TECHNICAL STANDARDS
DETAILED TECHNICAL CONDITIONS FOR THE CONSTRUCTION OF THE RAILWAY INFRASTRUCTURE OF THE SOLIDARITY TRANSPORT HUB – DESIGN GUIDELINES

VOLUME X
CONFLICTS WITH EXTERNAL NETWORKS

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The list of volumes constituting the detailed technical conditions for the construction of the railway infrastructure of the Solidarity Transport Hub:

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1 Introduction

This volume X of the Technical Standards – Design Guidelines is one of 30 volumes containing a description of detailed technical conditions for the construction of railway lines up to a speed of Vmax ≤ 350 km/h managed by STH.

1) While preparing the Standards, reference documents have been taken into account that can be found in chapter 4.
2) The requirements of the Standards are compliant with the applicable legal requirements concerning the railway system interoperability in the European Union.
3) For issues not regulated in the Standards, the applicable regulations and standards in this scope as well as technical knowledge shall be applied.
4) Whenever the Standards refer to the “STH railway infrastructure”, “STH railway lines”, etc., the new railway infrastructure, new railway lines or other structures constructed by STH, which may be managed by another railway infrastructure manager in the future, shall be taken into consideration.

1.1 Technical scope

1) These guidelines apply to all categories of the STH railway lines. The guidelines should be applied at crossings and at proximity of railway lines with other line structures, such as:
   a) power networks;
   b) gas networks;
   c) water supply networks;
   d) sewerage networks;
   e) district heating networks;
   f) telecommunications networks;
   g) long-distance transmission pipelines for crude oil and petroleum products;
   h) water drainage facilities and water facilities.
2) The guidelines specify the rules for removal of conflicts with the aforementioned utilities networks at the request of the railway infrastructure manager during construction or alteration of the railway line and for removal of conflicts with the said utilities networks at the request of the manager of those networks during their construction or alteration.
3) The guidelines specify the requirements for placement of new infrastructure elements in the railway area.
4) The guidelines do not contain requirements concerning crossings of railway lines with public and non-public roads.

1.2 Links to other volumes

The links between this volume of Standards with other volumes are presented in Table 1.

Table 1

Volume No	Volume title	Relation content
V.1	Non-public roads	Requirements for crossings of railway lines with non-public roads
V.2	Public roads	Requirements for crossings of railway lines with public roads
I.4	Gauge	Concerning the gauge applicable on the STH railway lines
III.1	Engineering structures	Concerning the routing of third-party equipment in railway

		engineering structures, joint use of civil structure.

1.3 Definitions of terms used

Railway area

Ground surface determined by cadastral plots on which a railway track, buildings, structures and facilities intended for the management, operation and maintenance of a railway line and for the transportation of persons and goods are located.

(as defined in the Railway Transport Act) [1]

Utilities networks

All types of above-ground, ground and underground conductors and equipment: water supply, sewerage, gas, thermal, telecommunication, power and other, as well as underground structures such as tunnels, passages, parking lots, tanks, etc.

(as defined in the Geodetic and Cartographic Law) [2]

Infrastructure manager

An entity responsible for managing the railway infrastructure, its operation, maintenance, renewal or participation in the development of the infrastructure, and in the case of construction of new infrastructure, an entity that commenced its construction as the investor.

(as defined in the Railway Transport Act) [1]

Water drainage facilities

These are ditches with functionally related structures, drainage, pipelines, pump stations for agricultural purposes only, land fish ponds, dykes in irrigated areas, gravity irrigation systems, pressure irrigation systems – if they serve the purpose of regulating water conditions in order to improve soil fertility and facilitate crops.

(as defined in the Water Law) [3]

Water facilities

Facilities or structures used to shape or use water resources.

(as defined in the Water Law) [3]

Carrier pipe

A pipe for medium transport.

(according to own definition)

Protective pipe / casing pipe

An outer shield of a carrier pipe to protect it from mechanical damage, humidity, weather conditions.

(according to own definition)

Jacking pipe

A pipe used to construct a passage under a ground obstacle using a trenchless method. After completion of the passage, it may be removed or left as a protective pipe.

(according to own definition)

Crossing

Any routing of a linear structure crossing a railway line or a railway area.
(according to own definition)

Longitudinal routing of a linear structure

It occurs when it is run in a railway area or approaches a distance of less than 10 m from the boundary of the railway area or a distance of less than 20 m from the axis of the extreme track.
(according to own definition)

Joint use of civil structures

It means in particular the operation of other linear structures on the STH railway structures, e.g. bridges, flyovers, etc.
(according to own definition)

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2 Essential, basic and general requirements for the STH railway infrastructure

Table 2 defines the link between the detailed technical conditions and the essential, basic and general requirements for the STH infrastructure.

Table 2

sub-chapter of this volume defining detailed technical conditions	essential requirements (Railway Interoperability Directive)						basic requirements	general requirements for the STH railway infrastructure			
	1.1. security	1.2. reliability and accessibility	1.3. health	1.4. environmental protection	1.5. technical compliance	1.6. accessibility	2.1. mechanical resistance and stability 2.2. fire safety 2.3. hygiene, health and the environment 2.4. safety and accessibility in use 2.5. protection against noise 2.6. energy economy and heat retention 2.7. sustainable use of natural resources	3.1. oriented towards the needs of the economy	3.2. orientation towards the needs of passengers	3.3. orientation towards the needs of carriers	3.4. compatibility with the railway infrastructure connected with the STH railway infrastructure
3.1	1.1.1	-	-	-	-		-	-	-	-	-
3.2	-	-	-	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-	-	-	-
3.4	1.1.3	-	1.3.3	1.4.2	-	-	2.1.1	-	-	-	-
3.5	1.1.3	-	1.3.3	1.4.2	-	-	2.1.1, 2.2.1, 2.4.1	-	-	-	-
3.6	-	-	1.3.3	-	-	-	2.4.1	-	-	-	-
3.6.1	1.1.3	-	1.3.3	1.4.2	-	-	2.1.1, 2.4.1	-	-	-	-
3.6.2	1.1.3	-	1.3.3	1.4.2	-	-	2.1.1, 2.2.1, 2.4.1	-	-	-	-
3.6.3	-	-	1.3.3	-	-	-	2.4.1	-	-	-	-
3.6.4	-	-	1.3.3	-	-	-	-	-	-	-	-
3.6.5	1.1.3	-	1.3.3	-	-	-	2.1.1, 2.4.1	-	-	-	-
3.7	-	-	-	-	-	-	-	-	-	-	-

2.1 Cybersecurity

Technical solutions which collect, store, process, make available or transmit data ensuring the compliance with essential safety requirements (requirements from 1.1.1. to 1.1.11. specified in Volume A of the STH Railway Standards) and general requirements for the STH railway infrastructure concerning security (requirements 1.1.12. and 1.1.13 specified in Volume A of the STH Railway Standards) should be designed taking into account cybersecurity, i.e. “security of network and information systems”, defined in the Directive concerning measures for a high common level of security of network and information systems across the Union, as follows:

> “security of network and information systems” means the ability of network and information systems to resist, at a given level of confidence, any action that compromises the availability, authenticity, integrity or confidentiality of stored or transmitted or processed data or the related services offered by, or accessible via, those network and information systems;
>
> *[as defined in Article 4 of Directive 2016/1148]*

Cybersecurity includes two types of threats resulting from unauthorised access to the systems/equipment/networks that collect, store, process, make available or transmit data:

1) physical security threats

It is necessary to secure systems/equipment/networks against direct access which could enable causing (intentionally or unintentionally) threats to functional safety.

2) IT security threats

It is necessary to secure systems/equipment/networks against logical access via IT systems/equipment/networks, which could enable causing (intentionally or unintentionally) threats to functional safety.

Cybersecurity defined this way applies both to information systems used for rail transport purposes and to operational systems used for rail transport purposes, but the STH railway standards do not include requirements for information systems, e.g. timetabling systems.

Physical security threats and IT security threats for operational systems for which requirements are defined in the STH railway standards should be addressed by railway operators as part of the risk assessment and by design engineers/manufacturers/contractors as part of threat control. Additionally, it is required for the applied protections to be documented and verified in accordance with the requirements included in Volume XVIII of the STH railway standards.

2.2 Cybersecurity within the scope of this volume of the STH railway standards

Currently, in the area covered by this volume of standards, there are no networks and information systems whose security could be endangered. However, it is possible that such networks and information systems or technical solutions that collect, store, process, make available or transmit data may arise. For example, a system of sensors may be used that, through wired or wireless networks, public or non-public networks or directly, will connect to, for instance, an infrastructure manager's system. Then, they should be protected against physical security and IT security threats in a manner compliant with the requirements of the Information Safety Management System (ISMS) implemented by the STH company.

At the same time, it should be kept in mind that the ISMS will be subject to changes because maintaining the required level of cybersecurity is not possible by meeting requirements of the standards once since cybersecurity is a process rather than a state. In order to minimise the number and size of cyber threats, the requirements (obligations) included in the Act of 5 July 2018 on the national cybersecurity system in Chapter 3 for operators of key services, in Chapter 5 for public entities should be continuously observed in operational processes and only digital service providers fulfilling the obligations described in Chapter 4 of that Act should be used.

3 Technical conditions

3.1 Formal arrangements

1) Pursuant to Article 53 section 2 of the Act of 28 March 2003 on rail transport[1], structures and buildings not used for railway traffic may be located at a distance not smaller than 10 m from the boundary of the railway area and the distance from the axis of the extreme track may not be smaller than 20 m. In view of the above, obtaining the building permit for a building or structure at distances smaller than those specified in the Act[1] involves the necessity to obtain a derogation from the provisions of Article 53 section 2 of the Act of 28 March 2003 on rail transport[1].
2) Regulation of the Minister of Infrastructure of 7 August 2008 on requirements for distances and conditions permitting the location of trees and bushes, acoustic protection elements and the performance of earthworks in the vicinity of railway lines, as well as the method of arranging and maintaining snow shades and fire breaks[4] prohibits in § 4 point 1 the execution of earthworks at a distance of less than 4 m from the boundary of a railway area. Therefore, obtaining a building permit for the construction of any utilities networks at distances smaller than those specified in the Regulation [4] involves the necessity to obtain a derogation from the provisions of § 4 of the Regulation [4].
3) The railway infrastructure manager is legally obliged to operate safely and maintain its railway infrastructure in accordance with safety requirements.
4) Each undertaking that involves locating any building or structure in railway areas or proximity to a civil structure at a distance of less than 10 m from the boundary of the railway area or at a distance of less than 20 m from the axis of the extreme track must be adapted to the site conditions of the railway line and developed as part of a separate building permit design (together with a technical design), which must be agreed with the railway infrastructure manager.

3.2 Conflicts of the route of the utilities networks with the planned railway investment

1) If, at the stage of implementation of the project of construction or alteration of the railway line, networks and systems in conflict with the designed railway infrastructure are identified, the railway infrastructure manager of the railway line being constructed or altered shall request the entity managing the utilities networks identified in a given area to issue conditions for removal of the conflict.
2) Alteration or protection of the utilities networks is required when the existing utilities networks on the real properties designated for the construction or alteration of the railway line cross the railway infrastructure being constructed or altered or the existing utilities networks are at a proximity of less than 20 m to the axis of the extreme track.
3) Regardless of the utilities networks identified, the railway infrastructure manager submits a request for the drawing on the master map of, and for the provision of information on, the water drainage facilities running through the area intended for the construction of the railway line, such request to be submitted to the selected unit of PGW Wody Polskie in accordance with the local jurisdiction.
4) The building permit design (together with the technical design) shall be agreed with the manager of the railway line being constructed or altered and with the manager of the utilities networks. The design should be compliant with the technical requirements of these standards.
5) A water permit should be obtained for the construction or alteration of water facilities or water drainage facilities. The design of alteration of water drainage facilities should be reviewed by the competent water company for the area or by a union of water companies.
6) The costs related to the preparation of the building permit design (together with the technical design), water management plan and other studies necessary to obtain arrangements and

decisions regarding removal of the conflicts, as well as the construction costs of removal of conflicts, shall be borne by the investor.

7) If, as a result of arrangements made by the railway infrastructure manager with the utilities networks manager, the parties agree to introduce improvements to the utilities networks being altered, the costs of such improvements shall be borne by their owner or user, as appropriate.

3.3 Location of new facilities and/or alteration of existing facilities in the railway area

1) General guidelines for networks and systems located in railway areas are specified in the Regulation of the Minister of Transport and Maritime Economy of 10 September 1998 on technical conditions to be met by railway structures and their location [9].
2) It should be ensured that works related to the construction and operation of third-party utilities networks in the railway area do not pose any risks, in particular with respect to stability of facilities, railway systems and railway traffic safety. For this purpose, it is required to coordinate the activities of the entity involved in the process of routing the utilities networks or other facilities within railway areas and the railway infrastructure manager.
3) The basis for the arrangement enabling the routing of utilities networks or other facilities in a railway area is the submission of an application with the technical office of the railway infrastructure manager for the issuance of conditions/arrangements of the possibility of location of new facilities and/or alteration of the existing facilities in the railway area.
4) The application is required both when creating a new facility and/or altering an existing facility and decommissioning an existing facility in a railway area. The application shall be accompanied by:
    a) a technical description containing the data of the facility to be located in the railway area;
    b) a current map for design purposes showing a proposed location of the new facilities and/or alteration of the existing facilities in the railway area;
    c) a longitudinal profile of the designed utilities networks running along the railway area;
    d) a power of attorney if the Investor acts through a representative.

3.4 Technical requirements for water, sewerage, district heating and gas pipelines routed in a railway area

When designing and constructing gas pipelines in the railway area, the requirements included in the Regulation of the Minister of Economy of 26 April 2013 on technical conditions to be met by gas networks and their location shall be observed. [5].

1) Water, sewerage, district heating and gas pipelines crossing railway lines shall be installed in protective pipes.
    a) steel protective pipes should be protected against corrosion with an insulation resistant to puncture with 50 Hz AC voltage with the value of at least 25 kV;
    b) protective pipes should be equipped along their entire length with casing spacers (sliders) ensuring appropriate distance from the carrier pipes;
    c) the inner diameter of the protective pipe must not be smaller than the outer diameter of the carrier pipe plus the height of the spacers;
    d) protective pipes should have a wall thickness of not less than the wall thickness of the carrier pipe and not less than 5 mm for steel pipes;
    e) the ends of protective pipes must be sealed.
2) The pipeline should not be laid under turnouts, switches or in the vicinity of connections of cables of railway traffic control systems. The distance of the pipeline from these places should be at least 10 m.

3) Electrical systems in the vicinity of pipelines with flammable media must be made as explosion proof;
4) It is not allowed to locate power and communication cables in the space between the gas pipeline and its protective pipe;
5) It is not allowed to change the direction of pipe routing in the plan and in the profile under the track system;
6) Protective pipes under the existing railway tracks should be installed using the trenchless method.
7) The trenchless technology applied should interfere with the soil structure to a limited extent and should not disturb the superstructure over the place of passage. Horizontal drilling is recommended.
8) Excavations for pipelines must be separated from the existing infrastructure, such as bridges, culverts, all types of masts. The minimum distance of 5.0 m from the excavation edges to the existing infrastructure should be maintained. If the distance of 5 m cannot be reached, calculations and verifications with respect to stability must be carried out (e.g. using the MES method).
9) The angle at which the pipeline intersects with railway tracks should be close to 90°, but not less than 60°.
10) Pipeline structures must not intrude into the gauge of railway tracks, including also the structure gauge below the rail head, and their overhauls and maintenance should not hamper railway traffic.
11) The pipeline should be located:
    a) as far away as possible from track devices related to railway traffic, in particular cable lines and control command and signalling equipment.
    b) it should be accessible without causing difficulties in railway traffic or in the use of railway facilities.
12) The distance from the boundary of the adjoining strip of land when the pipeline is laid in parallel to the tracks should be at least 5 meters.
13) The distance of the pipeline with non-flammable media when approaching and intersecting power and communication cables laid in the ground belonging to the railway infrastructure manager should be at least:
    a) 0.25 m + diameter of the protective pipe of the pipeline at the crossing with communication cables, telecommunication cables and power cable networks with voltage below 30 kV;
    b) 0.5 m + diameter of the protective pipe of the pipeline at the crossing with power cable networks with voltage above 30 kV;
14) At the passages of water, sewerage and district heating pipelines under the tracks:
    a) inspection chambers should be located on both sides of the passage under the tracks; it is recommended to locate the chambers at the boundary of the railway area;
    b) the inspection chambers should be provided with shut-off valves enabling the closing of the medium flow in case of failure;
    c) the chambers should be made of reinforced concrete or cast or prefabricated concrete, equipped with manholes ensuring access to the chamber;
    d) minimum diameter of the chamber: DN1200 mm;
    e) the chambers should comply with PN-EN 1917 [11]. Minimum material requirements for concrete or reinforced concrete chambers:
        - concrete grade C35/45;
        - absorbability 4.5 %;
        - water tightness W10;

- frost resistance F-150;

15) Vertical distance measured from the upper outer wall of the protective, casing or borehole pipe should be no less than:
    a) 1,5 m to the plane passing through the rail heads of the railway track;
    b) 0.5 m to the elevation of the bottom of the drainage ditch of the railway tracks;
16) The pipeline route and valving shall be permanently marked on site.
17) Pipelines running along the railway line should be laid outside the fenced area and outside the acoustic baffles.
18) After obtaining the consent of the owner of the overpass and the railway infrastructure manager, it is possible to cross the pipeline with the railway line by installing the pipeline in the road overpass above the railway line.
19) At the gas pipeline intersections with the railway line, the hoop stress of a steel pipeline under static conditions caused by the maximum operating pressure (MOP) shall not exceed the product of the minimum value of the yield point Rt0.5 and the design coefficient of 0.4 at a length of at least 10.0 m from the edge of the railway line.
20) Gas pipelines laid in places exposed to the risk of their displacement shall be properly secured. The method of protection should be presented in the technical documentation.
21) Surface elements of the gas pipeline at the points of crossing the railway line should be checked by performing radiographic (RT) or ultrasonic (UT) non-destructive tests.[5]
22) The steel pipeline should be protected against external corrosion by means of plastic insulation coatings.[5]
23) For the pipelines running near DC railway tracks, a cathodic protection system made in accordance with the Polish Standard PN-EN 12954:2019-12 should be used. [10].
24) A pipeline equipped with a cathodic protection system should:
    a) have electrical continuity;
    b) be equipped with electrical measurement points enabling measurements of the electric potential of the pipeline against the ground, measurements of the potential difference between the pipeline and the electric traction busbars and measurements of the current intensity in the pipeline;
    c) be electrically separated from unprotected structures by means of insulating joints;
    d) be electrically isolated from all structures and elements with low grounding resistance.
25) For pipelines routed in the vicinity of AC electrified railway tracks, the pipeline shall be protected by appropriate means, including using insulating joints. Pipelines made of steel pipes should be electrically separated by means of insulating joints from:
    a) steel pipelines not adapted for electrochemical protection;
    b) structures and components with low transition resistance to the ground;
    c) steel protective pipes;
    d) facilities that do not require protection.

3.5 Technical requirements for crude oil and petroleum product transmission pipelines running in the railway area

During the design and construction of crude oil and petroleum product transmission pipelines carried out in the railway area, the requirements included in the Regulation of the Minister of Economy of 21 November 2005 on technical conditions to be met by liquid fuel bases and stations, long-distance transmission pipelines for crude oil and petroleum products and their location shall be observed [7].

1) Passages of crude oil and petroleum product pipelines under railway tracks should be made in places where they are located on embankments or at an elevation equal to the ground level.

2) It is not allowed to change the direction of pipe routing in the plan and in the profile under the track system.
3) Excavations for pipelines must be separated from the existing infrastructure, such as bridges, culverts, all types of masts. The minimum distance of 5.0 m from the excavation edges to the existing infrastructure should be maintained. If the distance of 5 m cannot be reached, calculations and verifications with respect to stability must be carried out (e.g. using the MES method).
4) The angle at which the pipeline intersects with railway tracks should be close to 90°, but not less than 60°.
5) Pipelines running along the railway line should be laid outside the fenced area and outside the acoustic baffles.
6) Passages of long-distance transmission pipelines under railway tracks should be made in protective pipes or transition pipes. The diameter of the protective pipe should be at least 200 mm larger than the diameter of the carrier pipe.
7) Protective pipes under the existing railway tracks should be installed using the trenchless method.
    a) the trenchless technology applied should interfere with the soil structure to a limited extent and should not disturb the superstructure over the place of passage. Horizontal drilling is recommended.
8) When installing DN 400 and larger casing pipes under the railway track using the trenchless method, the trackbed shall be protected by the use of a load-decreasing structure.
    a) execution of the protective structure should not require stopping railway traffic, or dismantling the trackbed or the traction power supply;
    b) an example of the load-decreasing structure planned for the duration of jacking works can be a grate made of steel I-sections laid under the rail in the field between the sleepers.
9) Protective pipes should not have an electrical connection with the transmission pipeline and the ends of these pipes should be sealed so that water does not accumulate inside.
10) The technical solution of the passage should enable checking that there is no electrical connection using test terminals protruding from the pipeline and from protective pipes to connect a resistance meter.
11) The depth of laying the long-distance transmission pipeline sections under the railway track should be:
    a) at least 2 m from the rail head to the upper forming protective/borehole pipe;
    b) at least 0.5 m from the bottom of the ditch, chute or channel used to discharge water to the upper forming protective/borehole pipe.
12) Cable protection pipes should be installed above the protective pipe of the pipeline.
13) The transmission pipeline should not be laid under turnouts, switches or in the vicinity of connections of cables of railway traffic control systems. The distance of the pipeline from these places should be at least 10 m.
14) The distance between the long-distance transmission pipeline crossing and the connection point of the return circuit should be at least 1500 m.
15) The distance of the pipeline with flammable media when approaching and crossing power and communication cables laid in the ground belonging to the railway infrastructure manager should be at least:
    a) 2 m + diameter of the protective pipe of the pipeline at the crossing with communication cables, telecommunication cables and power cable networks with voltage below 30 kV;
    b) 2.5 m + diameter of the protective pipe of the pipeline at the crossing with power cable networks with voltage above 30 kV;

16) Passages of the long-distance transmission pipeline through rivers near a railway bridge should be located below this bridge, taking into account the direction of water flow, at a distance of at least:
    a) 150 m – from the centreline of the railway bridge for the width of the water table at the average water level in the multiannual period exceeding 20 m;
    b) 100 m – from the centreline of the railway bridge for the width of the water table at the average water level in the multiannual period of less than 20 m.
17) It is allowed to locate passages of long-distance transmission pipelines through rivers and channels above the railway bridge, taking into account the direction of water flow, at a distance of not less than 300 m.
18) The route of the long-distance transmission pipeline should be marked.
19) At the passages through railway tracks, the wall thickness of the long-distance transmission pipeline should be increased by 20% in relation to the design thickness.
20) At crossings with railway tracks upstream the railway area, long-distance transmission pipelines should be equipped with shut-off valves from the oil or oil product inflow side.
21) External surfaces of transmission pipelines shall be protected against corrosion by applying appropriate coatings in accordance with the requirements specified in the Polish standards concerning these protections.
    a) insulating materials and anticorrosive coatings made of plastics should meet the requirements of the relevant product standards and, if they are not available, the requirements of technical approvals, which should be confirmed by a certificate of conformity or a declaration of conformity;
    b) steel pipes used for pipeline construction should be factory protected with external anticorrosive insulation coating made of hot-applied polyethylene by pipe manufacturers or in specialized insulation plants;
    c) steel protective pipes should be protected against corrosion with an insulation resistant to puncture with 50 Hz AC voltage with the value of at least 25 kV;
    d) steel pipes laid in soils with a high corrosion and mechanical hazard, as well as carrier pipes laid in protective pipes and protective pipes should be protected with a reinforced coating. The reinforced coat should also be used for pipelines which will not be protected by active electrochemical protection.
22) If the long-distance transmission pipeline is exposed to an increased risk of corrosion due to stray currents or sulphate reducing bacteria, appropriate cathodic protection systems shall be used to eliminate this risk.
23) For the pipelines running near DC railway tracks, a cathodic protection system made in accordance with the Polish Standard PN-EN 12954:2019-12 should be used. [10]. A pipeline equipped with a cathodic protection system should:
    a) have electrical continuity;
    b) be equipped with electrical measurement points enabling measurements of the electric potential of the pipeline against the ground, measurements of the potential difference between the pipeline and the electric traction busbars and measurements of the current intensity in the pipeline;
    c) be electrically separated from unprotected structures by means of insulating joints;
    d) be electrically isolated from all structures and elements with low grounding resistance.
24) For pipelines routed in the vicinity of AC electrified railway tracks, the pipeline shall be protected by appropriate means, including using insulating joints. Pipelines made of steel pipes should be electrically separated by means of insulating joints from:
    a) steel pipelines not adapted for electrochemical protection;

b) structures and components with low transition resistance to the ground;

c) steel protective pipes;

d) facilities that do not require protection.

3.6 Technical requirements for power and communication networks installed in the railway area

When designing and constructing power networks routed in a railway area, the requirements included in the Polish standards PN-EN 50341-1:2013-03 [12], PN-EN 50341-2-22:2016-04 [13]shall be observed. With respect to communication and telecommunications networks, the general guidelines included in the Regulation of the Minister of Infrastructure of 26 October 2005 on technical conditions to be met by telecommunications civil structures and their location shall be observed[8].

1) The routing of power and communication lines in railway areas is subject to specific technical and legal conditions which must be observed in the period preceding the designing process, as well as during the designing and construction.
2) In the case of longitudinal routing of overhead power and communication lines, it is recommended to maintain a distance of at least 20 m from the axis of the extreme track.
3) The longitudinal routing of overhead power and communication lines must not intrude into the gauge of railway tracks, including also the structure gauge below the rail head, obscure railway signals, cause interference in signalling or reduce the visibility of tracks.
4) Construction, operation and maintenance must not hinder railway traffic or maintenance and operation of railway equipment.
5) Overhead and cable power and communication networks should be routed on the external side of the drainage ditch.
6) Overhead and cable power and communication networks running along the railway line should be laid outside the fenced area and outside the noise barriers.
7) It is not allowed to cross low voltage or medium voltage overhead power lines and communication lines with the railway line by routing the lines above the track. During the removal of conflicts, such lines should be routed as cables under the tracks.
8) Crossings overhead HV 110 kV power lines with the railway line (by routing the lines above the tracks) are allowed only in justified cases. During the removal of conflicts, such lines are recommended to be routed as cables under the tracks.
9) Excavations for columns, cables, etc. must be distant from the existing infrastructure, such as bridges, culverts, any types of masts. The minimum distance of 5.0 m from the excavation edges to the foundation of the existing infrastructure should be maintained. If the distance of 5 m cannot be reached, calculations and verifications with respect to stability must be carried out (e.g. using the MES method).
10) Where proximity of the power line or communication line is necessary, the horizontal distance of the extreme conductor from the external axis of the extreme railway track should be at least 5 meters.
11) It is forbidden to use rails or other railway devices and railway earth electrodes as earthing elements of power and communication lines.

3.6.1 Requirements for power and communication cable lines

1) Power and communication cable lines located in railway areas should be laid in protective pipes.
2) The depth of burying cables in the ground in the railway area outside the trackbed, measured perpendicularly from the ground surface to the upper surface of the protective pipe, should be at least:
   a) 70 cm for communication cables and power cables with a voltage up to 1 kV;

b) 80 cm for power cables with a voltage from 1 kV to 30 kV;

c) 100 cm for power cables with voltage above 30 kV.

3) The route of the cable line should be at least 5 m away from the traction poles line.

4) At crossings with railway tracks, the depth of the upper surface of the protective pipe should be at least 1.5 m from the upper crown of the rail.

5) At crossings with railway tracks, the depth of the upper surface of the protective pipe should be:

a) at least 0.5 m from the bottom of the drainage ditch for communication and power cables with voltage up to 1 kV;

b) at least 0.8 m from the bottom of the drainage ditch for power cables with voltage above 1 kV;

c) at least 0.8 m from the bottom of the cable duct intended for cables owned by the railway infrastructure manager.

6) Thick-walled RHDPE protective pipes shall be used under the tracks.

7) Cable joints cannot be located under the tracks.

8) The crossing of a power or communication line with a railway line should be executed using the shortest possible route. The angle between the railway line and the crossing power or communication line should be as close to 90° as possible, and not less than 60°.

9) The manholes should be located outside the drainage ditches at a distance of at least 5 m from them.

10) The trenchless method should be used when executing cabling under an existing railway line.

11) The trenchless technology applied should interfere with the soil structure to a limited extent and should not disturb the superstructure over the place of passage. Horizontal drilling is recommended.

12) Crossings of cable ducting with a railway line should be located at a distance of at least 5 m from the overhead catenary system supporting structures, 2 m from semaphores and at least 10 m from turnouts and switches.

13) Culvert exits should be located at a distance of at least 5 m from the axis of the extreme track.

14) Culverts must be sealed.

15) Crossings of cable ducting with a railway line should not be made near the connection of cables of the railway traffic control systems. The distance from these places should be at least 10 m.

16) The cable ducting route should be permanently marked.

17) The method of laying cables in the railway area should be compliant with the N-SEP-004[14] standard.

3.6.2 Joint use of civil structures

1) On bridges and overpasses, cables that are laid cannot reduce the mechanical strength of the facility.

2) Cables shall be laid on bridges and overpasses:

a) on properly constructed structures;

b) under walkways;

c) in cable ducts.

3) Cables laid on bridges and overpasses should have an increased resistance to flame propagation.

4) Cable joints shall not be used on bridges and overpasses.

5) When penetrating partitions, covers made of flame retardant materials should be used.

6) On bridges, overpasses, cables should be laid in shields or pipes which are not easily ignitable and in additional metal cable trays.
7) When routing telecommunications cable lines on bridges and overpasses, the guidelines included in the Regulation of the Minister of Infrastructure of 26 October 2005 on technical conditions to be met by telecommunications civil structures and their location shall also be observed [8].
8) Construction requirements concerning the routing of third-party systems on railway overpasses and bridges are specified in volume III.1 of the Technical Standards “Engineering structures”.

3.6.3 Additional requirements for power cable lines

1) Cable power lines routed in railway areas may not, at any point, be in contact with power and telecommunication lines owned by the railway infrastructure manager; at proximity and intersections, the distances specified in table 3 shall be maintained.
2) At crossings, power cable lines should be laid under power and telecommunication cable lines owned by the railway infrastructure manager.

Table 3

Item	Characteristics of power cable lines crossing, or routed at proximity to, cable railway infrastructure	Smallest permissible distance [m]	
		Vertical at intersection	Horizontal at approach
1	Power cables with rated voltage up to 30 kV with cables with voltage up to 30 kV and communication cables of the railway infrastructure manager	0.5	0.5
2	Power cables with rated voltage above 30 kV with communication cables of the railway infrastructure manager	0.5	1

3.6.4 Additional requirements for communication cable lines

1) Communication cable lines routed in railway areas may not, at any point, be in contact with power and telecommunication lines owned by the railway infrastructure manager; at proximity and intersections, the distances specified in table 4 shall be maintained.

Table 4

Item	Characteristics of communication cable lines crossing, or routed at proximity to, cable railway infrastructure	Smallest permissible distance [m]	
		Vertical at intersection	Horizontal at approach
1	Communication cables with cables with voltage up to 30 kV and communication cables of the railway infrastructure manager	0.3	0.5
2	Communication cables with power cables with rated voltage above 30 kV	0.5	1

3.6.5 Additional requirements for overhead power networks

1) It is possible to route an overhead power line above the railway track only for transmission networks with the voltage of 110 kV and higher.
2) The technical design of the crossing is required to include the power line profile with the overhead catenary system marked. Conductors should be presented in a manner enabling verification of the required electrical distances. In particular, the value and condition of determining the sag of the conductors over the overhead catenary system should be determined for the ambient temperature of +40°C and the operating temperature of the conductors. And for the temperature of -5°C and normal rime.
3) At the crossings, it is required to limit the spans of the crossings with strong poles taking over the tension of conductors (e.g. anchor supports or terminal supports).
4) At the crossing with the railway track, a power line with voltage above 1 kV should meet the requirements of the 3rd degree of restrictions according to the Polish Standard PN-EN 50341-2-22[13], consisting in reduced stress of conductors and increased mechanical strength of insulators.
5) It is forbidden to connect conductors in all spans of the line crossing the tracks.
6) It is forbidden to locate crossings over semaphores, bridges, overpasses and road barriers.
7) In case of proximity of overhead power lines with voltage above 1 kV to a railway line, the minimum distances specified in table 5 shall be observed.

Table 5

Item	Minimum horizontal distances of overhead power network conductors from railway line elements	Type of conductors	
		Bare conductors	Insulated or partially insulated conductors
1	Minimum horizontal distance from traction elements, railway line guard elements or overhead line elements of the railway infrastructure manager [m]	0.5 + D_{el}, but not less than 1.5 m	1.5
2	Minimum horizontal distance between the nearest part of the overhead line and the external edge of the nearest railway line trackbed	4 +D_{EL}, but not less than 6.6	4

8) For crossings of overhead power lines with railway lines, the vertical distances specified in Table 6 shall be observed.

Table 6

Item	Minimum vertical distances of overhead power network conductors from railway line elements	Type of conductors	
		Bare conductors	Insulated or partially insulated conductors
1	Minimum vertical distance from traction elements, railway line guard elements or overhead line elements of the railway infrastructure manager [m]	2 +D_{EL}, but not less than 2.6	2

9) The D_{el} coefficient of insulation clearances in the air according to PN-EN 50341-2-22[13] is provided in Table 7.

Table 7

grid voltage U [kV]	Del in [m]
3.6	0.08
7.2	0.09
12	0.12
17.5	0.16
24	0.22
36	0.35
52	0.60
72.5	0.70
100	0.90
123	1.00
145	1.20
170	1.30
245	1.70
300	2.10
420	2.80
525	3.50
765	4.90

3.7 Requirements for drainage facilities

1) The existing drainage facilities conflicting with the planned railway line and its associated facilities should be eliminated and removed from the project site.
2) New drainage facilities should be located outside the railway area.
3) In justified cases, e.g. the need to route a drainage facility across the railway line, it is allowed to locate it in the railway area under the following conditions:
   a) the crossing angle of the drainage facility with the railway line shall be as close to 90° as possible, and not less than 60°;
   b) deep collectors in the railway area must not perform the function of drainage;
   c) all pipelines (drainage, rainwater, etc.) passing under railway line facilities and public roads should be routed in a protective pipe as described in point 3.4 1);
   d) chambers and drainage outlets should not be located in the railway area.
4) At crossings with railway tracks, the depth of the upper surface of the protective pipe should be:

a) at least 1.5 m from the upper crown of the rail;
b) at least 0.5 m from the bottom of the drainage ditch;
c) at least 0.8 m from the bottom of the cable duct intended for cables owned by the railway infrastructure manager.

5) Technical parameters of the drainage facilities designed shall be adjusted to the parameters of the existing facilities. In the case of a network alteration that involves connecting facilities which were previously independent, it is necessary to:
   d) select the deep collector diameters on the basis of the Polish standards;
   e) check channel sections with hydraulic calculations.
6) The depth of installation of altered deep collectors should be adjusted to the depth of the existing deep collectors at the points of connection.
7) The existing drains from the water inflow side which have been cut should be connected to the new deep collectors. The ends of cut drains on the water outlet side should be plugged.
8) The depth of the drainage system at the sections beyond the planned connections is variable, however:
   f) drain cover should not be less than 0.6 m;
   g) a deep collector located much below the existing drainage depth should not perform the drainage function.
9) Upstream and downstream passages under railway lines and public roads outside the railway area and the roadway, concrete inspection chambers should be installed of a diameter of min. DN1000.
10) The other inspection chambers (deep collector connections, change of direction, drop reduction) made of plastics, system solutions.
11) All chambers should have a sedimentation tank of at least 0.4 m, and in green areas they should protrude by the minimum of 0.25 m above the surface.
12) All inspection chambers shall be located outside the railway area.
13) Gratings should be used at pipe outlets to prevent small animals from entering a collector; these gratings should be made of corrosion-protected steel bars.

4 Reference documents

The following reference documents were used to prepare Volume X:

4.1 Legal documents of the Republic of Poland

[1] Ustawa z dnia 28 marca 2003 r. o transporcie kolejowym. (Dz.U.2020.1043).

[2] Ustawa z dnia 17 maja 1989 r. – Prawo geodezyjne i kartograficzne. (Dz.U. 1989 nr 30 poz. 163).

[3] Ustawa z dnia 20 lipca 2017 r. Prawo wodne. (Dz. U. z 2021 r. poz. 624).

[4] Rozporządzenia Ministra Infrastruktury z dnia 7 sierpnia 2008 r. w sprawie wymagań w zakresie odległości i warunków dopuszczających usytuowanie drzew i krzewów, elementów ochrony akustycznej i wykonywania robót ziemnych w sąsiedztwie linii kolejowej, a także sposobu urządzenia i utrzymywania zasłon odśnieżnych oraz pasów przeciwpożarowych (Dz.U. 2008 nr 153 poz. 955)

[5] Rozporządzenie Ministra Transportu I Gospodarki Morskiej z dnia 10 września 1998 r. w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie. (Dz.U. 1998 nr 151 poz. 987 z późniejszymi zmianami)

[6] Rozporządzenie Ministra Gospodarki z dnia 26 kwietnia 2013 r. w sprawie warunków technicznych, jakim powinny odpowiadać sieci gazowe i ich usytuowanie. (Dz.U. 2013 poz. 640)

[7] Rozporządzenie Ministra Gospodarki z dnia 21 listopada 2005 r. w sprawie warunków technicznych, jakim powinny odpowiadać bazy i stacje paliw płynnych, rurociągi przesyłowe dalekosiężne służące do transportu ropy naftowej i produktów naftowych i ich usytuowanie. (Dz.U. 2005 nr 243 poz. 2063)

[8] Rozporządzenie Ministra Infrastruktury z dnia 26 października 2005 r. w sprawie warunków technicznych, jakim powinny odpowiadać telekomunikacyjne obiekty budowlane i ich usytuowanie (Dz.U. 2005 nr 219 poz. 1864)

[9] Rozporządzenie Ministra Transportu i Gospodarki Morskiej z dnia 10 września 1998 r. w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie (Dz.U. 1998 nr 151 poz. 987, z późniejszymi zmianami)

4.2 Normative documents

[10] PN-EN 12954:2019-12 Ogólne zasady ochrony katodowej zakopanych lub zanurzonych lądowych konstrukcji metalowych

[11] PN-EN 1917:2004 Studzienki włazowe i niewłazowe z betonu niezbrojonego, z betonu zbrojonego włóknem stalowym i żelbetowe

[12] PN-EN 50341-1:2013-03 Elektroenergetyczne linie napowietrzne prądu przemiennego powyżej 1 kV - Część 1: Wymagania ogólne - Specyfikacje wspólne

[13] PN-EN 50341-2-22:2016-04 Elektroenergetyczne linie napowietrzne prądu przemiennego powyżej 1 kV - Część 2-22: Krajowe Warunki Normatywne (NNA) dla Polski (oparte na EN 50341-1:2012)

[14] N-SEP-004 Elektroenergetyczne i sygnalizacyjne linie kablowe, Projektowanie i budowa

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