CRR-G-026-C Annex1 Author: Caoimhe Boland Reviewed by: Mary Molloy Authorised by: Brian Higgisson Status: 17/08/2021 version E update includes safety in railway tunnels, section 13	Note: The identification of requirements for different parameters is intended as an aid to applicants. It remains the responsibility of the applicant to perform the requirements capture for their project ((EU) 2016/797 Art. 18 (1)+(4))	"TSI ENE" refers to: (EU) No 1301/2014 and Corrigendum (amended by (EU) 2018/868 and (EU) 2019/776) "TSI INF" refers to: (EU) No 1299/2014 (amended by (EU) 2019/776) "TSI LOC & PAS" refers to:(EU) No 1302/2014 (amended by (EU) 2018/868, (EU) 2019/776 and (EU) 2020/387) "TSI OPE" refers to: (EU) 2019/773 "TSI SRT" refers to: (EU) No 1303/2014 (amended by (EU) 2016/912 and (EU) 2019/776) "TSI PRM" refers to: (EU) No 1300/2014 (amended by (EU) 2019/772)			
Ref.:	**Parameter:**	**Detailed Parameter:**	**TSI & EU Requirements:**	**Mandatory Standards:**	**Voluntary Requirements:**	**National Rules:**
1	General Parameters					
1.1	general parameters	Summary of General Arrangement and Type and Purpose of Project (e.g. Location/ Line/ chainage/ section of track/ Project boundary/ max. speed/ general layout/ etc.)	TSI ENE 2 + 4.2.1			
1.2	general parameters	Definition of Scope relating New Build/ Upgrade / Renewal (general description and description in the context of any applicable TSI)	TSI ENE 2			
1.3	general parameters	Declaration of intended design life for each aspect of the project				
1.4	general parameters	Data sheet containing Infrastructure Register information according to applicable TSIs and to (EU) 2019/777	TSI ENE 4.2.3+4.2.4.1+4.2.5+4.2.6+4.2.9.1 +4.2.9.2+4.2.13+4.2.14+4.2.15+4. 2.16.1+4.2.16.2 TSI OPE 4.8.1 + Appendix D Regulation (EU) 2019/777			
1.5	general parameters	absence and/or control of hazardous materials during installation, operation, maintenance, de-commissioning. At min. declaration on absence of Asbestos, PCB, radioactive material, etc.	1907/2006 REACH			
2	Additional requirements relevant					
2.1	environmental factors	environmental factors and related protection for all parameters (including drainage and ventilation)			safety requirements to be established based on: CSM 402/2013 EN 50126-1:2017 EN 50126-2:2017 EN 50128:2011 EN 50129:2018 EN 50159:2010	
2.2	access control	appropriate tamper protection for all parameters (including mechanical enclosure, locking arrangement, access management, intrusion detection, CCTV, etc.)			safety requirements to be established based on: CSM 402/2013 EN 50126-1:2017 EN 50126-2:2017 EN 50128:2011 EN 50129:2018 EN 50159:2010	
2.3	electrical protection coordination	electrical safety (protection against unsafe touch potentials, isolation co-ordination, repercussions into safety critical equipment, etc.)	TSI ENE 4.2.18 TSI ENE 6.2.4.6 TSI ENE Appendix D 2014/35/EU low voltage directive	EN 50122-1:2011+A1:2011 5.2.1 (only for public areas) + 5.3.1 + 5.3.2 + 6.1 + 6.2 + 9.2.2.1 +9.2.2.2 + 9.3.2.1 + 9.3.2.2	EN 50122 EN 60529	
2.4	earthing	bonding, earthing concept (incl. lightning protection and earthing of equipment near/under OHL equipment)	TSI ENE 4.2.18 TSI ENE 6.2.4.6 TSI ENE Appendix D	EN 50122-1:2011+A1:2011 5.2.1 (only for public areas) + 5.3.1 + 5.3.2 + 6.1 + 6.2 + 9.2.2.1 +9.2.2.2 + 9.3.2.1 + 9.3.2.2	EN 50119 EN 50153 UIC 533	
2.5	EMC	Electromagnetic Compatibility (emissions, susceptibility, EMC plan, compatibility with operating environment, rolling stock, other signalling and telecommunication system equipment and other railways, etc.)	EMC Directive 2014/30/EU		EN 50121 series	IRS-203-B
2.6	fire and evacuation	fire performance and evacuation concept (incl. material properties, detection, suppression, safe degradation of safety critical equipment, portable fire fighting equipment, etc.)			safety requirements to be established based on: CSM 402/2013 EN 50126-1:2017 EN 50126-2:2017 EN 50128:2011 EN 50129:2018 EN 50159:2010	
2.7	Environment	Protection of the environment				
3.0	Performance parameters of Energy supply system					
3.1	General performance	maximum speed permitted for OHLE, generic types of electric trains permitted to operate, max. permitted power demand of trains at pantographs inside one section.	TSI ENE 4.2.1 TSI ENE 4.2.2			
3.2	Substations	Design: specific requirements, type of equipment, (normal) permitted normal and degraded operational conditions, positioning of associated equipment, interfacing, local and remote control, SCADA (Supervisory Control and Data Aquisition), main circuit braker rating, etc.			safety requirements to be established based on: CSM 402/2013 EN 50126-1:2017 EN 50126-2:2017 EN 50128:2011 EN 50129:2018 EN 50159:2010	

3.3	Voltage and Frequency	nominal values and permitted limits of the voltage and frequency at the terminals of a substation and at any pantograph contact point supplied from that substation	TSI ENE 4.2.3	EN50163:2004 (4)		
3.4	Mean useful voltage	calculated mean useful voltage at pantograph contact point	TSI ENE 4.2.4.2 TSI ENE 6.2.4.1 TSI ENE Appendix C	EN50388:2012		
3.5	Current	nominal values and permitted limits of the current at the terminals of a substation and at any pantograph contact point supplied from that substation				
3.6	Current	max. permitted current per single pantograph				
3.7	Current	Standstill DC current capacity per single pantograph (in combination with contact force and temperature)	TSI ENE 4.2.5 TSI ENE 5.2.1.6 TSI ENE 6.1.4.2	EN50367:2012 4.2.5+ 7.2 + Annex A.3 EN50119:2009 5.1.2		
3.8	Current	the maximum permitted train current (incl. all panthographs and all power consumed by a train) and permitted limits (e.g.max. instantaneous DI/Dt, thermal tripping)	TSI ENE 4.2.4.1			
3.9	Stray Current protection	Protection of AC railway equipment (e.g. locomotive transformers) from DC stray current)				
3.10	Stray Current protection	stray current protection to railway equipment and any other parties				
3.11	Power Factor	limits to acceptaptable power factor of trains	TSI ENE 4.2.4.2	EN50388:2012		
3.12	Tunnel Installation	Continuity of power supply in case of disturbances in tunnels (sectioning)			TSI SRT 4.2.2.1 or CSM 402	
3.13	Regenerative braking	Regenerative braking concept for AC systems (including substations and their feed, etc.)	TSI ENE 4.2.6 (1) TSI ENE 6.2.4.2	EN50388: 2012 15.7.2		
3.14	Regenerative braking	Regenerative braking concept for DC systems (including substations and their feed, power storage devices, etc.)	TSI ENE 4.2.6 (2) TSI ENE 6.2.4.2			
3.15	electrical protection coordination of substations	electrical protection coordination (incl. performance of automatic circuit brakers (immediate limits for over/under voltage, max. instantanious voltage change over time, thermal limits, immediate limits for over current, max. instantanious current change over time, lightining surge arrestors, protection of autotransformer systems, etc.)	TSI ENE 4.2.7 TSI ENE Annex 6.2.4.3	EN50388:2012 (11 + 15.6)		
3.16	Harmonics	Harmonics and dynamic effects for AC systems	TSI ENE 4.2.8 TSI ENE 6.2.4.4	EN50388:2012 10.3 + 10.4		
3.17	Harmonics	Harmonics and dynamic effects for DC systems				
3.18	Harmonics	Harmonic emissions towards the power utility		European or national standards, requirements of the power utility		
4.0	OCL					
4.1	General performance	maximum speed permitted for OHLE, generic types of electric trains permitted to operate	TSI ENE 4.2.1			
4.2	OCL height	nominal height (min. /max.), permitted tolerances (design min, absolute min., design max., absolute max.) (considering sag, creep, ice loading, uplift, etc.)	TSI ENE 4.2.9.1 TSI ENE 5.2.1.1 TSI ENE 4.2.12 TSI ENE 5.2.1.4	EN50119:2009 fig1 EN50122-1:2011 (5.2.4 + 5.2.5)		
4.3	OCL gradient	permitted variation of height	TSI ENE 4.2.9.1	EN50119:2009 fig1+ 5.10.5 EN50122-1:2011 (5.2.4 + 5.2.5)		
4.4	OCL lateral deviation	max permitted lateral deviation from track centre line (under cross wind, curves, track tolerances, pathograph movement, etc.)	TSI ENE 4.2.9.2 + Appendix D			
4.5	OCL gauge	contact line gauge, Pantograph gauge and air isolation distance element within INF gauge	TSI ENE 4.2.10 + Appendix D	TSI L&P 4.2.8.2.9.2	EN50119:2020 EN 15273 series	Note: IRS Gauging required
4.6	current collection	mean contact force	TSI ENE 4.2.11 TSI ENE 5.2.1.2	EN50367:2012 Table 6		
4.7	current collection	dynamic behaviour and quality of current collection	TSI ENE 4.2.12 TSI ENE 5.2.1.3 TSI ENE 6.1.4.1 TSI ENE 6.2.4.5	EN50119:2009 (5.10.2, Tab.4, 5.2.5.2) EN 50318:2002 EN 50317:2012 TSI L&P 6.1.3.7 + 6.2.3.20	EN50119:2020 EN50317:2012 EN50318:2018	
4.8	current collection	panthograph spacing (min. spacing between adjacent raised panth.)	TSI ENE 4.2.13 TSI ENE 5.2.1.5			
4.9	current collection	max. no of permitted panthographs per train	TSI ENE 4.2.13 TSI ENE 5.2.1.5			
4.10	contact wire	contact wire material, crossection, permitted pantograph contact strip material (AC/DC)	TSI ENE 4.2.14 TSI ENE 5.2.1.7	EN50149:2012 (4.2(excluding ref to Annex B)+4.3+4.6 to 4.8) TSI L&P 4.2.8.2.9.4.2		
4.11	feeder lines	feeder, negative feeder, primary feeders paralel to the railway, material, crossection, etc.				
4.12	line crossings	electric protection concept of line crossings (OHLE, national grid, telecoms, etc.)				
4.13	level crossings	electric protection concept of level crossings (signage, goal frames, etc.)				
4.14	switch gear for OCL	local and remote switching (incl.SCADA, etc.)				
4.15	Mechanical properties of OCL	Mast systems, cantilevers, OCL support systems (standardised solutions, specific solutions, foundations/fixing to structures, drainage, etc.)		Eurocodes		
4.16	Mechanical properties of OCL	Outriggers and Catenary systems (incl. isolators, carrying wire, suspension wires, fittings, clamps, outrigger hinges, over-head rails, feeders, jumpers, etc.)				
5.0	Return Current System					
5.1	return current conductor	return conductors, bonding, earthing, impedance bonding, material, mechanical protection, etc.		EN50122-1:2011		
6.0	Phase and System Separations					
6.1	Phase separations	Geometry and general design concept of phase separation sections	TSI ENE 4.2.15	EN 50367:2012 4 + Annex 1 EN 50119:2009 5.1.3		
6.2	Phase separations	switchgear of phase separation sections (to allow re-start of trains)	TSI ENE 4.2.15	EN 50367:2012 4 + Annex 1 EN 50119:2009 5.1.3	safety requirements to be developed, using: EN50126-1 EN50128 EN50129 EN50159	
6.3	Phase separations	local and remote control/ status detection functions	TSI ENE 4.2.15	EN 50367:2012 4 + Annex 1 EN 50119:2009 5.1.3	safety requirements to be developed, using: EN50126-1 EN50128 EN50129 EN50159	
6.4	System separations	Geometry and general design concept of system seperation sections	TSI ENE 4.2.16.1	EN 50367:2012 4 EN 50119:2009 5.1.3		
6.5	System separations	System separations for raised pantograph transition (incl. provisions against short circuiting in case of vehcile circuit breaker failure)	TSI ENE 4.2.16.2	EN50119:2009 (5.10.3)		
6.6	System separations	System separations for lowered pantograph transition (incl. raised panthograph detection, short circuit detection, power supply switch off, etc.)	TSI ENE 4.2.16.3			

6.7	System separations	switchgear of phase separation sections (to allow re-start of trains)	TSI ENE 4.2.16	EN 50367:2012 4 EN 50119:2009 5.1.3 EN 50119:2009 (5.10.3)	safety requirements to be developed, using: EN50126-1 EN50128 EN50129 EN50159	
6.8	System separations	local and remote control/ status detection functions	TSI ENE 4.2.16	EN 50367:2012 4 EN 50119:2009 5.1.3 EN 50119:2009 (5.10.3)	safety requirements to be developed, using: EN50126-1 EN50128 EN50129 EN50159	
7.0	Signage					
7.1	Signage	OCL related signage				
8.0	Auxilliary equipment					
8.1	Auxilliary equipment	general information on aux. equipment powered by OCL (e.g. turnout heating, etc.)				
9.0	Consumption metering					
9.1	On board electric metering	on-board electric energy consumption measuring equipment	TSI ENE 4.2.15 TSI ENE 4.2.16	EN 50367:2012 EN 50119:2009 TSI L&P 4.2.8.2.8	UIC 930	
9.2	Substation electric metering	substation electric energy consumption measuring equipment				
9.3	On-ground energy data collection	On-ground energy data collecting system	TSI ENE 4.2.17 TSI ENE 7.2.4	EN 50463-3:2017 4.12 EN 50463-4:2017 4.3.6+ 4.3.7 TSI L&P 4.2.8.2.8		
10.0	Data recording equipment					
10.1	Data recording	specific requirements, type of equipment (normal) permitted normal and degraded operational conditions, positioning of associated equipment, information/signals/frequency to be recorded	TSI ENE 4.2.17 TSI ENE 7.2.4 TSI OPE 4.2.3.5.1			
10.2	Data recording	interface spec.: remote control, data transmission, power supplies, control/display/read-out systems, other equipment	TSI OPE 4.2.3.5.2			
11.0	provisions for operation					
11.1	provisions for operation	operating rules/ new rules/ specific training requirements for normal operations + degraded operations + emergency operations relating to this ENE (network/route) To cover at least documentation relating to the safety critical tasks of: -train preperation, -train dispatch, -authorisation for train movement (e.g. signalman), -driving of train, -accompanying a train	TSI ENE 4.4 TSI OPE 2.1 TSI OPE 4.2.1.1 TSI OPE 4.2.1.3 TSI OPE 4.2.1.4 TSI OPE 4.2.3.6 TSI OPE 4.2.3.7 2016/797(EU) 2016/798(EU)	TSI OPE App F TSI OPE App B		
11.2	provisions for operation	training and examination requirements relating to this ENE (analysis of training needs, training content, content of examinations)	TSI OPE 2.1 TSI OPE 4.6.1 TSI OPE 4.6.2 TSI OPE 4.6.3 2016/797(EU) 2016/798(EU)	TSI OPE App F TSI OPE App G		
11.3	provisions for operation	Safety Assessment of comprehensiveness and suitability of operating rules/ specific training requirements for normal and degraded operations	TSI OPE 2.1 TSI OPE 4.6.3.2 2016/797(EU) 2016/798(EU)	2016/798(EU) CSM 402/2013		
11.4	provisions for operation	INF specific IM network access requirements (Technical/ Operational) (incl. type of trains permitted, max. nominal current, etc.)	TSI OPE 4.1 TSI OPE 4.2.2.6.2			
11.5	provisions for operation	ENE specific IM information for Drivers Rule Book - nornal, degraded, emergency situations - safety assessment to ensure completeness and accuracy of information (incl. OCL signage, type of trains permitted, max. nominal current, etc.)	TSI OPE 4.2.1.2.1			
11.6	provisions for operation	ENE specific IM information for Route Book - nornal, degraded, emergency situations - safety assessment to ensure completeness and accuracy of information	TSI OPE 4.2.1.2.2			
11.7	provisions for operation	ENE specific IM Route Book Real Time Information for drivers (incl. train current limitations, etc.)	TSI OPE 4.2.1.2.2.1 TSI OPE 4.2.1.2.2.2 TSI OPE 4.2.1.2.2.3	.		
11.8	provisions for operation	Earthing equipment and other devices for emergency use (type, capacity, track connector, handling, storage positions, etc.)				
11.9	provisions for operation	Operational quality monitoring	TSI OPE 4.2.3.4.4			
12.0	Maintenence Requirements and Mantenance Plan					
12.1	general requirements	All limits for ENE must be co-ordinated with other subsystem requirements.	TSI ENE 4.5+4.6+4.7 + 6.2.4.7	2016/798(EU) CSM 402/2013		
12.2	provisions for maintenance	Occupational Health & Safety, specific training	TSI ENE 4.7			
12.3	Safety Critical Maintenance	Concept on scope, intervalls, maintenance records, tools, training	TSI ENE 4.5 2016/797(EU) 2016/798(EU) TSI OPE			
12.4	Traceability of Safety Critical Components, Configuration Management	Component identifiers (unique ID, type, version, origin)	TSI ENE 4.5 2016/797(EU) 2016/798(EU) TSI OPE			
12.5	Traceability of SW Components	Software identifiers (unique ID, type, version, origin)	TSI ENE 4.5 2016/797(EU) 2016/798(EU) TSI OPE			
13.0	Requirements for safety in railway	This seciton should be read in conjunction with the requirements for tunnels as provided for in CRR-G-024 INF				
13.1	Electricity supply for emergency response services	The electricity supply system shall be suitable for the emergency respose services equipement in accorance with the emergency plan for the tunnel (tunnels longer than 1km)	TSI SRT 4.2.1.9			
13.2	Reliability of electrical systems	Electrical systems identified by the Infrastructure Manager as vital to the safety of passengers in the tunnel shall be kept in use as long as necessary according to the evacuation scenarios considered in the emergency plan. (tunnels longer than 1km)	TSI SRT 4.2.1.10 (a)			
13.3	Reliability of electrical systems	Autonomy and reliability: an alternative electricity supply shall be available for an appropriate period of time after failure of the main supply. The time required shall be consistent with the evacuation scenarios considered and included in the emergency plan. (tunnels longer than 1km)	TSI SRT 4.2.1.10 (b)			
13.4	Communication and lighting at switching locations	When the contact line is divided into sections that can be locally switched, a means of communication and lighting shall be provided at the switching	TSI SRT 4.2.1.11			
13.5	Sectioning of contact line	The traction power supply system in tunnels may be divided into sections. (tunnels longer than 1km)	TSI SRT 4.2.2.1 (a)			
13.6	Sectioning of contact line	It shall be possible to switch off each section of the contact line, either locally or remotely. (tunnels longer than 1km)	TSI SRT 4.2.2.1 (b)			

13.7	Earthing of contact line	Earthing devices shall be provided at tunnel access points and, if the earthing procedures allow the earthing of a single section, close to the separation points between sections. These shall be either portable devices or manually or remotely controlled fixed installations. (tunnels longer than 1km)	TSI SRT 4.2.2.2 (a)			
13.8	Earthing of contact line	Communication and lighting means necessary for earthing shall be provided. (tunnels longer than 1km)	TSI SRT 4.2.2.2 (b)			
13.9	Switching off and earthing procedure	In the case it is required to switch off the traction power supply system the infrastructure manager shall make sure that relevant sections of the contact line have been switched off, and inform the emergency response services before they enter the tunnel or a section of the tunnel.	TSI SRT 4.4.4 (a)			
13.10	Switching off and earthing procedure	It is the responsibility of the infrastructure manager to switch off the traction power supply.	TSI SRT 4.4.4 (b)			
13.11	Switching off and earthing procedure	Procedures and responsibilities for earthing of the contact line shall be defined between the Infrastructure Manager and the emergency response services, and reported in the emergency plan. Provision shall be made for switching off the section in which the incident has taken place.	TSI SRT 4.4.4 (c)			