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Editor's

Andrzej Toruń

Head of the Railway Traffic Control and Telecom Department

The Railway Research Institute (Instytut Kolejnictwa) - Railway Traffic Control and Telecom Department participates in many innovative projects in the area of research and implementation of unique modern railway traffic control systems. Many of them were presented at international conferences, i.e. „New train location concept for rail traffic control processes" on the 1st UIC Global Conference on Signalling, focused on The Evolution of ERTMS, organized by the International Union of Railways (UIC), (Milan, Italy 2018), or "Integrated information management system, as a method of improving the effectiveness of carrying out rescue operations at railway accidents" presented on the 12th World Congress on Railway Research, co-organized by the International Union of Railways (Tokyo, Japan 2019).

Currently, we are working on two key research projects. The first one is the project called "Standardization of selected interfaces of railway traffic control equipment and systems" POIR.04.01.01-00-0005/17, which has been created as part of the BRIK (Research and Development in Railway Infrastructure) program and has been co-financed both by the NCBR (The National Centre for Research and Development), as well as the PKP Polskie Linie Kolejowe S.A. (PKP PLK - Polish State Railways) - which is a dominant railway operator in Poland. The project is implemented in cooperation with Rail-Mil Computers Company. The aim of the project is to develop specifications and requirements for the interfaces used in computer traffic control devices, based on purposely conducted research and tests, through which the validity of the adopted key research assumptions could be tested. The project findings would be then summarized in a form of a guideline document which would encompass standards, requirements, also recommendations in respect to the design, as well as the implementation, and which would facilitate connecting various railway traffic control devices and systems, along with other possible accompanying systems of different types, regardless of their manufacturer. Moreover, the additional advantage of the project would be standardization interface specifications for the entire railway network in Poland. Finally, although the current project has been dedicated specifically to the needs of the railway network which is managed by the PKP PLK, the developed framework could also be successfully employed by other operators of the railway infrastructure.

The project assumes the use of the latest technology in secure digital data transmission, utilizing the Ethernet standard, which is at the moment perceived to be the most developmental and universal. The proposed solutions will also have an advantage over the specialized and often atypical solutions that have been previously used by some suppliers, and which have been generating numerous problems. In addition, the rational approach of the applicant indicates the need to use elements and methods as universal as possible, so that none of the potential suppliers will feel more favored or hindered in respect to the selection of specific detailed technical solutions.

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New Locomotive for Warsaw Metro

Andrzej Chojnacki
Rail Vehicles Departmenet, Railway Research Institute

In 2017, Warsaw Metro announced a tender for the supply of a two-axle Diesel shunting locomotive of maximum speed of 40 [km/h], intended for light shunting movements on sidings as well as transporting metro vehicles. The locomotive had to be adapted to operate metro vehicles used by the Contracting Party.

The tender was won by a Czech company CZ LOKO, which offered a Diesel 794 class locomotive with Bo axle arrangement and axle load of 15 tonnes per axle. The dimensions of the locomotive met the requirements of the metro gauge. The diesel locomotive was designed as a modular one with a central driver's cab. Two traction engines driving wheelsets through axial gears are used to move. The locomotive's tractive force at constant power is 74.9 [kN] while the maximum tractive force on the hook is 114 [kN]. Spring-mounted wheelsets are guided by means of suspension beams (equalizers). The main frame of the locomotive is a welded construction. The total length of the locomotive is 7.98 [m]. The locomotive 794 class is adapted to cooperate with other locomotives operated in the Metro. In double traction, the locomotives are able to pull a six-carriage train of 200 [t] weight out of the Metro tunnel.

Fig. 1. Class 794 locomotive on the IK Test Track

Due to the intended use of the class 794 locomotive, its placing in service should be carried out on the basis of the Regulation of the Ministry of Infrastructure and Development of 13 May 2014 on placing into service certain kinds of constructions, equipment and railway vehicles (Journal of Laws 2014 item 720). In 2019, the Railway Research Institute (IK) carried out tests of the class 794 locomotive for compliance with the requirements of the Regulation.

Based on the conducted tests and the provided technical documentation, a technical opinion and a certificate of conformity with type were issued. On the basis of the above documents, the Office of Railway Transport (UTK) issued a certificate of placing in service for a specified period. During the validity of the Certificate, in accordance with the Regulation, operational tests of the class 794 locomotive were carried out, after which IK again issued a technical opinion and a certificate of conformity with type. These documents allowed the Office of Rail Transport to issue an certificate of placing in service without a time limit.

Fig. 2. Class 794 locomotive on the IK Test Track

achojnacki@ikolej.pl

Research Concerning Rail Transport Access for Persons with Disabilities in In2Stempo Project

Iwona Wróbel
Engineering and technical Specialist Railway Track & Operation Department, Railway Research Institute

The Railway Research Institute is participating in the EU In2Stempo project within a common European initiative Shift2Rail focused on research and innovation in rail transport as the PKP S.A. third party. The aim of the In2Stempo project is to search innovative solutions including, among others, the improvement of service quality and the travellers' feeling of safety at railway stations.

Work package 8 (WP8) Platform Train Interface is implemented within EU In2Stempo project, which concerns conditions of access for travellers from the platform onto a train, with particular attention to persons with disabilities. The main goal of WP8 is to look for technical and organizational solutions which in the future will enable a better adaptation of railway infrastructure and rolling stock for the travellers, like overcoming the space between the platform edge and a carriage while boarding or alighting the train. Apart from Poland, other WP8 participants come from Great Britain, Portugal and Finland.

One of the WP8 tasks was to carry out surveys concerning travellers' assessment of rail transport accessibility as well as existing problems with platforms' and trains' accessibility in the European Union. The surveys were addressed to organizations and associations which bring together people with different health dysfunctions and disabilities as well as the deaf and hard of hearing, the blind and visually impaired, persons with physical disabilities and reduced mobility (including those on wheelchairs). The questions and the survey methodology had been agreed with partners participating in the In2Stempo project.

The final version of the questionnaire contained 15 questions in total. The first four questions covered the matrix of a surveyed person concerning the type of health dysfunction, frequency of travelling by train and the choice of a train.

The thematic questions had both a closed question form (multiple choice questions providing uniform and standardized answers which consequently are easy to analyse and shorten the research time) and an open one which allows the respondent a complete freedom of expression.

The responders were asked in particular about the following:

- assessment according to the degree of importance of the following aspects:
  - availability of information before arrival at the station,
  - the correctness of the station's markings,
  - availability of qualified staff assisting disabled persons and persons with reduced mobility and accessibility of technical devices which remove barriers,
  - accessibility of places and services dedicated to the disabled,
  - the availability of adequate information in real time on interruptions to services (equipment failure, change of platform where the train stops),
- if crossing the space between the platform and the train makes the journey by train more difficult for them,
- what kind of assistance is expected in order to facilitate boarding the train from the platform,
- where technical equipment (aids) should be installed in order to board/alight the train and who is to operate it,
- opinion on providing up-to-date and relevant information by mobile applications,
- suggestions to improve conditions of travelling by train for the disabled,
- examples of good practice pursued on behalf of people with disabilities used in other means of transport or in the public sector,
- willingness to participate in consultations, testing and issuing opinions concerning suggestions of new solutions dedicated for the disabled in rail transport.

The surveys were carried out in October 2019. However, their results will be used in further work on WP8 and in proposals of new universal solutions facilitating access to rail transport and crossing the space on the platform-train interface.

iwrobel@ikolej.pl

Field Tests of In-company AC Traction Supply Systems Carried out by Electrical Power Engineering Department of the Railway Research Institute

Włodzimierz Kruczek
Engineering and Technical Specialist Electric Power Division

The traction supply system in Poland is a 3 kV DC system. Therefore in-company supply systems intended for starting and checking multi-system rolling stock must be separated from railway lines power supply and current return circuit belonging to PKP PLK and supplied from dedicated power supply sources. Electrical Power Engineering Department of the Railway Research Institute has carried out tests of AC systems energy infrastructure in the railway operator's technical maintenance facilities as well as NEWAG S.A. in-company test track in Nowy Sącz.

The performed tests were part of the placing in service process and their aim was to confirm the operational effectiveness of additional shock protection from traction voltage.

Field tests

Despite the lack of an AC traction power supply system in Poland, rolling stock manufacturers and railway operators maintaining a multi-system rolling stock equip their internal test tracks and maintenance workshops with energy devices enabling the supply of multi-system vehicles. Before placing in service of such a track or a maintenance workshop, it is necessary to perform tests confirming the operational effectiveness of the additional electric shock protection against all traction voltages that can be switched on in the catenary.

Fig. 1. The view of the multi-system substation traction converter
Source: the author's own elaboration

The power supply of separate tracks on which various traction supply systems can be connected comes from static traction converters dedicated to a specific solution. Such converters generate voltages with parameters compliant with the PN EN 50163 standard. For AC traction systems the voltages are 15 kV 16 2/3 Hz and 25 kV 50 Hz. For example, the tested test track at NEWAG S.A. in Nowy Sącz is supplied from a MEDCOM static converter dedicated to this track.

The converter enables the traction network to be supplied with alternating voltages of 15 kV 16 2/3 Hz, 25 kV 50 Hz and DC voltage of 750 V. The converter used has an output power of 800 kW, which allows for basic checking of multi-system rolling stock. The traction network can also be supplied with 1.5 kV DC voltage from a separate on-site DC traction substation. The traction converter installed at the traction substation is shown in Figure 1.

Electric shock protection is a set of technical, organizational and legal measures aimed at preventing the flow of life-threatening electricity through the human or animal body. Speaking of the effectiveness of protection against electric shock, one should refer to the effects of the current flow through the human body. These effects are characterized by two basic parameters: electrical shock time and electrical shock current. These parameters are specified in the regulations and standards for traction power systems. Due to the applied technical measures, the following are distinguished:

- Protection against direct contact (touch), the so-called basic protection, consists in providing such technical means that prevent contact with live parts that carry voltage in normal working conditions. In traction power supply systems, this protection is mainly provided by: isolating live parts and obstructing access.
- Protection against indirect contact, called additional. This protection consists in the application of technical solutions ensuring that the traction system device operates in such a way that its conductive parts are accessible, which under normal operating conditions are not under voltage (e.g. traction poles, traction vehicle boxes, switchgear housings), during emergency conditions, i.e. when the insulation is damaged and people touch a conductive part, they will not be capable of electric shock. Each conductive part of the traction system, which can be touched by humans and which, in emergency conditions, may carry voltage as a result of damage, must be subject to additional electric shock protection.

Supplying one traction network with alternating voltage generated in traction converters and direct voltage coming from the PKP PLK traction network, or another traction substation creates technical difficulties related to ensuring effective electric shock protection. These difficulties are mainly due to the fact that electric shock protection in DC traction systems is provided in a different way from AC traction systems. Therefore, it must be guaranteed that along with the selection of a given power supply system, the automation system should select an appropriate method of electric shock protection.

In DC electric traction supply systems, additional electric shock protection is obtained by direct connection to rail or in the so-called open system of all devices located in the impact area of the catenary. The current return circuit is insulated from the ground, the connection to rail limits the shock voltage to a safe level, while the power supply is turned off by a DC high-speed circuit breaker. In the AC traction power supply systems, the limitation of the effective touch voltage is achieved through the protective earthing of the current return circuit. This earthing should have parameters ensuring the limitation of the effective touch voltages to permissible values. Switching off the voltage when power supplied from the traction converter can be performed by the converter automatics.

Electrical Power Engineering Department of the Railway Research Institute carries out tests confirming the effectiveness of electric shock protection in all traction systems. Figure 2 shows NEWAG S.A. test track during tests and exemplary oscillogram of effective touch voltage recorded during the supply from a traction converter supplied with 25 kV 50 Hz voltage.

a)

b)

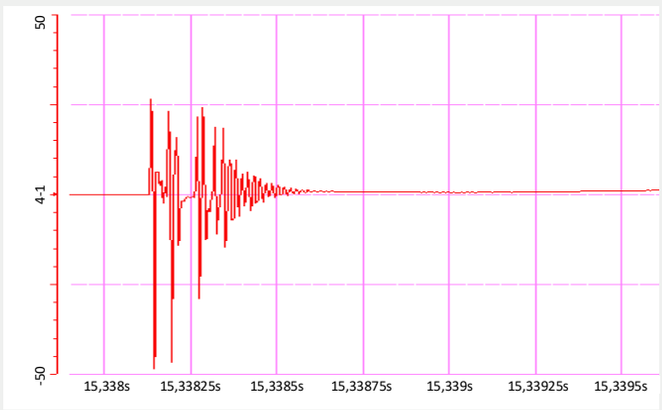

Fig. 2. Multi-system test track a) general view during tests, b) oscillogram of effective touch voltage recorded during the supply from a traction converter supplied with 25 kV 50 Hz voltage. *Source:* the author's own elaboration

wkruczek@ikolej.pl

Railway Research Institute develops technical standards: Detailed technical specifications to build railway infrastructure of Solidarity Transport Hub (STH)

The Railway Research Institute and Solidarity Transport Hub (Centralny Port Komunikacyjny Sp. z o.o. - CPK) have signed an agreement on the basis of which the Railway Institute will prepare Detailed technical specifications to build railway infrastructure of Solidarity Transport Hub (STH) - design guidelines for the CPK company. It is one of the most prestigious orders for the Railway Research Institute. The basic scope of work includes research and development which will result in developing technical standards for the future railway infrastructure of the Solidarity Transport Hub. The standards will cover all technical areas for the proper functioning of modern high-speed railway infrastructure. The development of technical standards is to enable trains to run on the future CPK main lines at speeds of up to 350 km/h, very high capacity on the sections leading directly to the airport, interoperability and compatibility with the technical railway infrastructure in Poland. Therefore, it is a complex and interdisciplinary task for specialists of the Railway Research Institute of all specialities. The CPK Railway Program consists of a total of 12 railway routes, including 10 so-called spokes leading from various regions of Poland to Warsaw and CPK. In total, these are 30 investment tasks and 1,789 km of new railway lines, the is Centralny Port Komunikacyjny Sp. z o.o.

wkruczek@ikolej.pl

The Polish Transport Research Institutes Network – POLTRIN

Renata Barcikowska
Head of Project Coordination and International Cooperation Unit, Railway Research Institute, Press Officer

In July 2018, Road and Bridge Research Institute, Railway Research Institute and Motor Transport Institute signed an agreement on establishing the Polish Transport Research Institutes Network – POLTRIN. Its goal is to strengthen the potential of research institutes which carry out major research projects on transport, economy and business competitiveness. The network characteristics is to function in the range of competence of a minister responsible for transport and focus the activities on land transport. This area has been underlined as one of the six most important in the Strategy for Responsible Development (SOR), and among thirteen strategic projects of the state.

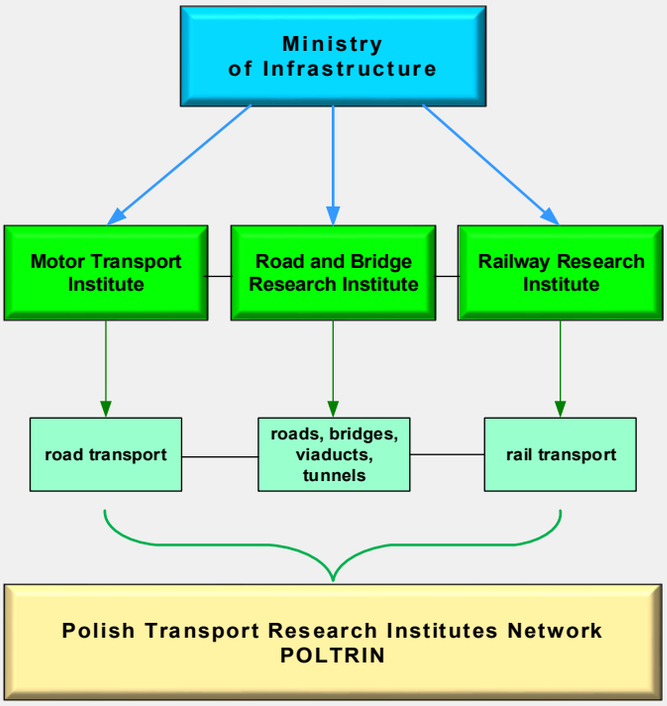

Fig. 1. POLTRIN organizational structure
Source: the author's own elaboration

The institutes within the network operate on the basis of the Organizational Regulations and Statutes approved by the supervising minister. They maintain their separate legal personality, acting on their own behalf and for their own account. The mission of the network is a broadly understood cooperation with the Polish economy in the field of road and rail transport. All the institutes are seated in Warsaw and do not require any restructuring or legal changes.

The institutes associated in the network conduct complementary activities and have been cooperating for many years both in the field of research projects and, for instance, in the area of certification. They are linked by many ad hoc and long-term agreements. The creation of a network bringing together scientific centres made it possible to systematize all activities and also facilitates ongoing joint initiatives.

POLTRIN
POLSKA SIEĆ INSTYTUTÓW BADAWCZYCH TRANSPORTU
POLISH TRANSPORT RESEARCH INSTITUTES NETWORK

Fig. 2. Logo of the network
Source: Report on the POLTRIN network activities for 2019, submitted to the Ministry of Infrastructure in January 2020

Activities related to major nation-wide transport projects, such as the construction of new roads and motorways and the modernization of railway lines, will be vitally important. The institutes' cooperation includes in particular:

- carrying out tasks which are crucial for planning and pursuing the policy of the state, and necessary to ensure development of innovative, effective, safe and low-emission land transport,
- identifying common problems concerning the transport sector and undertaking actions to solve them with the help of expert knowledge, scientific potential and research equipment at the disposal of the institutes,
- shaping strategic research programmes and initiating and implementing a joint research and implementation programme in the area of land transport,
- carrying out joint research and development projects as well as implementing and disseminating their results,
- cooperation between laboratories at the disposal of institutes and exchange of research experience [1],
- representing the network internationally in the field of research and development [2].

An important recent event within the Network's activities was the signing of a letter of intent between the POLTRIN institutes and Polskie Koleje Państwowe S.A. (Polish State Railways). The aim of the contract, concluded in March this year, is to start cooperation and exchange of knowledge relating to ongoing and planned innovative research and development projects in the field of road and rail transport.

rbarcikowska@ikolej.pl

[1] *Report on the activities of the POLTRIN network for 2019, submitted to the Ministry of Infrastructure.*
[2] *https://www.gov.pl/web/infrastruktura/powolanie-polskiej-sieci-instytutow-badawczych-transportu-poltrin (accessed on 20.03.2020).*

Signalling and Telecommunications Laboratory - Twenty Years of Accreditation

Marek Sumiła
Deputy Head of Signalling and Telecommunications Laboratory, Railway Research Institute

The present year is a jubilee year for the Signalling and Telecommunications Laboratory (LA) of the Railway Research Institute in Warsaw. On 1 September, 2000, on the basis of the results of the accreditation audit carried out on 25 January - 1 February, 2000 and the opinion of the Technical Committee for Testing Laboratories Accreditation, by the decision of the Polish Centre for Testing and Certification, for the first time the Laboratory was granted a research laboratory accreditation certificate (AB310) and became the first accredited research laboratory in today's Railway Research Institute (formerly CNTK).

For twenty years, the Laboratory has been continuously confirming its competence as part of its activities, despite the changing normative requirements, legal conditions and requirements set by the Polish Centre for Accreditation (PCA) associated within the International Laboratory Accreditation Cooperation (ILAC).

The laboratory operates on the basis of a management system compliant with the requirements of ISO/IEC 17025, offering a wide range of laboratory tests, including the requirements of standards for products and equipment mounted on rolling stock and rail vehicles (among others: EN 50155, EN 50121-2, EN 50121-3-1, EN 50121-3-2, EN 50500) and devices intended to be installed in the railway infrastructure (among others: EN 50121-4, EN 50125 3). The research area of the Laboratory includes climatic tests, electrical tests (insulation resistance), electromagnetic compatibility tests, tests of the radio interface of GSM-R standard radiotelephones (according to ETSI EN 300 607-1), measurement of radio coverage of the GSM-R system along the railway track n the frequency band from 921 MHz to 960 MHz, for compliance with EIRENE SRS specifications and the test procedure which we are accredited for.

The tests, recognized all over the world, are aimed at confirming the compliance of devices and vehicles with the normative requirements to be used in railways. In order to confirm the validity of the obtained results, the Laboratory participates in numerous inter-laboratory comparisons, and the measuring instruments used for the tests are regularly calibrated and checked.

As the only one in Poland, the Signalling and Telecommunications Laboratory has accredited test procedures for testing the levels of AC and DC magnetic fields generated by electrical and electronic devices installed in the railway environment with regard to human exposure (inside the vehicle and outside the vehicle) according to PN-EN 50500 and functional tests of railway traffic control systems and devices at railway stations and railway lines, functional tests of the CA active vigilance device (dead-man's handle), automatic braking devices for trains (SHP) and a radio telephone with the RadioStop function.

msumila@ikolej.pl

Monika Sawicka
Deputy Head for Quality at Signalling and Telecommunications Laboratory, Railway Research Institute

In addition to a number of accredited tests, the Signalling and Telecommunications Laboratory is competent to perform many non-accredited tests, recognized by the major railway infrastructure manager in Poland, PKP PLK S.A. The scope of these tests can be found on the Laboratory's website (http://www.ikolej.pl/en/units/la/).

The Laboratory contantly develops. Over the 20 years of operation, the scope of accredited tests has systematically expanded. At that time, many laboratory stations for EMC and climatic tests were built and launched. In the last decade, the Laboratory also acquired competence in the field of tests dedicated to Notified Bodies (NoBo) regarding GSM-R tests according to TSI CCS.

Last year, the Laboratory successfully passed the PCA assessment for compliance with the new edition of the reference standard EN ISO/IEC 17025:2017-02. Recently, the scope of performed tests has also been extended to include tests for immunity to conducted disturbances, induced by radio-frequency fields according to the EN 61000-4-6 standard.

The primary goal of the Laboratory is constant monitoring of changing requirements and responding to the needs of the railway market, as well as adjusting the scope of accreditation by verifying its own research procedures and modernizing the existing laboratory stands.

The current scope of the Laboratory's accreditation number AB 310 can be found on the PCA website at:

https://www.pca.gov.pl/akredytowane-podmiot/akredytacje-aktywne/laboratoria-badeniowa/AB%20310,podmiot.html

In the nearest future, the Laboratory plans to build and equip new test stands for photometric tests of railway devices and tests in an anechoic chamber.

Despite the generational changes taking place in the Laboratory's staff, the Laboratory Management undertakes activities aimed at preserving the knowledge and transferring the experience of employees who finish their cooperation with the Laboratory. Furthermore, young employees recruited from the best technical universities in the country can count on work offering many ambitious challenges in the field of researching new devices and systems intended for the railway market.

Concluding this information, we would like to wish the Laboratory another 20 years of activity, being aware of the role it plays in the process of approving more reliable and resistant to various types of exposure technical solutions.

msawicka@ikolej.pl

Intensive research work on the Test Track in Żmigród

Very intensive research work of new and modernized rolling stock was carried out on the Test Track in the second quarter of 2020. Nine research projects were concluded which related to: carriages for passenger traffic; 406A-40; 111A-30, TRAXX DC3 locomotive, diesel and electric multiple units such as 48WE, 21WE, 36WE in different variants, Flirt3 DMU4433, WINK 603. The tests covered all vehicle systems, including: the braking system and pantograph. The level of disturbances, noise and the interface between the traffic control (SRK) and ETCS systems were checked.

wszulc@ikolej.

Continued Introduction

The result of the project will be a breakthrough solution in the field of CCS systems, not only in the context of Poland, but also on the European scale. The project is assumed to be supra-local, supra-regional and although it is dedicated to the specific needs of the PKP PLK operator, the potential project implications can be much wider.

Currently, stages 1 - 3 have been fully completed, in which the specification for the interfaces listed below has been defined,

1) LB - IXL (block signalling - interlocking on the station),
2) LX - IXL (level crossing signals - interlocking on the station),
3) LCS - IXL (local control center - interlocking on the station),
4) LCS - LCS (remote control center - remote control center),
5) IXL - CUiD (interlocking on the station - maintenance and diagnostics center).

Since September 2020, the implementation of interfaces and the construction of the test stand have begun. The second key research project is the concept to use the WLAN WiFi network to build a CBTC class system for Warsaw Metro. The rmCBTC system has been created as part of a project co-financed by The NCBR POIR.01.01.01-00-0276/17 “CBTC class automatic train control system, based on unique bi-directional wireless data transmission and interoperational ETCS components, which increases efficiency and safety level in the agglomeration rail transport”. The project is implemented by Rail-Mil Computers Company and Faculty of Transport, Warsaw University of Technology, whereas the Railway Research Institute acts as an independent safety assessor and research body in the certification process.

The concept includes the installation of a radio communication system on vehicles and in the subway tunnel. That communication is intended for data transmission and to determine the position of the vehicle in real-time. The essence of the proposed solution is the use of WiFi access points arranged in the tunnel to determine the location of the front and end of the train. The concept presents the basic assumptions for the system and the boundaries of the rmCBTC system installed on the vehicle and in the metro infrastructure. In particular, the focus is placed on the WLAN WiFi transmission subsystem, the requirements for this subsystem in terms of availability, switching times, capacity etc. with regard to the exploitation parameters that are planned to be achieved after the implementation of the system in the Warsaw Metro.

Conceptual, programming and simulation studies of the test installation have been completed and the system has been installed in real conditions in the infrastructure and vehicles of the Warsaw Metro.

The rmCBTC system has been installed on 2 types of vehicles - METROPOLIS 98B (Alstom) and INSPIRO (Siemens). The tests were conducted in real conditions on the Warsaw Metro test track. They were to verify the acceptable levels of EMC interference after installing the rmCBTC system on these vehicles. The tests were carried out in accordance withCENELEC standards EN 50121 series. The scope of test covered radiated disturbance emission measurement and conducted disturbance emission measurements. The tests were carried out to certify the system for use in Poland by Urząd Transportu Kolejowego (Office of Rail Transport – a Polish Railway Safety Authority Office).

The conducted measurements show that the installed system has no negative impact on the above measurements and can be used as intended. No exceeding of permissible levels according to EN 50121-3-1 standard, which source is the SIEMENS INSPIRO and METROPOLIS 98B (Alstom) electric multiple unit, has been found. The confirmation of compliance with the EN 50121-3-1 standard is one of the tests required in the process of formal approval of rmCBTC system into operation.

atorun@ikolej.pl

Editors:

Dr Renata Barcikowska, Editor-in-chief
Jolanta Cybulska-Drachal
Jolanta Olpińska
Małgorzata Ortel
Andrzej Szmigiel

Contact:

IK - Railway Research Institute
04-275 Warsaw, Poland
www.ikolej.pl
E-mail: ikolej@ikolej.pl