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Upgrading the railway infrastructure technical parameters using the example of the *Control-Command and Signalling* subsystem with the EC verification certificate

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Summary
The financial resources allocated for upgrading the railway infrastructure in Poland over the last decade have brought measurable benefits in the length of railway lines with increased speed. In addition to the upgrade of railway tracks with supporting infrastructure, electrical power equipment and networks or control-command and signalling equipment, further railway lines are equipped with ERTMS/ETCS track-side equipment. All upgraded or retrofitted railway lines are subject to a certification process in accordance with European or national law. Among these lines with the A-Class system and the EC certificate of verification, there are cases where action should be taken to improve the performance of the railway infrastructure. Analysing various investment processes, the article looks at the impact of the tenders for ERTMS/ETCS track-side equipment, which legitimize the validity of the issued EC verification certificates, and whether they have authorisation for placing in service issued by the President of Urząd Transportu Kolejowego (Office for Railway Transport).

Keywords: authorisation for placing in service, certificate, declaration of conformity, ERTMS, ETCS

1. Upgrading infrastructure

PKP Polskie Linie Kolejowe S.A. as the infrastructure management, as of 31 December 2017 [25], uses the following in its daily operation:

- 18,513 km of railway lines constituting 35,967 km of tracks (27,120 km of main lines, running lines at stations and 8,847 km of station tracks);
- 39,482 turnouts (17,950 turnouts in main lines and running lines, as well as 21,532 turnouts in station tracks);
- 14,442 rail level crossings (including 12,354 on the lines in operation, including category A-level crossings – 2,392, category B – 1,192, category C – 1,386, category D – 6,343, category F – 562, Category E level crossings for pedestrians – 479);
- 25,324 engineering structures (including 6,375 bridges and viaducts);
- 5,823 buildings;
- 14,108 structures.

For many years, the financial resources allocated for maintenance, repair and upgrading works did not meet investment needs and this led to a situation where the number of railway lines along which there was a decrease in speed exceeded the length of the tracks with increased speed (see Fig. 1). There have been significant benefits from the work performed to maintain or restore the technical parameters of the lines, as well as the comprehensive upgrades. There has also been a significant increase in the length of railway tracks with increased speed, looking at the work completed over the last decade.

According to the statutory provisions of national law, PKP Polskie Linie Kolejowe S.A. is an entity responsible for the management of the national railway network within the scope of their duties and should observe the provisions of strategic documents and the regulations of the European Union. The development and the general strategic framework for infrastructure management are set out in strategic governmental documents concerning transport, as well as in the Community regulations.

The priority document setting out the strategy of infrastructure management at the national level is the Strategia Rozwoju Transportu (SRT) (Transport Development Strategy) [34] with the implementation document to the strategy [11]. Apart from the documents mentioned above, the policy for the implementation of railway transport projects is also defined by operational programmes – national, supra-regional

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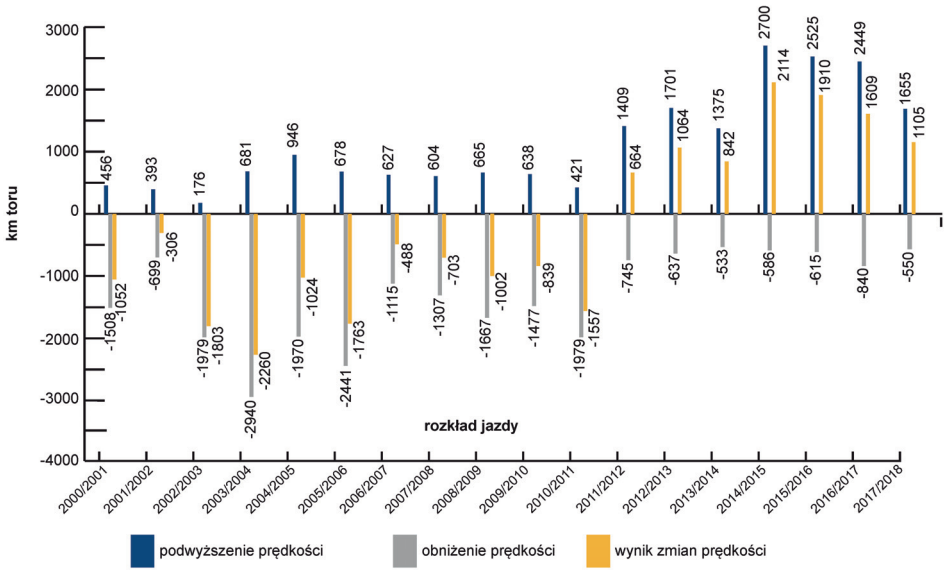

Fig. 1. The length of railway lines in operation, managed by PKP Polskie Linie Kolejowe S.A., with introduced maximum speeds (as of the date of timetable introduction) [25]

and regional, outlining the possibilities of using European structural and investment funds.

One of the first reference points was the document concerning the *Wieloletni Program Inwestycji Kolejowych* (Multi-annual Railway Investment Programme) [35] with subsequent amendments [1–3, 36], which defined and indicated the development of the national railway infrastructure. The provisions of these documents interpreted measures to upgrade the existing railway lines and indicated the need to build new sections in order to increase accessibility and improve the quality of railway transport.

The programme mentioned above, after its expiry (2011–2015), was replaced by a new document implementing the SRT, namely *Krajowy Program Kolejowy* (National Railway Programme) [16]. This document with amendments [4, 5], as a multi-annual programme, covers the projects implemented with financial resources of the Minister for Transport (railway). The plan is to remain in force until 2023, i.e. until the moment when the co-financing for investment projects under the EU financial perspective for the years 2014–2020 comes to an end. The document defines the financing amount and sources (including EU and national funds) and provides the basis for ensuring project financing in accordance with the Public Finance Law. Referring to the above programmes, the scale of the railway projects in progress, implemented or planned, is presented in the following Fig. 2.

By defining specific objectives for rail transport, the SRT also sets out the strategic objectives of infrastructure management. However, they are not the only ones, as PKP Polskie Linie Kolejowe S.A. is committed to ensuring the safety of railway traffic and constant improvement of its level in performance, maintenance and investment. Therefore, a long-term concept for the implementation of works is necessary, which will aim to maintain the technical parameters of the upgraded railway lines and to systematically improve the remaining lines by eliminating maintenance backlogs. Such work will strengthen the role of rail transport in the national integrated transport system. The assumptions formulated in this way are reflected in the document *Pomoc w zakresie finansowania kosztów zarządzania infrastrukturą kolejową, w tym jej utrzymania i remontów do 2023 roku* (Aid for financing the railway infrastructure management costs, including its maintenance and repairs until 2023) [23], which also establishes the financial framework and conditions for the implementation of the railway infrastructure management projects of the state.

This programme indicates the source of financing, namely the allocation of funds from the state budget and the Railway Fund. For its implementation in 2019 – 2023, it is approx. PLN 23.8 billion, including about PLN 21 billion from the state budget.

2. Basic information on the *Control-Command and Signalling* subsystem

The control-command and signalling subsystem is defined in current European legislation as all trackside equipment necessary to ensure safety and to control traffic on the network and all on-board equipment necessary to ensure safety and to control traffic on the network. The word 'all' plays an important role here because it clearly indicates that the *Control-Command and Signalling* subsystem is not limited to the equipment defined in the Technical Specification for Interoperability (TSI) *Control-Command and Signalling* [26],

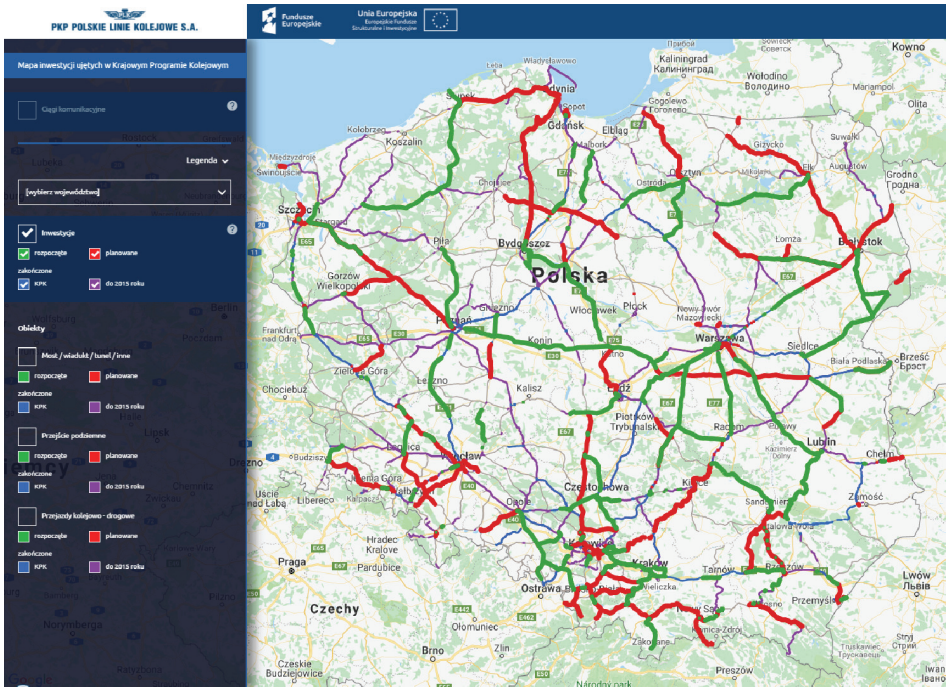

Fig. 2. Map of projects included in the National Railway Programme [19]: given that: **green** – projects in progress, **red** – planned projects, **blue** – completed projects, **violet** – projects completed by 2015

Source: PKP Polskie Linie Kolejowe S.A.

but also covers the equipment defined in national legislation [27, 38]. The *Control-Command and Signalling* subsystem consists of the following equipment:

- signal boxes for interlocking,
- marshalling control equipment, including primary rail-brakes,
- block system equipment,
- level crossing traffic protection system equipment,
- detecting emergency conditions of railway vehicles during train movement and incorrect loading of wagons,
- for track and turnout occupancy detection:
  - track circuits,
  - axle-counters,
- reversing or controlling the moving parts of a turnout,
- signals,
- vehicle / track interaction
- train control,
- CCTV for traffic control,
- control-command and signalling system equipment,

adapted to the railway area structure for automatic control-command and signalling or by operators (e.g. signalmen), which must be developed in accordance with the rules in force and which are also part of the subsystem:

- wired and wireless communication, including dispatch communication, train dispatcher-to-crossing guard communications and intrastation traffic communication, with the exception of the digital radio communication system equipment (GSM-R),
- wireless communication, including train, manoeuvring, road and maintenance, with the exception of the digital radio communication system equipment (GSM-R),
- a recorder for communication related to traffic control,
- other equipment supporting operators and their documentation where necessary.

In addition, this interpretation of the subsystem can be complemented by the statement that the *Control-Command and Signalling* subsystem is a system which, under all operating conditions, is intended to ensure safe control-command and signalling, i.e. in particular to prevent rear-end collisions, collisions of trains at turnouts, including incursions of railway vehicles from sidings to main tracks, derailments due to throwing-over the points under a running train, collisions with road vehicles at level crossings, exceeding speed limits and the crossing of railway vehicles beyond the end of the road made available to them. In summary, the control-command and signalling system specifies the equipment necessary to ensure safety and to control the movement of trains on the railway network, together with the communication equipment and software of the control-command and signalling equipment, including the equipment for generating and transmitting information on the train movement restrictions to train drivers (road speed limits) as well as the voice and data communication equipment. The area of control-command and signalling is divided into the following parts:

- the control-command and signalling baseline (includes track-side and on-board equipment) including: clear track and turnout reporting and systems using information about the presence of vehicles on the track – signal boxes, wayside (signalling) equipment and level crossing protection equipment,
- the superior layer based on digital safe data transmission downloaded from the baseline and transmitted to vehicles for the purpose of driving conformity control and supervision in relation to speed and distance restrictions, according to the received data resulting from the information downloaded from the baseline.

3. Authorisation for placing in service

Any equipment used on railways and part of a structural subsystem (including the *Control-Command and Signalling* subsystem) or any railway vehicle must receive authorisation for placing in service. Such a document is issued by the President of the Office for Railway Transport (UTK) on the territory of the Republic of Poland. The authorisation of the issuer of the EC declaration of verification shall confirm that the appropriate verification procedure has been performed in accordance with legislation and shall, under its own responsibility, ensure that the assessed object/subsystem/railway vehicle satisfies the relevant technical requirements, as laid down in statutory normative acts. The course of the procedure for issuing authorisation is specified in the relevant legal acts in force [38].

3.1. Competent assessment bodies

The submission of documents relating to the above mentioned authorisation for placing in service, whether indicating equipment, a subsystem or a railway vehicle, obliges the applicant to carry out, in steps, a series of operations aimed at certifying the essential requirements described by European and national law [17].

If the verification of products is performed in accordance with the requirements of European law, such work is carried out by a notified competent body in relation to the new approach directives (including the *Control-Command and Signalling* subsystem [26]), of which the member states have informed the European Commission as well as other member states [15]. The current competence of Polish entities is notified by the competent authority on the basis of the Act on Conformity Assessment and Market Surveillance [39]. Taking into account the scope of authorisation works performed by the notified body, according to the above act, it can be implemented by *a notified certification body, a notified inspection body or a notified laboratory*.

Notified certification bodies are the bodies independent from entities placing products on the market and which certify products in order to demonstrate that a properly identified product or its manufacturing process complies with the essential or detailed requirements. *Notified inspection bodies* are the bodies that verify the design of a product or its manufacturing process and determine its compliance with the essential or detailed requirements. *Notified laboratories*, on the other hand, are referred to as officially recognised testing or measuring laboratories that perform certification, inspection and testing, and are collectively referred to as conformity assessment bodies [30].

The mapping of the above mentioned European directives, regardless of the bodies defined in [39], reflects the executive order issued on the basis of the Railway Act [38] defining the bodies dedicated to verification with national requirements. Such bodies are usually referred to as authorised bodies. Polish directives use the terms: *organisational bodies authorised to perform tests and organisational bodies referred to in Article 22g(9) of the Railway Act* as a group of certification bodies and laboratories. They also use the terms *designated entities* and *authorised entities* as counterparts to inspection bodies. In accordance with the provisions of the directive on certificates [27], the bodies authorised to perform the tests, as the bodies authorised to issue opinions, have been obliged to carry out tests for the purpose of certificates authorising the placing in service of types of control-command and signalling equipment and certificates authorising the placing in service of types of rail vehicles. On the other hand, the amended Act [38] defines organisational bodies referred to in Article 22g(9) of the Railway Act, the task of which is to conduct compliance tests with national requirements and to issue certificates related to such tests. In the event of a positive type-test result, a type certificate is issued, which confirms that a given type of structure or equipment is compliant with Polish requirements. At the same time, these bodies carry out conformity tests with the already accepted types, which, in the event of a positive result of the conformity test with the type, a certificate of conformity with the type is issued. Obtaining such a certificate by the entity commissioning the assessment allows a declaration of conformity with the type to be issued. The scope of measures of these bodies includes a strictly defined closed list of products and does not include the verification of subsystem conformity with national requirements, which is the responsibility of notified bodies. The designated entities defined in the Railway Interoperability Directive were responsible for carrying out tests on subsystems non-compliant with TSI. The regulation, as amended by successive regulations [28] indicated the bodies authorised to assess new subsystems, considering them

as inherently compliant with TSI and to non-TSI conform vehicles. As part of the work performed by those bodies related to rolling stock, it is necessary to carry out conformance tests with the railway network.

In addition to the assessment of conformity with the European and national requirements carried out in accordance with the Interoperability Directive [13], there is also the evaluation and risk assessment carried out in accordance with the Safety Directive [12], for which the body assessing the risk prepares a safety assessment report. According to European regulations, notified bodies, authorised bodies and risk assessment bodies are collectively referred to as assessment bodies.

3.2. Requirements for conformity assessment

In order to assess the products for the common market, not only are the requirements for the products and their interfaces necessary, but the procedures carried out by notified bodies to verify whether these products meet the requirements imposed on them are also necessary [10]. Conformity assessment modules and conformity verification modules are conformity assessment procedures verifying conformity with European law, together with the obligations and rights of manufacturers and contractors who apply for assessment and the obligations and rights of notified bodies performing such assessments. The conformity assessment modules have been defined by the European Parliament [10]. For the common market in rail transport, the modules have been adapted to the specific needs of the rail market and descriptions of the modules adapted to the different subsystems and their interoperability constituents have been included in TSI. In its decision, the European Commission defined the conformity assessment modules and conformity verification modules dedicated to rail transport [9]. As a result, the successive TSIs indicate the modules defined by the Commission for rail transport in a separate document. This applies in particular to all TSIs currently in force, the application of which is mandatory for new projects [15].

The conformity verification of subsystems with national requirements is performed by notified bodies, while conformity assessment of structures and equipment, for which requirements are defined in Polish law, is carried out by organisational bodies referred to in Article 22g(9) of the Railway Act.

Polish requirements for structures, equipment and vehicles that do not comply with TSIs are defined by a regulation [29] which indicates the list of requirements as the document in force issued by the President of the Office for Railway Transport [18]. With regard to interoperability, attention should be paid to the need to collect type-certificates and declarations of conformity with type for components of all subsystems and, in the case of the *Control-Command and Signalling* subsystem, for equipment used for track-side and on-board parts.

The list of structures and equipment subject to conformity assessment with Polish requirements is specified in a regulation [27]. For example, an interlocking lever frame for the *Control-Command and Signalling* subsystem as, for all types of interlocking lever frames installed in the *Control-Command and Signalling* subsystem, the track-side equipment must be type-certified and all interlocking lever frames should have declarations of conformity to type.

Independently of the assessment carried out by notified bodies and authorised bodies, interoperable systems or subsystems must be assessed in relation to changes to the rail system and the risks involved. In this respect, European law defines common safety methods adopted by the regulations defining safety management in rail transport. For the assessment of interoperable subsystems, a risk assessment and evaluation shall be required and a safety assessment report shall be obtained. Such reports are prepared by bodies assessing the risk on the basis of evaluation and risk assessment which a contractor submits for independent assessment. The rules, according to which risk assessment and evaluation must be carried out, are defined in the European Regulation [32] supplementing the Railway Safety Directive [12, 14], further specified in another regulation [31]. This lays down the rules for analysing the risks associated with significant changes to the railway system. According to these rules, all risks associated with operating an interoperable subsystem within a rail system must be identified, defined, analysed and assessed as to their acceptability. The conditions and security measures are defined and included in the hazard records together with the risks.

4. Class-A equipment of the *Control--Command and Signalling* subsystem

According to strategic documents approved by the Government of the Republic of Poland [20], PKP Polskie Linie Kolejowe S.A., as the infrastructure management, is the entity responsible for the implementation of the European Rail Traffic Management System (ERTMS) on its railway network, including the implementation of the European Train Control System (ETCS) and the Global System for Mobile Communications – Railway (GSM-R). Over the last 10 years, the infrastructure management has already implemented both systems in several locations. The first part of the railway network equipped with A-class equipment

included the section of Rail Line No. 4, the so-called Central Rail Line (CMK) between Grodzisk Mazowiecki and Zawiercie stations. The ERTMS/ETCS Level 1 equipment developed here received authorisation from the President of the Office for Railway Transport (UTK) in 2013 [37], which enabled the system to be commissioned for commercial operation. At present, works are being performed in the above mentioned section in order to upgrade the properties of the system (speed increase). In 2016, on the basis of the authorisation obtained from UTK [41], it was possible to commission the ERTMS/ETCS Level 2 equipment built on the Legnica – Węgliniec – Bielawa Dolna section (sections of Rail Lines Nos. 275, 282 and 295). Moreover, the ERTMS/ETCS Level 1 system on the Psary – Kozłów section of Rail Lines 570 and 64 was placed in service, the equipment of which was granted the relevant authorisation from the Office for Railway Transport [40]Additionally, in the same year, the authorisation from the UTK [42] for placing in service was granted to the ERTMS/ETCS Level 1 Limited Supervision system developed on Rail Line No. 356 between the Poznań Wschód and Wągrowiec stations. The above mentioned railway lines are not the only ones on which the A-class system has been implemented. Over the last decade, Polskie Linie Kolejowe S.A. has announced further tender procedures [22] for the development of, among others, the ERTMS/ETCS system. The proceedings which were positively resolved include the works carried out on the development of the ERTMS/ETCS level 2 system on Rail Lines Nos. 9 and 202 on the Warszawa Praga Tranzytowa – Gdańsk – Gdynia section, on Rail Lines Nos. 1 and 17 on the Warszawa Zachodnia – Koluszki – Łódź Widzew section, on the sections between the Opole – Wrocław – Legnica stations connected by Rail Lines Nos. 132 and 275 (completion of works at the end of June 2018), Rail Lines Nos. 2 and 3 on the Terespol – Warsaw – Poznań – Kunowice section (excluding the Warsaw junction), the No. 7 Warsaw – Lublin Rail Line, between the Podłęże – Rzeszów stations on Rail Line No. 91, Rail Line No. 271 on the Wrocław – Poznań section or Rail Line No. 278 on the Węgliniec – Zgorzelec section.

However, among the announced proceedings, there were also those which were not positively resolved for the construction of the ERTMS/ETCS Level 1 system, i.e. on Rail Line No. 226 on the Pruszcz Gdański – Gdańsk Port Północ section or on Rail Line Nos. 227, 249 and 722, the Level 1 development improving access to the port in Gdańsk, changed to the ERTMS/ETCS Level 2 system during the proceedings.

Referring to the coincident period as mentioned above, a similar scope of implementation (especially for ERTMS/ETCS Level 2, not described in detail in this text) also applies to the radio part, i.e. ERTMS/GSM-R, which is a system already developed on specific parts of the railway network and has the appropriate authorisation from the Office for Railway Transport (UTK). As a result, it has been transferred for commercial operation or awaits authorisation, or individual railway lines are in the retrofitting process or await their implementation in the investment process covering the entire railway network managed by PKP Polskie Linie Kolejowe S.A.

5. Examples of the projects implemented on a certified *Control-command and Signalling* subsystem

As mentioned in the introduction, the upgrading works are to strengthen the role of railway transport in the integrated transport system of the country. The examples presented below are part of the signalled long-term concepts for the implementation of works, which, as a result of their completion, will be aimed at maintaining the technical parameters of the upgraded railway lines and improving the remaining lines by eliminating maintenance backlogs. The selection of these works, in relation to the railway lines with developed ERTMS/ETCS, is an interrelation of these lines and the tendering procedures announced by the infrastructure management for the work in question. The scope also applies to the *Control-Command and Signalling* subsystem, for which the provisions of the Technical Specification for Interoperability for this Subsystem do not apply.

5.1. Construction of a new bridge on the Nysa Łużycka River

The correct parameters of a railway line are determined not only by the good condition of the track system, but also by the condition of engineering structures. An exemplary project improving the parameters of the engineering structures in operation on railway lines is the *Upgrade of the Rail Line E 30, Stage II, the Bielawa Dolna – Horka section* project: *Construction of a bridge on the Nysa Łużycka River and electrification* [24], Figure 3. Thanks to this project, the infrastructure management intends to achieve the following objectives: introduction of double-track traffic and achieving compatibility with the equipment in operation on the DB Netz railway network.

This project relates to the construction of a railway border bridge on the Nysa Łużycka between Horka and Węgliniec at 130.470 km of the river, at 13.424 km of the No. 295 Węgliniec – Bielawa Dolna railway line, with line electrification from the electrification completion point (track 1 km 13.315; track 2 km 13.384) to the contact line point managed by the Polish and

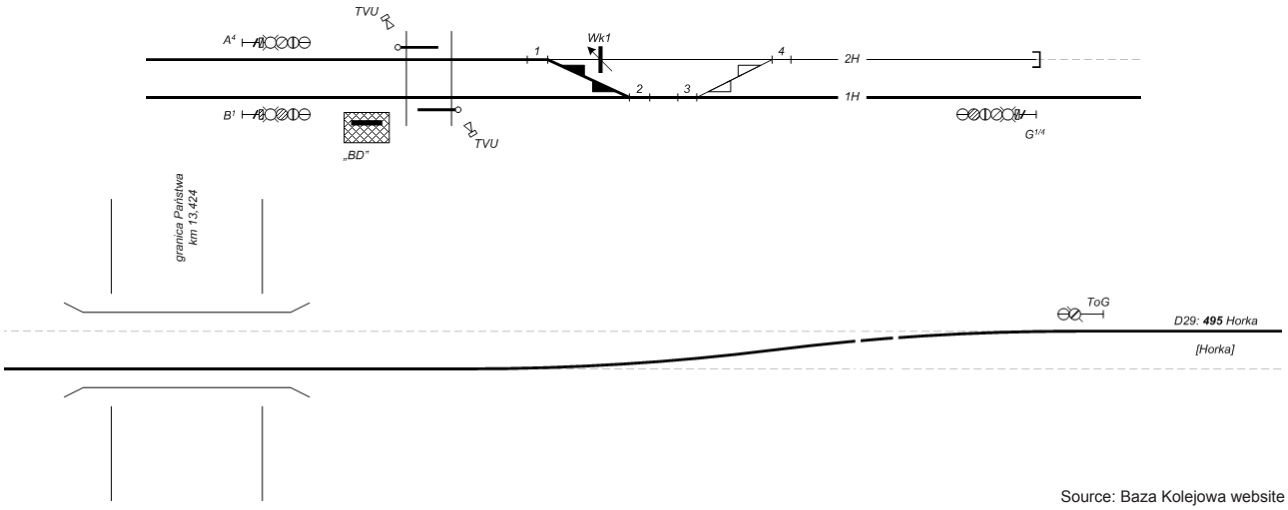

Fig. 3. Part of the Bielawa Dolna junction signal box to be upgraded [6]

the German infrastructure management. PKP Polskie Linie Kolejowe S.A. is planning to carry out works on:

- the construction of a border bridge on the Nysa Łużycka River on an extended international freight corridor (transport corridor C-E 30) within the Pan-European Transport Corridor III,
- conversion of the track system from single track to double track (on the dashed line trail, Fig. 3),
- adaptation to the double-track system of external control-command and signalling equipment at the Bielawa Dolna junction signal box, with a change of application in the computer control-command and signalling equipment system at this junction signal box and the Węgliniec station, and auxiliary equipment of the control-command and signalling subsystem,
- conversion of the telecommunication cable and fibre optic lines,
- contact line development over the new track system to the contact point of the contact line of PKP Polskie Linie Kolejowe S.A. and DB Netz.

In accordance with the provisions of the previous chapters, Rail Line No. 295, inter alia, was the first of the railway lines with fixed ERTMS/ETCS Level 2. The tender to carry out this task (completion of works in December 2016) was announced after obtaining intermediate certificates of EC verification at the design and construction stage, was going through the entire testing process, which in November 2015 confirmed the fulfilment of the essential requirements at the final testing stage. The entire pilot line, after obtaining the final certificate of EC verification of the system, was authorised by the national security authority [41] on 3 March 2016, which opened the legal basis for the infrastructure management to hand it over for commercial operation.

With reference to the works described above, within the framework of the new project (bridge construction), the provisions verify how, in the tender documentation, the contracting authority (infrastructure management) refers to the relationship between these two projects and the issues related to certification. This refers to certification of the engineering structure reconstruction and linking the new bridge with the altered track system and adapted railway control-command and signalling equipment with the necessity of re-certification in the altered elements (Węgliniec station and Bielawa Dolna junction signal box), assessed in the certified ERTMS/ETCS Level 2 system on the Legnica – Węgliniec – Bielawa Dolna section. While reviewing the documentation of the contract, the following provisions characterize the general description of the contract object, including:

- preparation of design documentation to the extent necessary for the preparation and execution of construction works,
- obtaining, on behalf of the contracting authority, a construction permit or notification in accordance with the requirements of the Building Code,
- obtaining, on behalf of the contracting authority, a permit required by the Water Law Act,
- execution of construction works on the basis of design documentation with a construction site survey and geotechnical evaluation to the extent necessary for the proper performance of these works,
- obtaining, on behalf of the contracting authority, an occupancy permit.

The order includes the following tasks:

- construction of a new bridge and associated works, including demolition of the existing structure – in two phases, with traffic on one track,

- reconstruction to the necessary extent of control-command and signalling equipment on the Bielawa Dolna – Horka section in connection with the railway bridge construction project, taking into account construction in two phases with traffic on one track,
- construction of the contact line, which is an extension of the existing network to the contact point of the contact line of PKP PLK S.A. and DB Netz with accompanying works, including the altered location of the station sectioning cabin,
- conversion of the telecommunication cables and construction of a fibre optic line from the newly located sectioning point to the container supplying telecommunication units located at the station sectioning cabins of the Bielawa Dolna junction signal box.

While reading the individual parts of the Functional Programme of this project, the contracting authority, only in the part related to the works performed in the telecommunications part, informs about the works related to the development of the ERTMS/ETCS Level 2 system and GSM-R, implemented under a separate contract. It is the only information in the entire document informing about other works being carried out on Rail Line No. 295.

Detailed analysis of the provisions in the individual chapters of the bridge reconstruction requirements describes in detail the reference to the objectives presented above as well as the expected results, which relate not only to the civil engineering structure but also to the associated industries, including the control-command and signalling equipment. With regard to the applicable law – the certification requirement – the infrastructure management requires certificates of conformity and declarations of conformity for the of railway subgrade and drainage system, embankments, as well as telecommunication equipment and systems for the bridge project with accompanying works. In the detailed provisions, the contracting authority does not indicate the need to obtain an agreement on the bridge project with other projects.

5.2. Platform extension at the Nowy Dwór Mazowiecki station

Another project improving the parameters of the railway infrastructure in operation is the project involving *design documentation preparation for the extension of the existing platforms No. 1 and 2 of the Nowy Dwór Mazowiecki station* [21], Fig. 4. As part of the project implementation, the infrastructure management shall plan to achieve the following objectives:

- adaptation of railway infrastructure to the current conditions – the actual needs of carriers and contracting parties and forecast development,
- improved accessibility of rail transport,
- improved travelling comfort and passenger services.

This project refers to the existing platforms located on the No. 9 East Warszawa Wschodnia – Gdańsk Główny railway line, which is an electrified main arterial double-track route with a design speed of 200 km/h. The area covered by the project, i.e. the area to be reconstructed (the length of the existing platforms – 200 m each) is 40.343–40.555 km. PKP Polskie Linie Kolejowe S.A. is planning to carry out works on:

- extensions of existing platforms using the same technology, so that the extended parts of the platform do not deviate from the existing part – all of the extended platforms should be uniform,
- adapting the existing part of the platforms, in the least intrusive manner possible, to the new requirements (tactile signage, surface, small furniture),
- replacement of fixed signage on the existing parts of platforms in order to unify the system in question within the entire station, in accordance with the colours and standards currently in force at PKP Polskie Linie Kolejowe S.A,
- construction of new platform roofing in the technology identical to the existing ones and additional access and entrances to the platforms,
- reconstruction of contact lines,
- reconstruction of the track surface – displacement of 4 turnouts (trapezoid – see right side Fig. 4) in

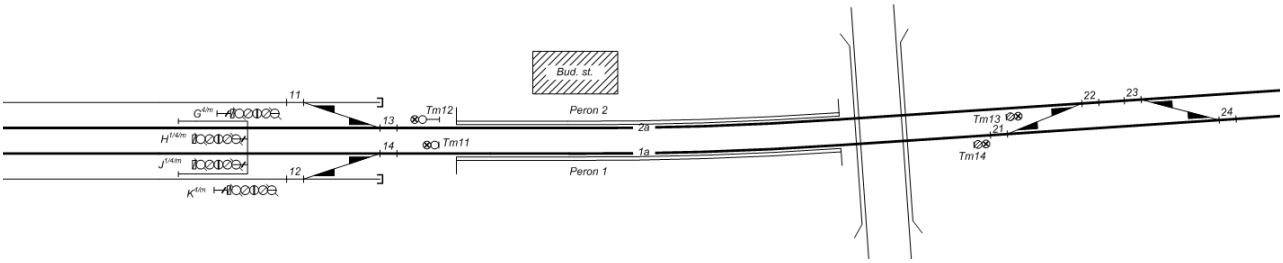

Fig. 4. Part of the Nowy Dwór Mazowiecki station to be upgraded [7]

variants of platform extensions up to the length of 300 and 400 m platforms,
- reconstruction – removal of collisions between equipment, cables of control-command and signalling equipment and telecommunications within the scope of the scheduled works.

As mentioned earlier, Rail Line No. 9 is one of the railway lines with a developed ERTMS/ETCS Level 2 system, which at present (planned completion of December 2018), after having obtained the intermediate EC verification certificates at the design and construction stage, is going through the entire length of the testing process to finally confirm that the essential requirements have been met at the final testing stage. After obtaining the final EC verification certificate of the system and the authorisation of the national safety authority, it is to be placed in service by the infrastructure management.

Therefore, within the framework of the new project (platform extension project), with reference to the provisions, it is possible to verify how the contracting authority (infrastructure management) refers, in the tender documentation, to the interrelation of these two projects and issues related to certification, i.e.: certification of the platform design documentation and the interrelation of the new platform project with the need to re-certify the altered elements (trapezoid in the case of platform extension by over 280 m) in the certified ERTMS/ETCS Level 2 system. When reviewing the contract documentation, the provisions of the documents indicate that:
- the purpose of the contract is to obtain: construction design documentation for the selected programme and spatial concept, materials necessary to obtain building permits together with obtaining the actual permits, detailed design, tender materials necessary for the contracting party with consulting support at the tender procedure stage for the selection of the contractor of the reconstruction,
- the required result of the contract is the development of: a programme and spatial concept (3 variants), bills of quantities and budget estimates, notification of a building permit with necessary decisions, survey documentation for design purposes, full construction designs for the selected variant, a set of materials for submitting the application for the building permit with obtaining the actual permit, working plans and specifications, intermediate EC verification certificates and declarations of subsystems, specifications for work accomplishment and acceptance, tender materials for invitation to tenders, all relevant reports, other documents necessary for the execution of works,
- in addition, as part of the results, the contractor is obliged to: supplement the submitted application for issuance of a location decision with its full service, preparation of replies to contractors' questions in the tender procedure with possible modification in the prepared documents, author's supervision, agreement on design documentation with the contracting authority, railway track development and construction unit in Warsaw, network managers and users of the related railway infrastructure; obtaining contracts for issued conditions for connection with network managers, obtaining and agreeing on conditions for removing any collisions with the technical infrastructure of third parties, applying to appropriate parties for technical conditions in the scope resulting from the adopted design solutions and field / technical conditions.

If, on the other hand, the *Assumptions and Risks* chapter of the Description of the Object of Contract of this project is indicated, then, both in the assumptions and in the risks, the contracting authority shall not formulate any requirements relating to the correlation of this project with other projects implemented within the framework of the works performed on Rail Line No. 9.

A similar lack of indications is also present in the next chapter of tender materials describing the *Definition of the Object of Contract*. This part of the tender documents presents in detail the objectives presented above and the expected results relating solely and exclusively to the construction of new longer platforms, taking into account the reference to the control-command and signalling equipment resulting from the possibility to move the turnouts. In accordance with the applicable legislation, the infrastructure management expects to receive, for platform reconstruction projects, an intermediate certificate of EC verification and the corresponding declarations for the *Infrastructure* subsystem at the design stage. Reading such requirements, even the provision placed in the tender source materials about the necessity to agree on the design documentation with the contracting authority (railway track development and construction unit), suggests only references to the interrelations around the railway rather than internal ones related to other projects. This tender process has been, however, cancelled. Investment works started in 2019, covering extending of platforms without any changes in location of turnouts, are performed on the basis of other documents of the infrastructure manager.

5.3. Structure of turnouts with a larger-angle crossing

A project improving the parameters of the railway infrastructure in operation is the project *Design documentation development and execution of construction works within the framework of the project entitled: "Ad-*

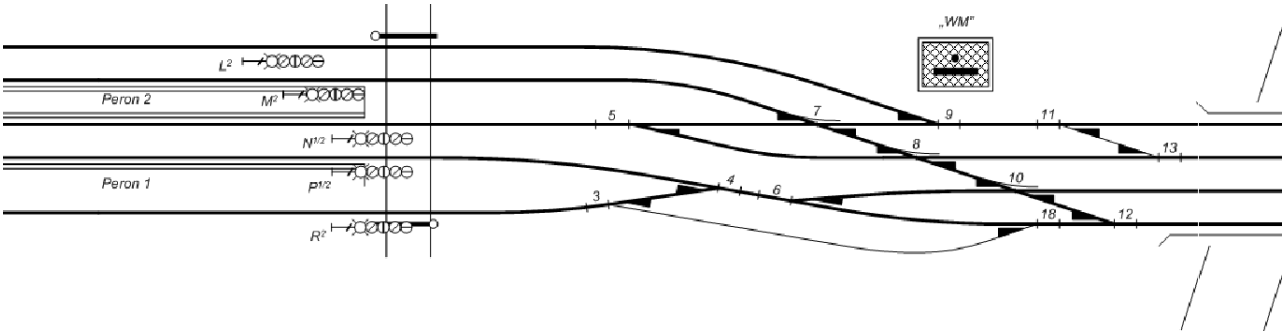

Fig. 5. Part of the Wrocław Muchobór station to be upgraded [8]

aptation of Rail Line No. 273 for passenger transport in the WrOF (Wroclaw Functional Area) by upgrading the Wrocław Muchobór railway station" [33], Fig. 5. As part of this project, the infrastructure management expects the design and construction of track industry, passenger service facilities, engineering structures, control-command and signalling equipment, contact lines, non-contact lines and power lines up to 1 kV and a telecommunications system. This contract covers:

- design documentation based on the concept presented in the *Feasibility Study* provided by the contracting authority – an excerpt from the feasibility study of the project of the same title as this project (contract execution variant approved by the Contracting Authority) necessary for the proper performance of all works and obtaining all required opinions for it, agreements, approvals, conditions, decisions and permits necessary for the performance of the object of the contract,
- all works in accordance with the scope of the contract on the basis of the design documentation prepared by the Contracting Authority, and all preparatory works necessary for the performance of the entrusted contract and the performance of all activities required by law,
- information boards and memorials at the implemented station according to the guidelines applicable to information activities on the day of instal-lation,
- assessment of the technical conformity of the interoperability specification of *Persons with Reduced Mobility* and the *Infrastructure* subsystem to a limited extent only for the works included in the project covered by the object of the contract at each stage (design, construction and final testing of the subsystem),
- performing procedures of the Safety Management System of PKP Polskie Linie Kolejowe S.A. in relation to: *Safe design of railway infrastructure and principles of cooperation with designers*; *Construction, upgrade and revitalisation of railway infrastructure*; *Cooperation with contractors*; *Technical and operational risk assessment*; *Change management*

The object of works is located in the area of the railway track development and construction unit in Wrocław, which includes the Wrocław Muchobór passenger stop and junction signal box located on Rail Line No. 273 between the Grabiszyn junction signal box and the Wrocław Kuźniki station, terminating line No. 757 between the Wrocław Świebodzki station, the Wrocław Muchobór passenger stop and junction signal box, terminating line 758 between the Wrocław Stadion junction signal box and the Wrocław Muchobór passenger stop and junction signal box, Rail Line 275 located at the Wrocław Muchobór junction signal box at 5.040 km to 5.780 km.

According to the previous provisions (compliant with 05.04.2018 – bid opening day), Rail Line No. 275 is one of the railway lines on which the ERTMS/ETCS Level 2 system development process is in progress (planned completion at the end of June 2018), which, after obtaining intermediate certificates of EC verification at the design and development stage, undergoes the entire testing process, which is to finally confirm that the essential requirements have been met at the final testing stage. After obtaining the final EC verification certificate of the system and the authorisation of the national safety authority, it may be placed in commercial service by the infrastructure management.

Based on basic information, it is possible to check how the infrastructure management plans to combine this project with other projects in the common area. When analysing the provisions of the contract object, one can find articulated information about the coordination with other projects, where the contractor is obliged to carry out the contract object in close cooperation with contractors of other projects prepared by the Contracting Authority, as well as other entities in the area covered by this project and the impact area. The indicated projects for which cohesion should be maintained include the project implemented by Wrocławskie Inwestycje on the reconstruction of Otyńska and Traktowa Streets.

When analysing the provisions of individual chapters of the requirements related to the reconstruction

of the platforms and adaptation of the railway line to passenger traffic within the Wrocław functional area, the contractor is required to carry out:

- design documentation, containing all the information resulting from the provisions of the technical specification for interoperability of Persons with Reduced Mobility, which shall enable the notified body to perform the subsystem verification process with regard to surveying, design concept, building permit design, detailed design, which will fulfil the requirements as regards the form of the design documentation,
- the documentation necessary to obtain a structure use permit,
- terminal inspection report for the surveying and technical part, in which, if necessary, the speed profiles for the ERTMS system are to be given, among others.

As part of the works to be implemented, the Infrastructure Management expects to perform tasks related to: railway surface, substructure, engineering structures, rail level crossings, passenger service buildings and facilities, control-command and signalling equipment, telecommunications, contact and non-contact electrical power engineering as well as collisions with external networks.

With reference to the works planned for the implementation of the railway surface construction parameters affecting the developed ERTMS/ETCS Level 2 system, there is the replacement of turnout No. 6 (RzL-S60-1:12-500) in track No. 1 of Rail Line No. 273 with an insert between turnout No. 6 and turnout No. (Rkp-S49-1:9-190) for a turnout ensuring the speed of reverse travel at 100 km/h, i.e. double-sided switch and crossing work with the main line curved Rłd-60E1-1:18,5-9631/1369 with regulation in the plan of the existing turnouts Nos. 12 and 18 with adjacent sections of tracks.

As part of the works related to control-command and signalling, interrelated but maintaining the current location markers and not affecting the ERTMS/ETCS Level 2 system, there are anticipated works related to M1 signal installation on the rigid portal structure located on the six-foot way of Lines 757 and 758, changing the method of anchoring signal P1 for direct attachment to the ceiling structure of the passage under the tracks, changing the way of displaying the traffic on signal P1, enabling running at 100 km/h in the reverse direction of turnout No. 6. In addition, the level crossing at 5.032 km should be developed with new A-category crossing signalling devices, equipped with new traffic lights and a minimum of four bar drives ensuring the opening functionality of the crossing as soon as the rolling stock leaves the crossing zone, as well as the dependence of the crossing signalling devices in the existing control-command and signalling system.

While reviewing the provisions of the functional programme for this project, in the provisions related to the conditions and requirements during the execution of works, it is required, in accordance with the Building Code, to keep the construction documents, which include, among others: documents of surveys and laboratory tests – records of testing, declarations of conformity or declarations of performance and certificates of product conformity, designs and control results of tests, i.e. test reports and working papers.

In addition, this document specifies the requirements and conditions in relation to the construction products used, specifying guidelines for their compliance with the requirements of the functional programme, the Act on Construction Products, the Building Code, the Railway Act, internal regulations, Specification for Work Accomplishment and Acceptance and other regulations governing the use of construction products in the construction industry.

The functional programme in the information part of the section on certification indicates that structures and equipment affecting the level of railway traffic safety must, in accordance with the rules, have permission to operate a rail vehicle type, supported by appropriate certificates and declarations of confor-mity to a type. The contractor is obliged to use such materials – subsystem constituents, classified as interoperability constituents, which are covered by the relevant EC certificates of conformity or suitability for use issued by the notified certification body and for which an EC declaration of conformity or suitability for use has been issued. Where it is necessary to use an interoperability constituent which is not covered by an EC certificate of conformity or suitability for use and/or for which no EC declaration of conformity or suitability for use has been issued, the contractor shall have the notified certification body assess the conformity or suitability for use of that interoperability constituent. On the basis of the relevant EC certificate, the contractor is obliged to issue the relevant EC declaration.

The contractor, performing the works indicated in this document [33], is obliged to commission a conformity assessment of the *Infrastructure, Rolling Stock, Telematics Applications for Passenger Transport and Operating Aspects* to a notified certification body in the part covered by the object of the contract, at each stage (design, construction and final testing of the subsystem) in accordance with the provisions of the Railway Act. After receiving the relevant EC certificate of verification of the subsystem, the contractor has to issue the relevant EC declaration of verification of the subsystem. The exact scope of verification, resulting from the scope of works in the subsystem, shall be agreed between the Contractor and the notified body and shall be subject to the Contracting Authority's approval.

6. Conclusion

Authorisation for placing in service is not permission for placing in service. This is because it is a document that allows the carrier or infrastructure management to decide on the use of a vehicle or a subsystem. This decision is taken by an entity that intends to integrate a new vehicle or subsystem into its safety management system. Only railway vehicles and structural subsystems for which the President of the Office for Railway Transport has issued authorisation for placing in service may be operated by railway managers and carriers. Each of the subsystems may be placed in service only if it is designed and installed in such a way that it satisfies the essential requirements for interoperability and is compatible with the existing rail system of which it is composed, while the interoperability constituents of which it is composed are installed and used in an appropriate manner [15].

The assessment of structural subsystems is multilevel and multifaceted. Individual products, interoperability constituents and control-command and signalling structures and equipment are assessed at the level of individual products. The structural subsystems co-creating railway lines and the structural subsystems co-creating railway vehicles are assessed at the subsystem level. Finally, for the entire project – upgrade or construction of a railway line or upgrade or production of a railway vehicle – the risk of unacceptable hazards being introduced into the railway system is evaluated and assessed. At the same time, at each level, it is necessary to take into account the European requirements defined in TSI and Polish requirements. In addition, sometimes different European requirements or other Polish requirements apply, both at the product level and at the subsystem level. The overall assessment also identifies European and national requirements, as well as those directly related to rail transport law and other applicable regulations.

For the further part of the conclusion, it should be said that when analysing the information presented in individual chapters with the above synthetic list of information on the authorisation or conformity assessment results, the conclusions presented result only from the analysis of the technical provisions contained in tender materials. They do not take into account the correlation with the interpretation of the provisions of the Safety Management System (SMS) rules in force of the infrastructure management. Individual documents describing the requirements quoted in tender procedures performed on the railway network managed by PKP Polskie Linie Kolejowe S.A. refer only and exclusively to the works that are to be carried out within the framework of a given procedure. In the cited projects, for all new solutions, the contracting authority specifies the need to obtain the documents required by law, i.e. conformity assessment and the certificate(s) and declaration of conformity for specific subsystems or types of equipment. However, at the same time, in individual parts of the quoted documentation, there is a clear lack of reference to, among others, works that must be carried out additionally in other subsystems, such as in the *Control-Command and Signalling* subsystem. The *Control-Command and Signalling* subsystem, more specifically the ERTMS/ETCS system, can play a key role in this respect as the work carried out under a specific tendering procedure results in the appropriate adjustment of individual parts of the track-side equipment of the system.

For many people, despite the specification [20] of the way balises are distributed, a seemingly trivial change in their position by a certain distance to the right / left may be insignificant, but from a technical point of view this altered location entails significant technical changes. In addition to the global alternation of the location for the entire system, the following must also be changed, among other things: software of the displaced balises, the interrelation of these balises to the other elements of the system, the distances in the movement authority or the data in the radio control centre software of the system. The different elements of the system and the entire subsystem, taking into account the architecture or the location of the equipment, shall be subject to an assessment process performed by a notified body, which shall issue an EC certificate of verification.

In the projects presented, the ERTMS/ETCS equipment already has the EC verification certificates or is at the final stage of their collection. Therefore, any modification of the system for the altered elements should result in a re-certification of the changed area. A key risk for the infrastructure management at this point is the risk of losing the authorisation documents held, which can be eliminated by including, in internal requirements, the obligation to include appropriate information about the requirements for the interrelation modification within the different subsystems in the tender materials. This situation becomes even more complicated, from the technical, organisational or legal point of view, when such reconstruction is carried out on a section of a railway line which has authorisation for placing in service issued by the President of the Office for Railway Transport. Looking at the presented example of the bridge construction – changes in the track system, the addition of equipment and changes in the control-command and signalling applications, without changes in the ERTMS/ETCS system – it indicates that the certificate issued for the development of the interoperable system, as well as the authorisation for placing in service obtained on its basis, is invalidated from the technical and legal point of view. Of course, it is possible to look for "oopholes" to exclude the altered area from the authorisation for

placing in service, although, from the technical point of view, the question arises as to whether such an area has been correctly defined and who certifies that the required level of safety at the border of the exclusion and for the non-excluded area is maintained. With the increasing number of kilometres of railway lines with the implemented ERTMS/ETCS, one should be aware, taking into consideration the trend of applying for authorisation for placing in service of the entire equipped railway lines (also in the *Control-Command and Signalling* subsystem), of the organisational consequences of the lack of correlation between projects or between projects and the actual situation on-site, visible in the tender materials. Other organisational or operational consequences will result from the loss of authorisation for the cited bridge tender (approx. 85 km of the line) than in the case of the platform tender (approx. 300 km of the line). Only the turnout tender indicates that infrastructure information may need to be modified and indicates that information on speed profiles may need to be updated for the ERTMS/ETCS movement authority.

Despite the apparent lack of indications concerning the necessity to correlate the investment process specified in tender materials with other proceedings or subsystems installed on railway lines, it should be assumed in good faith that PKP Polskie Linie Kolejowe S.A., as the infrastructure management within the approved SMS, has identified risks resulting from insufficient knowledge of the personnel about the systems in operation, insufficient knowledge about the conformity assessment processes, or the internal lack of information flow between the centres announcing tender procedures, from the interrelation of such problems and that it has specific measures to eliminate them. It should also be presumed in good faith that valuation and risk assessment, despite the wide range of risk valuation options available, in similar successive cases (such as the tender documents cited with technical alternations to the subsystem (not only the *Control-Command and Signalling* subsystem), thereby infringing EC certificates of verification or authorisation for placing in service), will often result in the conclusion that the implementation of such projects for other subsystems is a significant change and has an impact on the safety of the railway system.

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