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Editor's

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Dear Readers,

Fourth railway package composed by three directives and three regulations, accepted by EU Parliament in 2016, forming two pillars, market and technical one, has been implemented in Member States law. Due time, postponed due to Covid-19, has already passed, and old interoperability directive cannot be utilized as a basis for formal decisions any longer. Railway Research Institute as a Notified Body has issued nine hundred thirty

six EC certificates based on the old EU Railway Interoperability Directives. Since November 2020, as a body formally already notified to the new EU Railway Interoperability Directive (2016/797), we are issuing EC certificates for railway interoperability constituents and railway structural subsystems (infrastructure, energy, control command and signalling as well as rolling stock) in accordance with EU Commission Implementing Regulation (2019/250) precisely defining appropriate templates. Railway Research Institute under new EU Railway Interoperability Directive acts as a Notified Body fully prepared and authorised to fulfil EC conformity assessment and EC verification tasks for railway industries, suppliers, undertakings and infrastructure managers, utilizing both presently binding TSI specifications for new projects and old TSIs for projects at an advanced stage of development. Railway Research Institute is still your strong NoBo partner ready to undertake all types of notified body activities, having its own accredited laboratories focused on interoperability and safety.

Legal progress is accompanied by technical development. Formally those are separate processes, but progressing railway digitalization shall be caught up for cybersecurity reasons. Legal EU framework - EU Directive 2016/1148 concerning security of network and information systems (NIS), already affects railway undertakings and infrastructure managers in that respect, but presently it is omitting notified bodies. Disregarding this omission, Railway Research Institute carrying out activities of the railway safety assessment body under Railway Safety Directive (presently 2016/798) and taking into account importance of the cyber risks and the scale of the railway digitalisation, together with main Polish railway entities has signed a declaration to constitute the first cybersecurity Information Sharing and Analysis Centre (ISAC-Rail) - the first ISAC in Poland establishing basis for cybersecurity related cooperation. ISAC-Rail acting within rail transport subsector and cooperating with Polish Computer Security Incident Response Team (CSIRT-NASK) legally pointed for managing responses in case of cyberattacks on energy, transport, banking, financial, health, water supply and digital civil infrastructure. It is due time also to be ready for digital challenges especially as both rail infrastructure and rolling stock are utilised over dozens of years whilst cyber-environment changes every few years. Risks related to digitalisation, which is already high, have to be widely understood, properly recognised and taken into account by existing and additional security means ensuring inherent security.

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Brief information on the updated notification of the Railway Research Institute to Directive (EU) 2016/797

On 28 November, 2020, the Railway Research Institute was the first body in Poland to be re-notified by the European Commission, this time to the Directive of the European Parliament and of the Council (EU) 2016/797 on the interoperability of the rail system in the European Union. The notification was preceded by obtaining on 16 April, 2020 the accreditation no. AC 128 of the Polish Centre for Accreditation (PCA) for the purposes of notification to the above-mentioned Directive and granting the authorization of the President of the Office of Rail Transport on 30 October, 2020.

The Institute's re-notification was necessary due to the implementation of the Directive (EU) 2016/797, which replaced the previously binding Directive 2008/57/EC, to which the Institute was also notified.

In accordance with the scope of granted accreditations, authorizations and notifications, the Railway Research Institute as a Notified Body No. 1467 has the powers to carry out legally regulated EC certification and EC verification of all railway subsystems and all interoperability constituents using all modules of conformity assessment procedures.

The first in Poland ISAC Information Sharing and Analysis Center (ISAC-Railways)

On 2 October, 2020, an agreement was signed on the establishment of the first in Poland ISAC Information Sharing and Analysis Center (ISAC-Railways). Signatories of the agreement on the establishment of ISAC-Railways include the PKP Group companies - PKP S.A., PKP Intercity S.A., PKP CARGO SA, PKP Informatyka Sp. z o.o., PKP Linie Hutnicza Szerokotorowa Sp. z o.o., PKP Szybka Kolej Miejska w Trójmieście Sp. z o.o., PKP Polskie Linie Kolejowe S.A., as well as the Railway Research Institute and the Research and Aca-

demical Computer Network (NASK) - National Research Institute. The main goals of the establishment of ISAC-Railways is the constant exchange of knowledge and experience in the field of cybersecurity incidents between the entities involved in the project. The initiative is of key importance for the operation of the entire railways, as it contributes to raising the cyber resilience of ICT systems used by rail transport. The improvement of IT security level will contribute to the overall safety of the critical railway infrastructure.

Purchase and modernization of modern research and laboratory equipment for the Rolling Stock Testing Laboratory of the Railway Research Institute in Warsaw

On 29 December, 2020 at the seat of the Marshal's Office in Warsaw, Deputy Director for Studies and Research Projects of the Railway Research Institute, Dr. Eng. Andrzej Massel and the Marshal of the Mazovian Voivodeship, Adam Struzik and the Vice-Marshall Wiesław Raboszuk, signed a contract for co-financing the project entitled "Purchase and modernization of modern research and laboratory equipment for the Rolling Stock Testing Laboratory of the Railway Research Institute in Warsaw". The project will be funded within Activity 1.1. Research and development activities of research units RPO WM 2014–2020.

The aim of the project is to modernize and achieve higher-quality research in line with EU standards and to strengthen cooperation between the research and economy sectors in the field of testing the elements of rolling stock and rail transport infrastructure. As part of the project, the Rolling Stock Testing Laboratory of the Railway Research Institute will be retrofitted with laboratory and research equipment, devices and components. Additionally, the brake stand for testing the friction pairs of the railway brake will be modernized and retrofitted. As part of the project, tests of rolling stock elements will be carried out in the field of tribological tests:

- developing a new system for monitoring and diagnostics of components of the dynamometric stand equipment,
- developing a stand programming system with the possibility

of importing batch files (e.g. regarding railway route requirements, profile, etc.),

- developing a system for measurement test data recording and processing,
- developing the control system and control of the dynamometric station,
- developing a spraying system for pairs of rail friction-shoes simulating the behaviour of these elements during tests in wet and winter conditions.



Photo: IK

3 kV DC or 25 kV AC Comparison of Electric Traction Power Supply Systems

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The development of power supply systems for railway electric traction in Europe is pursued along various development paths. The choice of a given system is determined by technical reasons, knowledge and technological development, as well as economic and political issues. As a result, four basic power supply systems for electric traction are currently in operation in Europe: 1500 and

3000 V DC, 15 kV 16 2/3 Hz and 25 kV 50 Hz. Each of these systems has both its advantages and disadvantages.

Plans related to the construction of new railway lines related to Central Transport Hub (CPK), including high-speed lines, and technical conditions related to the modernization of railway lines included in the transport corridors, prompt considerations and analyses of the advisability and possibility of introducing a 2 x 25 kV 50 Hz system in Poland. One of the activities in this field was the development of a document commissioned by Doradztwo Kolejowe company entitled "Report describing the issue of changing the voltage of the traction network in Poland from 3 kV DC to 25 kV AC", which was presented on 30 November, 2020 at the on-line conference organized by the ProKolej foundation.

This document compares the currently operated 3 kV DC system with a 25 kV AC system in a 2 x 25 kV 50 Hz solution. Both power supply systems are described in general, their requirements and conditions in terms of power supply to substations from the power system and the area occupied by power supply facilities are compared. The weight of wires and cables per 1 m of the network was determined on the basis of exemplary types of contact networks. Based on the simulation, energy consumption and losses in both systems were determined and compared.

One of the chapters of the report is dedicated to answering the question of whether the type of electric traction power supply system affects the train performance and traffic parameters. Another chapter presents the results of calculations of energy consumption by vehicles with resistor and power electronic start-ups. The results of calculating the energy consumed by trains with a wagon composition and EMU on four routes - two theoretical and two real ones - have been presented.

The report shows that despite the fact that the distance between traction substations in the 2 x 25 kV AC power supply system is much greater than in the 3 kV DC system, section cabins with autotransformers are installed in the AC system. Thus, power supply facilities occupy similar areas.

In contrast to the 3 kV DC system, the 2 x 25 kV AC system can cause asymmetry and other disturbances to the power system. In order for the introduced disturbances not to exceed

the permissible levels, it is necessary to supply the substation with high voltage at the level of 220 and 400 kV. Reducing the impact of the 2 x 25 kV AC system on the electrification system is possible by using transformers other than single-phase in substations. It is related to the reduction of the substation output voltage from 55 kV even to 39.9 kV, which, however, negatively affects the maximum possible distances between the substations.

The cross-sections of the overhead contact lines in the 2 x 25 kV AC system have about twice the cross-section compared to the 3 kV DC system, but in this system an additional power supply and protective conductor are required. As a result, the weight of wires and cables installed on the supporting structures is equal for both systems.

Electricity losses in the 2 x 25 kV system are approximately four times smaller due to the elimination of transformers lowering the voltage supplying substations from the power supply system as well as from lower losses in the traction network, which results from the flow of over eight times lower current.

The 2 x 25 kV AC power supply system allows trains to run at higher speeds than the 3 kV DC system above 250 km/h. Moreover, lower energy losses in the AC system and the related voltage drops in the overhead contact line mean that the trains powered by this system are less exposed to the need to limit the consumed current (power). If the traction power supply system supplies the trains with rated voltage, then the type of power supply system does not affect the accelerations achieved by the trains, maximum speeds (up to 250 km/h), and thus the travel times.

It is not possible to unequivocally determine which type of traction vehicles has better efficiency - with resistor or power electronic start-up. This depends on the type of route and the number of stops. The simulations show that the efficiency of the locomotives is comparable. In the case of EMU, a modern vehicle with power electronic start-up and AC motors has better efficiency in most cases.

Taking into consideration the above, it is not possible to state unequivocally which of the analysed catenary power supply systems is definitely better, especially at speeds up to 200–250 km/h. Furthermore, the construction of a 2 x 25 kV AC system in Poland requires a lot of work in the field of high voltage power system.

There are almost 12,000 km of electrified railway lines in Poland in the 3 kV DC system, supplied from more than 500 traction substations, mostly new or modernized in recent years. Consequently, the introduction of the 2 x 25 kV AC system is now rational on new, isolated lines or non-electrified lines over 100 km long.

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Fourth Railway Package – Changes in Railway Market Pillar

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The 4th Railway Package has been in force since 30th October 2020. In compliance with the provisions of the Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union and the Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety, the final date

of entry into force of their provisions was set on 16 June 2020. However due to the Covid 19 pandemic, it was extended until 30 October 2020 by the Directive (EU) 2020/700 of the European Parliament and of the Council of 25 May 2020 amending Directives (EU) 2016/797 and (EU) 2016/798, as regards the extension of their transposition periods.

In the period prior to the entry into force of new legal regulations in Poland, the Railway Research Institute prepared its quality management system documents in order to obtain accreditation, authorization and then notification to the new Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union. On 28 November 2020, the Railway Research Institute was re-notified to the European Commission as the first unit in Poland. The notification was preceded by obtaining on 16 April 2020 the accreditation number AC 128 of the Polish Centre for Accreditation (PCA) for the purpose of notification to the above-mentioned Directive and, on 30 October 2020, the authorization of the President of the Office of Rail Transport (UTK).

The Institute's re-notification was necessary due to the entry into force of Directive (EU) 2016/797, which replaced the previously binding Directive 2008/57/EC, to which the Institute was also notified.

The idea and the overarching goal of introducing the 4th railway package is to liberalize the market and make it more competitive with other modes of transport, which, as expected, should result in the elimination of barriers to the achievement of the single European railway area and the improvement and facilitation of activities for market participants.

The fourth railway package comprises the entire market, dividing it into a market pillar and a technical pillar.

Market pillar

The market pillar recasts cover the regulation on opening the market for domestic passenger rail transport services and the directive establishing a single European railway area. A number of changes were introduced that significantly influenced the functioning of infrastructure managers, operators, applicants and operators of infrastructure facilities and the President of the Office of Rail Transport. The supervisory powers of the President of UTK were extended, and significant changes

were made to the provisions on licensing operators and open access. Furthermore, the possibility of concluding new types of contracts between the operator and the manager, aiming to provide benefits to the customers of the railway operator, was introduced. The rules to ensure the independence of infrastructure managers were also established.

The powers of the President of the UTK were extended, who can now consider railway operators' complaints regarding railway traffic management, planned and unplanned works related to the renewal or maintenance of railway infrastructure and violation of the provisions on the independence and impartiality of infrastructure managers. The President of UTK also has the right to supervise the course of negotiations between applicants and managers regarding the level of charges for access to railway infrastructure. Moreover, he may issue opinions on draft cooperation agreements between the operator and the manager in order to provide customers with benefits, as well as recommend the contracting parties to terminate these agreements.

Another change comprises the rules for granting railway operator license. In order to obtain such a license, the operator must provide documents confirming compliance with the requirement of good repute. This will be evidenced by a certificate or statement that members of the management body, partners or persons conducting business activity have not been convicted by a final court judgment for a crime or tax offense committed intentionally, repeated involuntary infringement of the rights of persons performing paid work, or serious breach of the law regarding obligations arising from collective labour agreements.

Operators operating only narrow-gauge rail transport on local and regional rail networks and on private infrastructure (including railway sidings) are exempted from the obligation to have a rail operator license.

The catalogue of documents necessary to assess whether the company meets the financial viability requirements was extended with information on the charges on an undertaking's assets. The requirement to provide information on expenses related to the performance of the licensed activity (information on the purchase of vehicles, land, buildings, installations and rolling stock) was also clarified.

In the area of intermodal transport, the possibility of negotiating rates of charges for access to infrastructure, the amount of which is a significant barrier to the development of combined transport, was introduced. The possibility of negotiating the rates may lead to their reduction, which will increase competitiveness in relation to road (car) transport, which is not as burdened with charges as rail. This should encourage customers of rail operators to shift their freight transport to rail.

The biggest Polish infrastructure manager, PKP PLK S.A., was obliged to enable entities in question to comment on the content of the network regulations and the needs related

Fourth Railway Package – Changes in Railway Market Pillar (continuation)

to the maintenance and development of infrastructure, intermodality and interoperability issues, and the contract on the implementation of a multi-annual programme.

Technical pillar

In the technical pillar, the Regulation on the European Agency for Railways, the Directive on the interoperability of the rail system in the EU and the Directive on railway safety were changed.

Current regulations in force include:

- Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016 on the European Union Agency for Railways and repealing Regulation (EC) No. 881/2004,
- Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union,
- Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety.

The last two documents have been implemented into Polish legislation by relevant acts of law.

The European Agency for Railways were assigned new tasks, i.e.:

- a) issuing uniform safety certificates,
- b) granting of authorisations for placing on the market,
- c) pre-authorisation of ERTMS.

The European Commission defined by means of implementing acts:

- a) details of the EC verification procedures of subsystems, including verification procedures in the case of national regulations, and documents to be provided by the applicant for this procedure,
- b) the templates of the "EC" declaration of verification, including, in the case of modifications to the subsystem or, in the case of additional verifications, an intermediate Statement of Verification, and the models of the documents for the technical file to accompany these declarations, and the models of the "EC" certificate of verification.

The changes also included Common Safety Methods. New Common Safety Methods (CSMs) have been introduced:

- a) a method for assessing the safety level and safety parameters of rail operators at national and EU level,
- b) method of assessing compliance with safety requirements at the national and EU level,
- c) other methods involving the safety management system processes which need to be harmonized at the European Union's level.

With regard to changes in safety reports, an obligation was introduced to submit annual safety reports for the previous calendar year by all infrastructure managers and all railway undertakings to the President of UTK by 31 May at the latest. The safety report should contain:

- a) information on compliance with internal safety requirements and information on the results of safety plans,
- b) a description of the development of national safety indicators and CSIs,
- c) the results of internal safety audits,

d) observations on deficiencies and malfunctions in rail operations and infrastructure management that may be important for the national safety authority, including a summary of information provided by others in the framework of risk information exchange,

e) a report on the application of the relevant CSMs.

The changes also covered the fulfillment by Member States of the obligations related to the identification of the entity in charge of maintenance with alternative measures to the vehicle maintenance system in the following cases:

- a) vehicles registered in a third country and maintained under the law of that country,
- b) vehicles used on networks or lines the track gauge of which is different from that of the main rail network within the Union and for which compliance with safety requirements is ensured under international agreements with third countries,
- c) freight wagons and passenger carriages shared with third countries, where the track gauge differs from that of the main rail network in the Union,
- d) vehicles used on the network, which may be exempted from the requirements of the Directive, and military equipment and special transport equipment requiring a specific approval from the national safety authority prior to use.

The European Agency for Railways, in the performance of its duties, supports the Commission in monitoring notified conformity assessment bodies by providing assistance to accreditation bodies and competent national authorities, as well as through checks and inspections. This will include supporting the harmonized accreditation of notified conformity assessment bodies, in particular by issuing appropriate guidelines to accreditation bodies on assessment criteria and procedures to determine whether notified bodies meet the relevant requirements. In practice, the Agency will participate in:

- audits and inspections in notified bodies,
- defining a joint accreditation programme for notified bodies,
- defining a common model for the EC verification certificate,
- monitoring the functioning and decision-making of national safety authorities through checks and inspections.

Conclusions

It can be concluded that the implementation of the 4th railway package brought great benefits, first of all, to infrastructure managers, operators, service infrastructure operators and rolling stock manufacturers. The OSS (one stop shop) system was implemented, due to which the applicant obtains all necessary permits and decisions with one submission of the application and the required documents. Certification activities were also improved by standardizing the procedures and activities of Notified (NoBo), Designated (DeBo) and Assessment (AsBo) Bodies, as well as templates of certification documents. The criteria and requirements to be met by notified bodies were also clarified and ERA was granted the authority to inspect notified bodies, which should contribute to the uniform quality of certification services provided.

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Q4 2020 at the IK Test Track in Żmigród

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A visible growth in interest in rail transport, in both passenger and freight services, has been noticed for the last few years. Despite the epidemic, increased traffic, often with modern vehicles, can be observed while the railway infrastructure is constantly improved. Newly built locomotives can run in countries with a different rail traction

supply system pulling modern freight wagons or passenger carriages. Certainly not only in Poland but also in other European countries, although the time for public transport is difficult, passenger operators implement new solutions and invest in new rolling stock, looking forward to the future. Newly built, modernized vehicles must undergo a series of tests in order to be placed in service. One of such places where field tests can be carried out is the Test Track Operation Centre in Żmigród.

The last quarter of 2020 was fraught with numerous rolling stock research projects concerning freight wagons and passenger carriages, electric and diesel locomotives as well as electrical multiple units. There were carried out braking system tests of such vehicles as a special coach to carry soldiers, a Sdggmrss T30000eD wagon designed for the transportation of containers equipped with two kinds of linings (in cooperation with a Czech Institute), EMU 22WEh and EMUs – FLIRT type for the Mazovian Railways Ltd. (*Koleje Mazowieckie, KM*), Łódź Agglomeration Railways (*Łódzka Kolej Aglomeracyjna*) and Slovenian Railways (*Slovenske železnice, SŽ*). Software validation in relation to multiple operation was conducted in Firt-type vehicles. Tests were performed of 3.3 kV DC and 25 kV AC supply systems of the E6MST electric locomotive produced by Newag S.A. for PKP Cargo. Another interesting project covered tests of a diesel shunting locomotive 418 Da for the Warsaw Metro. Due to the fact that PKP PLK did not grant permission for that locomotive to drive on the PKP PLK network, the locomotive was delivered by truck, unloaded with the use of cranes and after the tests completion it was transported to its destination by road.

Despite the high occupancy of the test track in the fourth quarter of 2020, essential and necessary maintenance work was carried out. A comprehensive tamping of the test track was performed and the rails were re-profiled along the entire section. Consequently, the dynamic and acoustic comfort of the conducted tests was significantly improved.



Photo: IK



Photo: IK



Photo: IK



Photo: IK

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The publication activity of the Railway Research Institute in 2020

Joanna Cybulska

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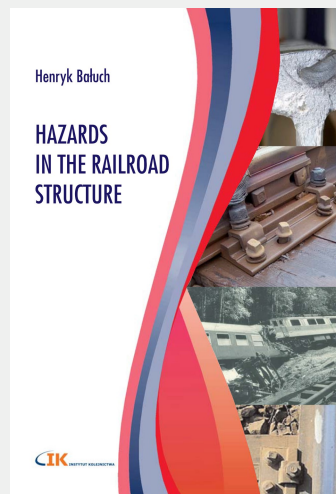
The publication activity of the Railway Research Institute is one of the ways to disseminate knowledge on railways. The IK Publishing House is included in the List of the Minister of Science and Higher Education. The Institute publishes periodicals dedicated to rail transport and also scientific monographs in this field.

Our Publishing House aims at having such a publishing offer that addresses the most current problems of rail transport and is intended not only for research workers and students of transport faculties, but also for managers and entrepreneurs in the area of broadly understood rail transport.

In 2020, two scientific monographs on rail transport were published.

The first of the them is a monograph written by Prof. Henryk Bałuch, a long-time employee of the Railway Research Institute who died last year, entitled "Hazards in the Railroad Structures". It is an English translation of the last monograph by Prof. Henryk Bałuch "Zagrożenia w nawierzchni kolejowej".

This publication concerns safety in rail transport, which is closely related to the ability to recognize risks, their assessment and the knowledge how to fight them. The great importance of these skills results from the fact that currently and probably for some time in the future it will not be possible to remove all the hazards that are noticed.



Consequently, drawing attention to hazards most likely to cause accidents or significant losses is required. Considerable skills and appropriate expenditure are necessary for the construction and maintenance of railways. Failure to meet these two elementary conditions leads to risks and a reduction in safety.

It is a very important publication as the threats on European railways result in several hundred freight train derailments per year, with average losses of approximately EUR 1 million per

derailment. 33% of these derailments are caused by the poor condition of railway tracks.

Author: Henryk Bałuch

ISBN: 978-83-943246-3-6, Number of pages: 286, Items in bibliography: 402, Published by Instytut Kolejnictwa, Year of publication: 2020

In December 2020, the IK Publishing House issued Andrzej Massel's scientific monograph entitled "Methods and Tools for Assessing the Use of Transport Infrastructure on the Example of Railway Infrastructure Research in Central Europe in 1989–2019".

The monograph is devoted to railway infrastructure in selected countries of Central and Eastern Europe, i.e. Bulgaria, the Czech Republic and Slovakia (until the end of 1992, constituting one country - Czechoslovakia), Poland, Romania and Hungary. The selection of these six (until 1992 - five) railway networks as the object of analysis resulted from three premises: from the functioning of the centrally- controlled economy in all these countries until 1989, from the economic transformation in the entire region after 1989 and accession of the countries under analysis to the European Union in 2004, and in the case of Bulgaria and Romania - in 2007.

The monograph features potential methods to be applied in this type of research. For the purposes of research on the use of infrastructure, a new method of analysing the use of maximum speed is presented. For a number of methods known from other scientific disciplines, in particular - economics, socio-economic geography as well as earth and environmental sciences, new areas of application have been indicated. This concerns taxonomic methods used to compare the level of development of railway infrastructure, as well as to the Data Envelopment Analysis (DEA) method used to research the efficiency of railway infrastructure use. In addition, for the needs of those studies, a set of operational, demand and supply indicators has been defined.

The empirical part of the monograph covers the research on the similarities and differences in the condition of the railway infrastructure in this part of the continent as well as the changes that it underwent in 1989–2019. A considerable emphasis is put on the way infrastructure is used in individual countries of Central and Eastern Europe and on its effectiveness.



Author: Andrzej Massel

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24th International Scientific Conference Transport Means 2020

24th international scientific conference TRANSPORT MEANS 2020 held on 30 September - 02 October, 2020 was organized by Kaunas University of Technology in cooperation with Klaipeda University, IFToMM National Committee of Lithuania, Lithuanian Society of Automotive Engineers, The Division of Technical Sciences of Lithuanian Academy of Sciences, Vilnius Gediminas Technical University.

The Railway Research Institute presented lectures:

Future Stations Solutions within IN2STEMPO Project of Shift2Rail (Wawrzyn, E., Stencel, G.)

One of an important element of the railway system are stations. They are addressed in the project "Innovative Solutions in Future Stations, Energy Metering and Power Supply" called IN2STEMPO within Shift2Rail Joint Undertaking of Horizon 2020. The IN2STEMPO Future Stations project's actions lead to improve the quality of customer service and safety at stations, thus providing better experience for passengers using the railway. Research is focused on improved station concepts and responds to evolving passenger needs in terms of information, technologies, punctuality, crowd management, accessibility including persons with reduced mobility, to transit busy stations and to switch modes.

Evolution of High-Quality Express Passenger Train Services in Poland in 1989-2019 (Massel A., Soczowka A.)

In the article on the basis of historic timetable data, the evolution of express train offer of the Polish railways in the 1989-2019 period has been analysed, either in terms of quantity of trains or their quality (journey time, on-board services). The research results have been presented in the series of maps illustrating changes in the shape of the network and the number of services. Moreover, several synthetic indicators have been developed. In the discussion, the development of express train services in Poland has been compared to the evolution of similar services in other Central-Eastern European countries.

Standardization of Selected Interfaces of Railway Traffic Control Equipment and Systems – Aspects of Cyber Security and Transmission Safety (Sokołowska L.)

The paper presents the results of the first stage of the project entitled "Standardization of selected interfaces of railway traffic control equipment and systems" POIR.04.01.01-00-0005/17, created as part of the BRIK (Research and Development in Railway Infrastructure) joint initiative and co-financing by The National Centre for Research and Development and PKP Polskie Linie Kolejowe S.A.

Assessment Requirements TSI CCS for the Trackside Subsystem in the Field of GSM-R Coverage (Sumiła M., Sawicka M., Tchórzewski K.)

The article presents issues related to the problem of verification of the requirements of the TSI CCS imposed on a Notified Body in the assessment of basic parameter 4.2.4, i.e. measuring GSM-R signal coverage. Notified Body carries out tests in the aspect of the integration of Control-Command and Signaling Trackside Subsystem (CCT) with rolling stock as a Control-Command and Signaling Onboard Board Subsystems (CCO) described in TSI CCS, Table 6.3. The article discusses the

requirements of CCS TSI described in EIRENE documents, then outlines the research methods used during radio tests. The final part presents the results of an exemplary GSM-R radio measurement and analysis of radio test results.

Viewpoint on Cybersecurity in FRMCS (Sumiła M.)

The article presents the current knowledge of the next generation of the railway radio communication system (FRMCS) and its impact on the safety and security of the railway. The following sections describe the status of work on the new standard and the scope of applications. Next, they take into consideration the impact of the new radio system on security in various areas. The second part of the article indicates the methods applied to the system to improve security in the field of technological mechanism, system architecture and applications.

Communications-Based Train Control System –EMC Testing Disturbance Emission Generated by on-Board rmCBTC System (Toruń A., Białek K., Wetoszka P.)

The paper presents the results of EMC interference tests on the rmCBTC system installed in vehicles of the Warsaw Metro Lines. The rmCBTC system was created as part of a project co-financed by The National Centre for Research and Development 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 rmCBTC system has been installed on 2 types of vehicles - METROPOLIS 98B (Alstom) and INSPIRO (Siemens). The paper presents the conditions for testing, their scope and the results obtained for the INSPIRO vehicle. The tests were carried out to certify the system for use in Poland by the Polish Railway Safety Authority - Office of Rail Transport (UTK).

Standardization of Selected Interfaces of Railway Traffic Control Equipment and Systems – the General Information (Gryglas M., Wontorski P.)

The paper presents general information on a project aimed at developing a digital interface standard for selected rail traffic control command and signalling systems. The project entitled "Standardization of selected interfaces of railway traffic control equipment and systems" POIR.04.01.01-00-0005/17, has been created as part of the BRIK (Research and Development in Railway Infrastructure) program and co-financed both by the National Centre for Research and Development (NCBiR), as well as the PKP Polskie Linie Kolejowe S.A.

Proposals for the use of renewable energy sources for traffic control devices power supply (Białoń A., Kuznetsov V.G., Hubskeyi P.V., Ostapchuk O.)

Modeling the quality of current collection under the conditions of a growing speed of rolling stock (M. Kaniewski, V. Kuznetsov, P. Hubskeyi, Sychenko V., Antonov A.)

Optimization of traction power supply system with variation of train flow sizes (Kuznetsov V.G., Hubskeyi P.V., Sychenko V.G., Kosarev E.M., Papakhov O., Bekh P.)

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