irregularities in formal and legal requirements, diagnostic errors, equipment malfunctions and power system failures.

The following risks may be related to the investigated occurrence:

Section 2.5.6 of the register: Failures of the power supply system of railway equipment due to overvoltage,

Section 2.5.8 of the register: Failures of the power supply system of railway equipment due to renovation work carried out by contractors,

Section 2.5.9 of the register: Failures of the power supply system of railway equipment as a result of modernization/revitalization work carried out by contractors.

After analyzing the surveillance footage of the area around the control station, the Investigation Team concluded that the course of the firefighting operation and the failure to use the capabilities of the fire extinguishing system may have had a significant impact on the course of the occurrence and its consequences. The response time between the start of the alarm and the use of the fire extinguisher available at the control station was relatively long, while the fire extinguishing system was manually switched off for the acceptance procedure.

However, the hazard register does not include the hazards related to a fire in the SRK equipment of the relay room due to the malfunction of the equipment of the automatic fire extinguishing system, the shutdown of this system or its improper operation (failure to use its capabilities due to lack of knowledge of its functions).

4.2 Processes, methods, content and results of risk assessment and monitoring activities carried out by any of the parties involved: railway undertakings, infrastructure managers, entities in charge of maintenance, maintenance workshops, other maintenance providers, manufacturers and other entities, as well as the reports of the independent assessment referred to in Article 6 of Implementing Regulation (EU) No. 402/2013

The Investigation Team did not identify any factors in the above area affecting the occurrence.

4.3 Safety management system of the railway companies involved and infrastructure managers, taking into account the basic elements set out in Article 9(3) of Directive (EU) 2016/798 and any EU implementing acts

Infrastructure manager PKP Polskie Linie Kolejowe S.A.

The Safety Management System (SMS) at PKP Polskie Linie Kolejowe S.A., was introduced by Resolution No. 30/2011 of January 24, 2011 on the adoption of an order introducing the Safety Management System at PKP Polskie Linie Kolejowe S.A.. The following elements of the SMS in effect at PKP PLK S.A. are related to the occurrence under review.

- SMS-PW-04 Conduct of railway accident recovery operations,
- SMS-PW-09 Safe design of railway infrastructure and principles of cooperation with designers,
- SMS-PW-10 Construction, modernization and rehabilitation of railway infrastructure,
- SMS-PW-11 Cooperation with investment contractors,
- SMS-PW-12 Cooperation with suppliers and contractors,
- Risk Register
- The PKP Polskie Linie Kolejowe S.A. Railway Traffic Safety Improvement Program for 2019.

4.4 The management system of the entity(ies) responsible for maintenance and maintenance workshops, taking into account the functions set forth in Article 14 (3) of and Annex III to Directive (EU) 2016/798 and any subsequent implementing acts

Not applicable.

4.5 Results of supervision by national safety authorities in accordance with Article 17 of Directive (EU) 2016/798

Not applicable.

4.6 Authorizations, certificates and assessment reports issued by the Agency, national safety authorities safety or other conformity assessment bodies

a) Safety authorizations/safety certifications for involved infrastructure managers and railway companies

Security Permissions for Infrastructure Manager PKP PLK S.A.:

- | | |
|-------------------|---------------|
| - EU number | PL2120150007, |
| - Date of issue | 30.12.2015 |
| - Expiration date | 30.12.2020 |

b) Permits for the release of fixed equipment for operation and permits for placing vehicles on the market

Certificate of Approval for the operation of a type of equipment intended for railway traffic management No U/2008/0041 for the MOR-1 type monitor mapping system with the MOR-1.01 variant issued on May 16, 2008 at the request of the Automation Machinery Plant "KOMBUD" S.A. in Radom.

Conformity of the device installed at Leszczyny station has been confirmed by the following type conformity declarations issued by Zakłady Automatyki "KOMBUD" S.A.:

- NR: 018/MOR-1.01/2017 dated 19/12/2017.
- NO: 018/17/1/MOR-1.01/2018 dated 10/10/2018.
- NO: 018/17/2/MOR-1.01/2019 dated 11.07.2019.
- NO: 018/17/3/MOR-1.01/2019 dated 03/10/2019.

c) Entity responsible for maintenance and maintenance workshops (including certification)

Not applicable

4.7 Other system factors

Not applicable.

5. Previous occurrences of a similar nature

As part of its investigation, the Investigation Team analyzed selected events that occurred in 2015-2019. A brief description of the selected events, the impact of the events, and the causes of the events that occurred are presented below:

- Incident - Fire in the room of the container with built-in control equipment of LCS Niedrzwica, occurred on 04.02.2018 at 13:10 at the station Niedrzwica, km 20.181 of line 68 Lublin - Przeworsk, in the area of the Infrastructure Manager of the Railway Department in Lublin.
At 13:10 there was a complete power failure at the LCS signal box, the images on the monitors disappeared and there was no power supply to the signal box. The generator started without switching to the emergency power supply. This situation prompted the traffic officer on duty to observe the facility and the LCS container. The dispatcher noticed black smoke coming from the container, located 10 meters from the interlocking building, which contained the LCS computer control and power supply equipment. He immediately notified the company dispatcher and then the fire department.
After the arrival of the fire brigade and the switchman, the container was opened (LCS Niedrzwica station) on the order of the traffic officer and the rescue operation began. After removing the corrosive smoke, the firefighters entered the container and extinguished the fire.
Backup power components - UPS, battery banks, power supply unit, wires connecting power components were burned.
Due to the damage to the main UPS and battery bank, the entire system did not start up.
Trains were operated on the basis of telephone announcements.
Reasons for the incident:
 - (a) direct: fire in a building facility,
 - (b) primary: the flow of a large current in the battery charging circuit,
 - (c) indirect: melting and ignition of the insulation on the wires connecting the batteries to the UPS.
- Incident - fire in the J⁻ disposition control station.
Occurred on 12.08.2019 at 14:05 at the station Jankowa Zaganska, km 93.955 of route 282 Miłkowice - Żary in the area of the infrastructure manager Zakład Linii Kolejowych in Zielona Góra.
At approximately 12:30 p.m., an electrician from Zakład Ogólnobudowlany from Zielona Góra, who was carrying out repairs to the control room building, started to replace the electrical switchgear after receiving verbal permission from the traffic manager of Jankowa Zaganska station. The permission was given until 14:20 (a break in train traffic). The electrician disconnected only the reconstructed switchboard without disconnecting the entire building (the three-phase cables connected to the dismantled box were energized) and began to disconnect the remaining electrical systems. At approximately 14:05, the traffic officer on duty in the control room heard the sound of an electrical short coming from the communications cabinet and the sound of the generator starting. The electrician did not hear the sound of the short but smelled a burning odor. The ISEDR ran outside to make sure the generator was working. After assessing the situation, he notified the Automation Master.
At the same time, the electrician ran outside the building to completely disconnect the power supply, then returned to the building to disconnect and insulate the power wires from the switchgear. The traffic officer on duty in the switchgear building could not enter the building because of the thick smoke in the stairwell. So he stayed outside and used the company phone to notify the ISEW for traffic engineering, the fire department, the company dispatcher, and the SOK of the occurrence. The control cables of the signaling devices were burnt in the signaling room, the power supply of all signaling devices was missing.
Reasons for the incident:
 - (a) direct: a short circuit in the electrical system occurring during repair work in the JZ control room building,
 - (b) primary: the emergence of voltage during the execution of electrical repair work from the 230-volt circuit into the 24-volt installation, causing excessive current flow, resulting in damage to the 24-volt emergency lighting power supply circuit and a fire outbreak.

V. CONCLUSIONS

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

The Investigation Team identified the following causal factors for the incident:

- Excessive temperature rise of the components of module 4 in the expansion tray of PLC A as a result of an increase in voltage relative to the internal resistance of the module, which caused an excessive power consumption and an increase in the value of the current flowing. The damage to the module was caused by a prolonged power supply at a voltage higher than the maximum allowed by the manufacturer.
- Unauthorized modification of the computer cabinet wiring with the use of wiring connections in the MOR-1 system equipment cabinet that do not comply with the manufacturer's solutions.
- Failure of the thermostat to detect the increased temperature of the upper PLC cabinet due to excessive air circulation caused by leaving the door of this cabinet open for a long time.

The Investigation Team concluded that contributing factors to the incident were:

- Failure on the day of the occurrence to turn on the automatic extinguishing system on the control panel located in the traffic control room after the receiving committee left the relay room.
- Late and unprofessional firefighting.
- Installation of an emergency button for the fire extinguishing system in the traffic officer's room that is not provided for in the documentation.
- Changes made by the contractor to the connections of the computer cabinet, despite the existence of the correct connections required for this facility, confirmed by the issuance of a Declaration of Conformity to Type No. 018/17/3/MOR-1.01/2019 issued on 03/10/2019 by the manufacturer.
- Loss of stable connection on the terminal strip due to multiple wire connections on the strip.
- Placing the computer cabinet thermostat at the level of the top PLC cassette, instead of at the highest point of the cabinet.
- Arrangement of the RX3i cassettes in the computer cabinet, not in accordance with the requirements contained in the documentation of the manufacturer of PACSystems RX3i controllers, reducing the cross-section of gravity cooling channels.

In addition, as a result of the investigation, the Investigation Team found:

- system factors of the occurrence, which were defined as:

- Lack of regulations on the requirement of participation of the contractor (manufacturer) of computer systems of railway station equipment or its authorized representative in the process of internal acceptance of the equipment before commissioning,
- Lack of regulation in the technical and operational documentation (DTR) of the manufacturer of the equipment obliging to permanently close the door of the computer cabinet during operation.
- The dismantling of the cabinet was carried out in violation of the rules of preservation of evidence. The dismantled cabinet was turned over to the manufacturer by the railway commission without any evidence that all investigations affecting the determination of the causes of the occurrence, including an inventory, detailed photographic documentation and a detailed description of the destroyed elements, had been conducted. This constitutes a violation of Instruction Ir-8 (§ 17(1) and (2)(6)).
- The Chairman of the Railway Commission investigating the causes of the incident at Leszczyny station and one of the members of the Railway Commission had previously participated in the work of the acceptance commission for signaling equipment. This is inconsistent with the provisions of § 11 of the Instruction on the handling of serious accidents, incidents and malfunctions in railway transport Ir-8:

"A member of the Railway Commission participating in the proceedings may not be an employee who has a direct connection with the accident or incident or who is related to a person who has a connection with the occurrence; this exclusion also includes personnel directly responsible for the maintenance of the infrastructure in the area where the occurrence took place".

According to the Investigation Team, this had the effect of prolonging the investigation process due to conflicts of interest and compromised the railway commission's determination of the causes of the occurrence.

2. Measures taken since the occurrence

The Railway Commission has not made interim recommendations requiring immediate action.

3. Additional notes

In the course of its investigation, the team found the following other irregularities:

- Lack of all declarations of conformity to the type of the MOR-1 system in the railway traffic control industry's collation report,
- In the relay room of the Leszczyny control room, the fire switches were installed on the wrong side of the entrance door, and the white "extinguishing interlock" button was not installed.

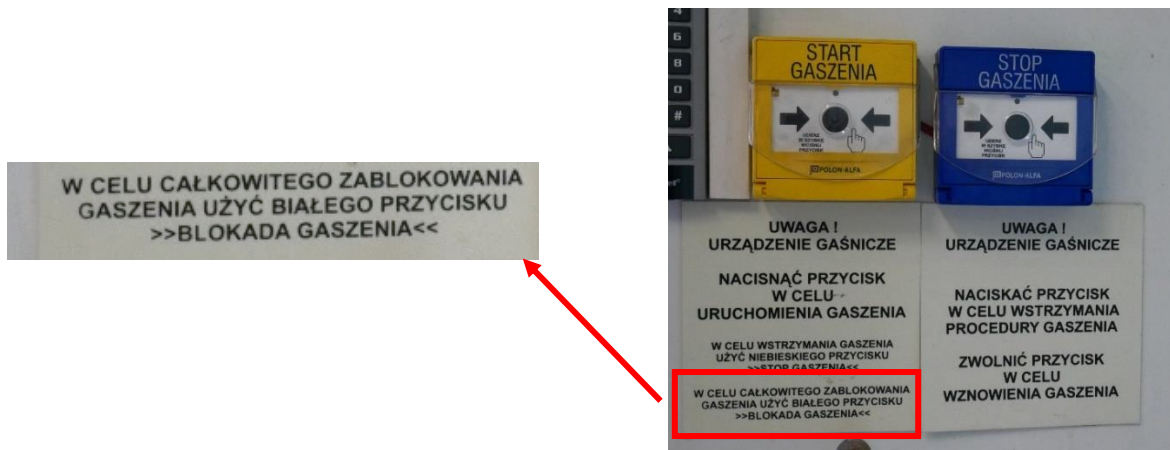


Photo No. 11 - Fire buttons in the relay room

In addition, the Investigation Team found that the operators were required to check the temperature of the in the relay room, which is inconsistent with the regulations of PKP PLK S.A.'s internal regulations. (Instruction Ie-20 § 11).

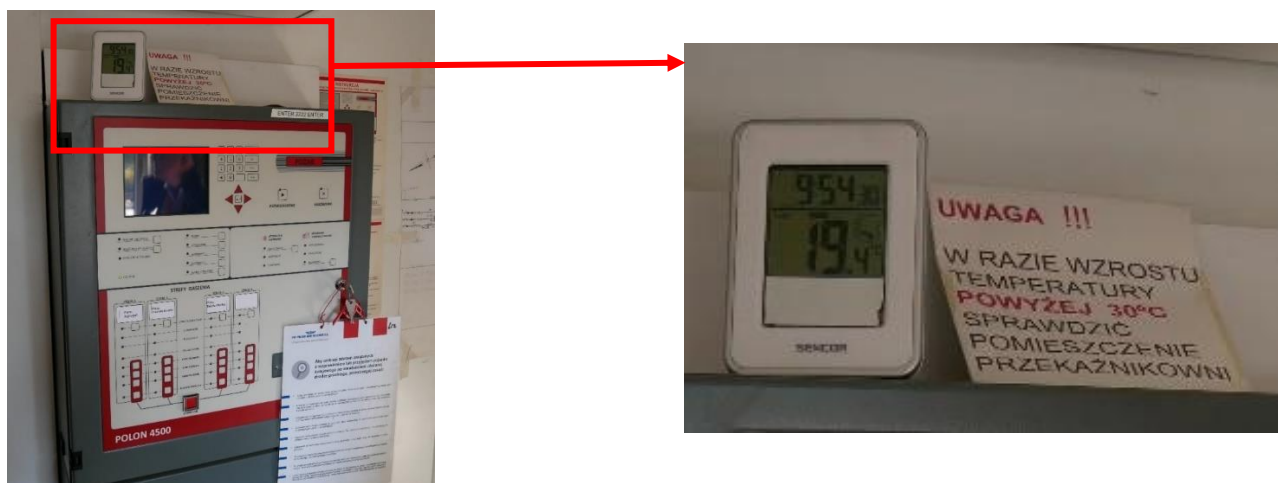


Photo No. 12 - The control panel in the room of the traffic officer on duty

VI. SAFETY RECOMMENDATIONS

- 1) Infrastructure managers shall introduce a requirement for the participation of the manufacturer of railway station equipment computer systems or its authorized representative in the process of internal acceptance of the equipment before commissioning.
- 2) Infrastructure managers shall include in the programs of periodic training of personnel for operation and maintenance of railway equipment the subject of operation of fire-fighting equipment, in particular fixed gas extinguishing equipment.
- 3) Infrastructure managers shall install an emergency extinguisher button in the rooms of the staff of srk equipment operation at stations equipped with an automatic extinguishing system.
- 4) PKP PLK S.A. shall supplement the records of the Hazard Register in terms of diagnosed risks of fire source of railway equipment.
- 5) PKP PLK S.A. shall change the location of fire switches in the Leszczyny switchyard relay room from the right side to the left side of the door leading out of the relay room, and will install a white "extinguisher interlock" button.
- 6) Zakłady Automatyki Kombud S.A. shall specify in the DTR of the equipment:
 - permissible time to leave the door of the computer cabinet open for the duration of the performed maintenance,
 - the maximum permissible ambient temperature of the cabinet in a closed room,
 - the limits of setting the thermostat of the computer cabinet fan.
- 7) Zakłady Automatyki Kombud S.A. shall make changes in the MOR-1 system regarding the sending of information to the traffic officer's service station about alarms with information about exceeding the operating temperature of PLCs.
- 8) Zakłady Automatyki Kombud S.A. shall change the location of the fan thermostat in the computer cabinets of the MOR-1 system, so that there is a possibility of receiving the increase in temperature values from the upper part of the cabinet.
- 9) Zakłady Automatyki Kombud S.A. shall install computer cabinet elements in the newly built MOR-1 system installations, which will ensure the arrangement of controllers with the minimum free space around the base cassette, in accordance with the requirements of the manufacturer of controllers.

State Commission on Railway Accidents Investigation
Chairman

.....
Tadeusz Ryś

List of entities appearing in the contents of Report No. **PKBWK 01/2023**

| No. | Symbol (abbreviation) | Explanation |
|----------|-----------------------|---|
| <i>1</i> | <i>2</i> | <i>3</i> |
| 1. | EUAR | European Union Railway Agency |
| 2. | MSWiA | Ministry of Interior and Administration |
| 3. | UTK | Office of Rail Transport |
| 4. | IZ | PKP PLK S.A. - Railway Lines Department |
| 5. | CRI | Investment Execution Center |