



**Strategic Direction for the
Combined High Speed and Conventional Energy TSI**

Issue 1.0

**Approved by the
Industry Standards Coordination Committee**

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Contents

1	Purpose.....	4
2	Background.....	4
3	Guidance for developing the TSI.....	5
4	Principles for developing the TSI	7
5	GB specific issues.....	7
6	General issues	9
7	Feedback to ISCC.....	13
8	Appendices	13
Appendix A	Electrification – principal known areas where GB and standard European practice are known to differ today.....	14
Appendix B	Existing GB Specific Cases - HS-CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI	15
Appendix C	Existing GB Specific Cases - HS-CR ENE (Energy) TSI.....	18
Appendix D	Open points.....	22
Appendix E	Requirements missing from the LOC+PAS TSI and the Energy TSI..	23

1 Purpose

- 1.1 This document sets out the strategic direction for GB involvement in the development of the Combined High Speed and Conventional Energy TSI (HS-CR ENE TSI) and what GB aims to achieve with this TSI.
- 1.2 This paper documents the areas or parameters where GB requires a specific case to preserve current domestic practice, with an explanation of why convergence with Europe is impracticable or uneconomic.
- 1.3 This paper does not consider the application of the HS-CR Energy TSI to the railways of Northern Ireland. The listing of specific cases applicable to high speed lines does include recognition of those applicable to the Channel Tunnel and connections to the main line railway. It is assumed that HS1, and any future high speed lines will be compliant with the relevant parts of the main text of the new HS-CR ENE TSI.

2 Background

2.1 Responsibilities

- 2.1.1 This strategic direction has been developed by Energy Standards Committee TSI Working Group and is intended for use by ISCC, the Energy Standards Committee TSI Working Group, and the mirror groups for interfacing TSIs as a point of reference.

2.2 ERA mandate

- 2.2.1 ERA mandate (COMMISSION DECISION C(2010)2576 of 29.04.2010 “concerning a mandate to the European Railway Agency to develop and review Technical Specifications for Interoperability with a view to extending their scope to the whole rail system in the European Union”) sets out the scope of the changes to the TSI. This strategic direction therefore covers the following technical areas:
 - a) The HS and CR TSIs will be merged technically into a single TSI on Energy.
 - b) The electrification system, including overhead lines and the trackside of the electricity consumption measuring system. (COMMISSION DIRECTIVE 2011/18/EU).
- 2.2.2 If required for the extension of scope, a revision of this strategy may need to consider new supply voltages, overhead line geometries and current collection systems (3rd rail). Also HS lines not included in the current TEN rail system will be considered, depending upon the conclusions of a complementary study.

2.3 Key stages in the development of the TSI

- 2.3.1 The key stages in the process for development of a TSI are:
 - a) Drafting and development of the TSI by the ERA.

- b) Recommendation of the draft TSI by the Railway Interoperability and Safety Committee (RISC).
 - c) Adoption of the TSI in a decision by the European Commission (EC).
 - d) Notification of the EC decision to Member States (by formal letter).
 - e) Publication of the TSI in the Official Journal (OJ).
 - f) The TSI 'becoming applicable' (i.e. coming into force).
- 2.3.2 UK are represented at the ERA working group by Network Rail (NR) for the European Rail Infrastructure Managers (EIM), RSSB for the Community of European Railways (CER) and the ORR for the National Safety Authority (NSA).

2.4 Period of validity of the strategic direction

- 2.4.1 The strategic direction is valid until December 2012 or until the time that the CR-HS ENE TSI is voted on by RISC.

3 Guidance for developing the TSI

3.1 Documents

- 3.1.1 The following documents are available on the [RSSB website](#) and should be used by Energy Standards Committee TSI Working Group in developing the TSI:
- a) A '[Guide for persons involved in the development of TSIs](#)' which has been developed by the Industry Standards Coordination Committee (ISCC) to provide guidance to individuals from the GB railway community who are involved, in some way, in the development of TSIs. The guide is supported by a '[checklist of factors](#)' which should be borne in mind when a TSI is being drafted, either for the first time or as a revision.
 - b) A '[technical check list for TSIs](#)' which covers structural sub-systems (Infrastructure, Energy, Rolling Stock, Control-Command and Signalling) is intended to ensure, as far as possible, that the technical review of TSIs and specific cases is thorough.

3.2 Scope extension of TSIs

- 3.2.1 Article 1(4) of the Interoperability Directive, 2008/57/EC, requires that *'The scope of the TSIs shall be progressively extended in accordance with Article 8 to the whole rail system, including track access to terminals and main port facilities serving or potentially serving more than one user, without prejudice to the derogations to the application of TSIs as listed in Article 9'*.
- 3.2.2 The way in which TSIs are written must depend on the way the term *'the whole railway system'* is interpreted. If the interpretation is too wide, the TSI becomes impossible to write as it would need to cover a very wide diversity of odd systems.

- 3.2.3 The TSI should therefore be drafted on the assumption that the Member State has adopted the exclusions set out in Article 1(3) of the Directive which states that:
- ‘3. Member States may exclude from the measures they adopt in implementation of this Directive:*
- a) *metros, trams and other light rail systems;*
 - b) *networks that are functionally separate from the rest of the railway system and intended only for the operation of local, urban or suburban passenger services, as well as railway undertakings operating solely on these networks;*
 - c) *privately owned railway infrastructure and vehicles exclusively used on such infrastructure that exist solely for use by the owner for its own freight operations;*
 - d) *infrastructure and vehicles reserved for a strictly local, historical or touristic use.’*

3.3 General consideration of references to ENs in TSIs

- 3.3.1 Article 5(8) of Directive 2008/57/EC states:
- ‘TSIs may make an explicit, clearly identified reference to European or international standards or specifications or technical documents published by the Agency where this is strictly necessary in order to achieve the objective of this Directive. In such case, these standards or specifications (or the relevant parts) or technical documents shall be regarded as annexes to the TSI concerned and shall become mandatory from the moment the TSI is applicable. In the absence of such standards or specifications or technical documents and pending their development, reference may be made to other clearly identified normative documents; in such case, this shall concern documents that are easily accessible and in the public domain.’*
- 3.3.2 Making an explicit reference to ENs is therefore only permitted ‘where this is strictly necessary in order to achieve the objective of this Directive’. Article 5(8) should be read as a prohibition on including explicit references to ENs in TSIs, with a permitted exception under the specified circumstances. It should not be read as a general permission to include references to ENs under the specified circumstances.
- 3.3.3 Generally, ENs should only be referenced as ways of defining something (such as gauges). They should not be references as a way of imposing a requirement, as any necessary requirements should be set out in the TSI itself.
- 3.3.4 As an example, a reference to an EN was necessary in the CR INF TSI: the capability requirements for structures are defined by a parameter called (misleadingly) ‘Line Category’. EN 15528:2008 is referenced simply to define what a Line Category is, and the method of deriving it (a matter too detailed to be specified in the TSI). However, EN 15528:2008 was not referenced as a way of specifying the TSI requirement – it simply permits that requirement to be expressed unambiguously.

3.4 National rules

- 3.4.1 The TSI should be drafted to eliminate references to the use of national rules as a way of meeting an essential requirement (other than as a specific case in chapter 7). Such references are common in TSIs drafted under AEIF but are not usually present in TSIs drafted under ERA.
- 3.4.2 If the TSI intends to cover a point, but here is no agreed requirement, this should be identified as an open point.
- 3.4.3 If the TSI has nothing to say about a point, it should remain silent. It does not need to say that the issue is dealt with by application of national rules.

4 Principles for developing the TSI

- 4.1 The overall aims for GB in developing the TSI shall be to:
 - a) Achieve a specification that allows GB to build an economic and cost effective Energy subsystem.
 - b) Produce a specification that delivers the essential requirements but is not too prescriptive.
 - c) Produce a specification that does not inhibit innovation.
 - d) Produce a specification that is aligned with the RST and INF TSIs.
 - e) Produce a specification that has a well structured relationship with the wider field of European standards and specifications.
 - f) Produce a standard that is fit for purpose within GB requirements and structure gauge.
 - g) Ensure that there is no reduction in existing overall levels of safety.
 - h) Enable the achievement of a cost effective transition to conformity with TSI target subsystems, to the extent that GB intends to do so.
- 4.2 Each of these principles is to be applied to the GB specific technical issues as the TSI is developed.

5 GB specific issues

5.1 Background

- 5.1.1 The GB railway is constrained by its small loading gauge, together with other embedded traditions that are inherently difficult and expensive to alter. There should be a working presumption that current GB domestic practice should be preserved (by means of a permanent specific case if necessary, but preferably by preserving choice within the main body of the TSI) unless a conscious decision is made by industry through its stakeholder groups, or by the DfT, to adopt standard European practice – having understood the economic consequences of such a decision.

5.2 List of different GB practices

5.2.1 **Appendix A** lists the principal known areas where GB and standard European practice differ. It indicates the known reasons for retaining a GB specific case (or for adopting standard European practice).

5.3 Permanent specific case

5.3.1 **Appendix B** lists the GB special cases that will be needed in the HS-CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI to reflect those needed to build an electrified railway within the constraints of the “spatial envelope” of the existing GB railways. The appendix quotes the text of the current GB specific cases, acknowledging that these will need to be revised to reflect the text of the revised TSI.

5.3.2 **Appendix C** lists the GB special cases that will be needed in the HS-CR Energy TSI to reflect those needed to build an electrified railway within the constraints of the “spatial envelope” of the existing GB railways. The appendix quotes the text of the current GB specific cases, acknowledging that these will need to be revised to reflect the text of the combined CR-HS ENE TSI.

5.3.3 The ERA will require that an economic justification is provided for each specific case. The Energy Standards Committee TSI Working Group will develop the necessary justifications for each specific case. The Member State representative at the V/TE SIC indicated that the Member State would support the necessary specific cases and would ensure that they were included in the final text of the combined TSIs.

5.4 Temporary specific cases

5.4.1 All the specific cases set out in Appendix B and Appendix C are long term and listed as “P Cases”, although migration towards the TSI standard may be possible where this is economic or required for interoperability.

5.5 Changes to GB practices

5.5.1 Some existing GB electrification could be changed to conform to standard European practice. However, these changes could not be effected immediately, and a thorough analysis of the costs of the transition and the actual benefits in doing so will be needed. Consideration must be given to the necessary transitional arrangements if this is to be done

5.5.2 European practice is generally defined by the suite of Euronorms, which are referenced by the TSIs. Existing GB practice often differs from these standards. Where TSIs are not being implemented, Railway Group Standards will reference these Euronorms so that, in future, the GB minimises the use of specific local practice.

- 5.5.3 As an example, the V/TE SIC has considered the issue of using euro-pantograph on the existing electrified GB network and concluded that the costs would significantly outweigh the benefits. The current policy of the UK government is to move towards European standardisation only on major new construction.
- 5.5.4 This recognises that the UK experts are agreed that the euro-pantograph is incompatible with existing GB infrastructure by virtue of the insulated horns that it is defined to incorporate. Reduction of contact wire deviation, and dealing with the issues that arise at crossovers, and with “out of running” wiring would add significant costs of electrification.
- 5.5.5 It is worth noting that the euro-pantograph is no more than a gauge profile or shape that is defined as having 200 mm of horn insulation. There is no definition of head dynamics or mass or along-track head width, although many production designs do have independent suspension of the carbon strip, which does reduce head mass. Work on the working group for EN 50367 reveals that the euro-pantograph is actually far from a standard design as some suppliers offer an articulated collector head of low weight, but standards limiting the nominal shape are still being drafted.
- 5.5.6 Single strip pantographs and extra wide pantographs are also incompatible with existing OLE.
- 5.5.7 In part this is an internal GB policy issue, to be resolved in the member state implementation plans for the CR-HS ENE TSI.

6 General issues

6.1 Introduction

- 6.1.1 In addition to the specific technical issues, there are a number of general issues that need to be considered in shaping the TSI to produce a good quality document.

6.2 Changes required for extension in scope

- 6.2.1 The UK delegations will seek to ensure that there is a clear scope for the drafting activity, and the technical and geographical scope for the revision of the HS-CR ENE TSI. The TSI should be appropriate for what is commonly understood as the 'mainline' railway (in GB, Network Rail managed infrastructure and HS1), albeit with appropriate differentiation in the value of parameters by line category, speed or other relevant criteria. The current assumption is that member states will exercise their right to exclude the categories defined in Article 1(3) of the Interoperability Directive.
- 6.2.2 The idea of having separate specifications for different categories of electrification should be pursued. The line categories in different TSIs reflect the requirements of those sub-systems, and Energy should be no different.
- 6.2.3 For CR-HS ENE TSI the line categories that make sense for GB implementation are:

- a) New (electrified) Lines – for speeds well in excess of 125 mph (200 km/h).
- b) New (electrified) lines – for speeds up to 125 mph (200 km/h).
- c) New electrification of existing lines – (Major upgrades) – speeds of 125/140 mph (200/225 km/h).
- d) New electrification of existing lines – (Major upgrades) – speeds less than 125 mph (200 km/h).
- e) New electrification of existing lines – (Minor upgrades) – speeds of less than 125 mph (200 km/h).
- f) Existing electrification – renewal/maintenance work.

6.3 Technical corrections

- 6.3.1 The current Energy TSIs contain clauses that relate to requirements that cannot be verified at the time of placing into service, or relate to ongoing operation. The UK will seek to have such clauses removed from the TSI.
- 6.3.2 The opportunity shall be taken when drafting the TSI to avoid any clause that does not relate to the 'basic objectives' of the TSI. The basic objectives are:
 - a) Trains from one country shall be able to circulate on TSI-compliant energy subsystems of other countries (where compatible) without further assessment.
 - b) Permit standardisation of equipment thus reducing the range the products that manufacturers need to produce, reducing costs to the industry.

6.4 Closing out open points

- 6.4.1 Where the current TSI contains open points, errors or omissions, the ERA plan to develop proposals to resolve the points.
- 6.4.2 **Appendix D** lists the open points from the CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI and the HS Energy TSI that relate to the electrification interface. The CR ENE TSI lists no open points.

6.5 Additional open points

- 6.5.1 **Appendix E** lists the requirements missing from the CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI and the HS Energy TSI that relate to the electrification interface.

6.6 TSI issues log

- 6.6.1 There are no items listed in the TSI Issues Log related to the Energy TSI.

6.7 Changes to minimise references to ENs

- 6.7.1 A clear understanding is needed as to how Euronorms (ENs) are to be used. References are to be minimised and not used as part of the specification of requirements as the TSI should contain all the specifications necessary. Exceptionally, ENs can be used in definitions, but the normal use of an ENs will be the detailed standard that enables compliance with the TSI, and becomes “harmonised”. (Article 5(8) of Directive 2008/57/EC covers this point.)
- 6.7.2 In many cases the ‘subsystem characteristics’ included within the TSI are referenced externally to European Standards, many of which are specifically commissioned to support the TSI itself. Many of these externally commissioned standards are poorly structured, and their adoption for use with ‘Interoperability’ sometime inhibits their more general use elsewhere. GB feels that a more effective approach would be the use of TSI specific EN specifications, rather than EN standards. In this case, the overarching standards could be retained, or at least modified in a way that retains its more general applicability, and the specification could sit ‘underneath’ the standard and refer only to the specificities of TSI requirements.
- 6.7.3 For clarity, a standard will deal with matters such as types, forms and characteristics of systems and equipment, naming of parts, optional forms of construction or use, and general characteristics, and details of test for compliance.
- 6.7.4 A specification would use the general requirements in the standard, but apply values, quantities, dimensions and capacities to the definitions in the standard, specify options and exclude others, etc.
- 6.7.5 In this way the more widespread general usefulness of the standard is not compromised by the specific requirements of ‘Interoperability’.
- 6.7.6 An example in the Energy field is that EN50367 would preferably be a specification, where the main concepts, generically, are in EN50119, and EN50367 only gives the dimensions and values applicable for ‘Interoperability’.

6.8 Changes to eliminate the use of national rules

- 6.8.1 The UK delegation will seek to ensure that appropriate rewording of the TSI removes the few remaining references to national rules.

6.9 A TSI that is aligned with the RST and INF TSIs

- 6.9.1 The ENE TSI must be consistent with the various other TSIs in particular those for rolling stock and infrastructure. Equally, the requirements of other, matching TSIs should be compatible with the ENE TSI. For instance, the INF TSI should make provision for the implementation of the ENE TSI. The TSIs must be capable of progressive implementation, and for existing lines, should not be written assuming that all TSIs will be implemented at the same time.

- 6.9.2 It should be noted that to ensure compatibility of new electrification with existing rolling stock, that some detailed design “choices” will be necessary, whilst meeting the TSI specifications – (for example vehicle sway). One of the roles of Notified Technical Rules (NTRs) as currently understood is to define what is needed for technical compatibility on a network-specific level.
- 6.9.3 The UK delegations will seek to ensure that the ERA manages the interfaces with the other subsystems. The interface between ENE and LOC&PAS TSIs is particularly critical here. UK representatives will seek to ensure that there is agreement within CER and EIM about these interfaces.

6.10 A CR-HS ENE TSI that achieves a cost effective transition from current GB domestic practice to standard European practice

- 6.10.1 The CR-HS TSI should have an ability to acknowledge the state of the implementation of matching TSIs when being applied. This may link to the categories of line referenced above, or may stand alone. For the GB position, the implications of the application of the CR-HS ENE TSI, and the extent of the characteristics employed, is governed by:
- a) Line speed.
 - b) Whether rolling stock is captive to that line or not.
 - c) Whether rolling stock to be employed is new (and TSI compliant) or cascaded.
 - d) Whether the electrified line is connected to any other existing line.
 - e) Whether inter-running over the existing network will occur.
 - f) Compatibility of infrastructure and overhead line geometry.
- 6.10.2 In deciding how the TSIs are to be applied, and in relation to the clauses that will be needed for the “implementation plan” sections of the TSI, a better understanding is needed of the Member State’s requirements for gauge (for instance is GB+ to be a target?), pantograph spacing and numbers of pantographs to be allowed for in design.
- 6.10.3 Industry is expecting that the Member State will clarify future application of the TSI, and sees the preparation of a map (detailed to track level) as a possible way forward.

6.11 A TSI that does not inhibit innovation

- 6.11.1 Clarity of the purpose of the TSI is required; detailed prescriptive requirements are only one way to fulfil the essential requirements. The TSI process allows for the adoption of “novel solutions” but if it means changing the TSI to incorporate those novel solutions, this is neither easy or quick.

- 6.11.2 Because the GB railway is constrained by its small loading gauge, together with other embedded practices and features that are inherently difficult and expensive to alter, it may be necessary to adopt “novel solutions” in order to allow the economic benefits of electrification to be applied to the GB railway. The GB Technical Strategy Leadership Group (TSLG) is researching possible novel approaches for the future. These solutions may need to be developed as specific cases.

7 Feedback to ISCC

- 7.1 Regular reports will be made to ISCC at specific milestones within the project to produce the CR-HS ENE TSI, including when:
- a) The preliminary draft of the TSI is available.
 - b) The GB Specific Cases are developed.
 - c) Presentations by the ERA are due to be made to RISC.
 - d) The final draft is submitted to RISC for vote.
- 7.2 Where it appears that the development of the TSI is at risk of deviating significantly from the direction set out in this document, a report shall be provided to ISCC on the issues with recommendations on any further action that needs to be taken.

8 Appendices

- 8.1 The appendices below provide detail of the following items:
- a) Electrification - principal known areas where GB and standard European practice are known to differ today.
 - b) GB Specific Cases - HS-CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI.
 - c) GB Specific Cases - HS-CR ENE (Energy) TSI.
 - d) Open points.
 - e) Requirements missing from the TSIs.

Appendix A Electrification – principal known areas where GB and standard European practice are known to differ today.

- A.1 This is a preliminary list of areas where GB and standard European practice are known to differ. The Energy Standards Committee TSI working Group should further develop the list. If the scope of the TSI increases, then there may be further differences of GB practice.
- A.1.2 British loading gauge and “spatial envelope”
 - a) Wire height - the railway infrastructure within Great Britain was historically built to a smaller gauge than the other railways of Europe. It is uneconomic or impracticable to increase the gauge, other than on newly constructed lines.
 - b) Gauge method and Pantograph Kinematic gauge – GB approach to gauge is “absolute” rather than using a “reference” profile.
 - c) Incompatibility of existing systems with the insulated horns specified on the “Euro-pantograph”.
- A.1.3 British engineering practice
 - a) 600/750 V DC Electrified Railway using ground level conductor rails.

Appendix B Existing GB Specific Cases - HS-CR LOC+PAS (Locomotives and Passenger Rolling Stock) TSI

B.1 GB currently has Specific Cases for the following topics, and these are proposed for retention, but subject to modification to reflect the wording of the revised TSI:

B.1.2 Working range in height of pantograph

(“P Case”) Retain because of constricted “spatial envelope”.

All rolling stock required to operate on the GB AC 25kV 50Hz sub-system that has not been upgraded in accordance with the HS-CR ENE TSI, the following requirement shall apply:

Pantographs shall have a working range of 2100 mm. When mounted on an Electric unit, the pantograph shall operate between 4140 mm (the lower operating position, ref. EN50206-1, 3.2.13) and 6240 mm (the upper operating position, ref. EN50206-1, 3.2.13) above rail level.

In exceptional topographical circumstances where electrical clearances are limited by physical restrictions, and a reduced maximum rolling-stock (static) height of 3775 mm applies, pantographs on these vehicles shall have a working range of 2315 mm. When mounted on an Electric unit, the pantograph shall operate between 3925 mm (the lower operating position, ref. EN50206-1, 3.2.13) and 6240 mm (the upper operating position, ref. EN50206-1, 3.2.13) above rail level.

B.1.3 Pantograph head geometry

(“P Case”) But aim to withdraw over an extended period of time.

For rolling stock required to operate on the GB AC 25kV 50Hz sub-system that has not been upgraded in accordance with the HS-CR ENE TSI, the following requirement shall apply:

In order to maintain compatibility with the existing infrastructure the profile of the pantograph head shall be as depicted in EN 50367:2006, Annex B.7.

In order to maintain compatibility with requirements for running through phase or system separation sections, pantograph heads shall have a maximum along track width of 250 mm (400 mm HS), [and a minimum of 200 mm] unless permitted by arrangements set out in the Infrastructure Register.

For lines in Categories II and III, pantograph heads shall not have insulated horns, unless permitted for specific routes by an entry in the infrastructure register.

B.1.4 Pantograph contact force and dynamic behaviour

(“P Case”) Retain because of constricted “spatial envelope”.

Rolling stock and pantographs fitted on rolling stock shall be designed and tested to exert a mean contact force F_m on the contact wire in a range as specified in clause [...] of the CR Energy TSI, in

order to ensure current collection quality without undue arcing and to limit wear and hazards to contact strips. Adjustment of the contact force is made when dynamic tests are performed.

The conformity assessment principles of the current quality collection are described in clause [...] of the CR Energy TSI.

For the purposes of clauses [...] and [...], on trains intended to be certified for use in Great Britain and elsewhere, the tests shall additionally be conducted at a wire height between 4700 mm and 4900 mm.

For the purposes of clauses [...] and [...], on trains intended to be certified only for use in Great Britain, it is permissible to verify compliance only within the range of 4700 mm to 4900 mm contact wire height.

B.1.5 Pantograph gauge

(“P Case”) Retain because of constricted “spatial envelope”.

In Great Britain, for upgrade or renewal of the existing energy subsystem, or the construction of new energy subsystems on existing infrastructure, the mechanical kinematic pantograph gauge is defined in the diagram below.

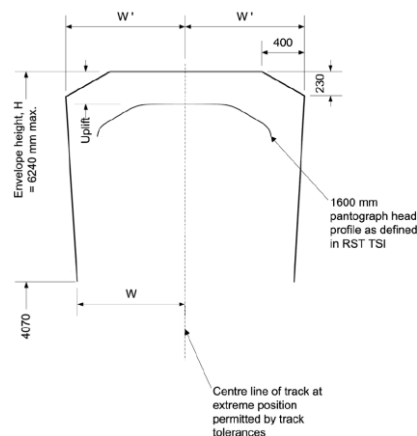


Figure — pantograph gauge

The diagram shows the extreme envelope within which movements of the pantograph head shall remain. The envelope shall be placed on the extreme position of track centre-lines permitted by track tolerances, which are not included. The envelope is an absolute gauge, not a Reference Profile subject to adjustments.

At all speeds up to line speed; maximum cant; maximum wind speed at which unrestricted operation is possible, and extreme wind speed, defined in the register of infrastructure:

$$W = 990 \text{ mm,} \quad \text{when } H \leq 4300 \text{ mm; and}$$

$$W' = 990 + (0.040 \times (H - 4300)) \text{ mm,} \quad \text{when } H > 4300 \text{ mm.}$$

Where:

H = Height to top of envelope above rail level (in mm). The dimension is the sum of the contact wire height and the provision for uplift.

[Note that this is the gauge in the ENE TSI, but with variable J fixed at 190 mm.]

[The research currently being undertaken on “Pantograph Sway” under RSSB research project T942 will inform possible new dimensions for this gauge. It may be possible to reference our national rules which mean that the specific case would not change if the national rule were to be amended.]

B.1.6 600/750 V DC Electrified Railway using ground level conductor rails

P Case – System Unique to the GB.

It is permissible to continue to procure rolling stock to operate on, and be compatible with, lines equipped with the electrification system operating at 600/750 V DC and utilising ground level conductor rails in a three and/or four rail configuration. Notified National Technical Rules shall apply.

[Consider the wording of this specific case to re word ‘permission to procure’ and references to ‘Notified National Technical Rules’.

Appendix C Existing GB Specific Cases - HS-CR ENE (Energy) TSI

- C.1 GB currently has Specific Cases for the following topics, and these are proposed for retention, but subject to modification to reflect the wording of the revised TSI.

The railway infrastructure within Great Britain was historically built to a smaller gauge than the other railways of Europe. It is uneconomic or impracticable to increase the gauge, and therefore the target gauge for Great Britain will be the UK1 issue 2 (see High Speed Infrastructure TSI). GB requires Specific Cases for the following topics:

[Note check references to gauge with the V/S SIC and HS-CR INF TSI requirements.]

- C.1.1 Contact wire height

("P Case") Retain because of constricted "spatial envelope".

In Great Britain, for upgrade or renewal of the existing energy subsystem, or the construction of new energy subsystems on existing infrastructure, the nominal contact wire height adopted shall not be less than 4700 mm.

(HS) Variable contact wire height and gradient will be retained on electrified lines in Categories II and III. The nominal wire height adopted in future on upgraded lines in the Great Britain will not be less than 4 700 mm. However where constraints require it, the minimum permissible wire height is 4 140 mm, sufficient to allow the passage of electric trains built to UK1B gauge.

(HS) The contact wire height on the Continental Main Line, (the interface between Network Rail, the Channel Tunnel Rail Link, and Eurotunnel) the contact wire height varies between 5 935 mm and 5 870 mm.

[Note check references to gauge with the V/S SIC and HS-CR INF TSI requirements]

- C.1.2 Lateral deviation

("P Case") Retain because of constricted "spatial envelope".

In Great Britain, for new, upgraded or renewed energy subsystems the permissible lateral deviation of the contact wire in relation to the design track centre line under the action of cross - winds shall be 475 mm (unless a lower value is declared in the register of infrastructure) at a wire height of less than or equal to 4700 mm including allowances for construction, temperature effects and mast deflection. For wire heights above 4700 mm, this value shall decrease by $0.040 \times (\text{wire height (mm)} - 4700)$ mm.

- C.1.3 Contact wire lateral deviation under the action of cross wind.

("P Case") Retain because of constricted "spatial envelope".

J = 200 mm on straight track.

J = 230 mm on curved track.

J = 190 mm (minimum) where constrained by clearance to civil infrastructure that cannot be economically increased.

Additional allowances shall be made including wear of contact wire, mechanical clearance, static or dynamic electrical clearance.

[The research currently being undertaken on “Pantograph Sway” under RSSB research project T942 will inform possible new dimensions for this gauge. It may be possible to reference our national rules which mean that the specific case would not change if the national rule were to be amended.]

C.1.6 Phase Separation Sections

(“P Case”) Retain because of constricted “spatial envelope”.

The overhead line equipment shall be designed for operation with pantograph heads with an along track width up to a maximum of 400 mm.

C.1.7 Protective provisions of overhead contact line system

(“P Case”) Retain because of constricted “spatial envelope”.

In the reference to EN50122-1:1997 clause 5.1, the special national condition to this clause (5.1.2.1) shall apply.

C.1.8 Voltage and frequency

(“P Case”) Retain if required to avoid open requirement.

For the purposes of this TSI and references to EN 50163:20xx and EN 50388:20xx, abnormal operating conditions includes the unavailability of two or more incoming electricity supplies in any combination.

[Consider the issues relating to voltage limits and fault currents and compatibility with existing stock. These are areas where current GB practice is different to Europe, but where we should harmonise.]

C.1.9 Maximum train current

(“P Case”) Retain if required to avoid open requirement.

The maximum train current in Great Britain for electrified lines in Categories II and III, shall be 300 A, unless a higher value is defined within the Register of Infrastructure for a particular route.

C.1.10 600/750 V DC Electrified Railway using ground level conductor rails

P case – System Unique to the GB.

Lines equipped with the electrification system operating at 600/750 V DC and utilising ground level top-contact conductor rails in a three and/or four rail configuration shall continue to be upgraded, renewed and extended where this is economically justified. National Standards shall apply.

C.1.11 Particular features on the Eurotunnel network

(P Case) – System Unique to the GB.

The contact wire height on Eurotunnel infrastructure in the Channel Tunnel varies between 6 020 mm and 5 920 mm.

C.1.12 Novel Solutions

(P Case) – System Unique to the GB.

[An additional specific case may be required if GB requires this option for some TSI lines, but noting that research work has only identified a value in the installation of an occasional neutral section where clearances are constrained]]

Where constrained by existing infrastructure, the GB may adopt discontinuous electrification or other novel solutions, in order to allow the economic benefits of electrification to be applied to the GB railway.

Appendix D Open points

D.1 Open points in the CR LOC+PAS TSI that affect the ENE sub-system

- D.1.1 Pantograph lowering - Mandatory presence of an automatic dropping device (ADD)

ADD accepted on the CR TEN; not mandatory everywhere (national rule). Described in the technical documentation; to be considered for operation and maintenance

- D.1.2 Pantograph –Contact strip material - other material to be used on AC and/or DC lines

If other material used [for contact strips], verification by application of national rules.

D.2 Open points in the HS ENE TSI

- D.2.1 Mean contact force

Values for Fm, C1 and C2 curves for speeds above 320 km/h.

- D.2.2 Current at Standstill (DC Systems) (Not relevant to GB)

Permissible temperatures are an open point; this is expected to be solved by the next issue of EN50119 (under preparation by CENELEC).

- D.2.3 Effects of DC operation on AC systems

The maximum DC current for AC systems to withstand; this study is undertaken by CENELEC in the general frame of the mutual influence between AC systems and DC systems, when lines are parallel. (Not considered to be necessary when discussing the CR TSI.)

Appendix E Requirements missing from the LOC+PAS TSI and the Energy TSI

- E.1 The following points are considered by the GB representatives to be missing controls in the current TSIs.
- E.1.1 Effect of Wind
- There is no consideration in the gauging method for the pantograph, of the effect of wind on the vehicle.
- E.1.2 Along track width of the pantograph
- The along track width of the pantograph is a dimension that is not specified, but for the GB is critical to the correct operation of the GB designs of Neutral Sections, and section insulators.
- E.1.3 Force Curves
- The CR and HS TSIs apply force curves and permitted tolerances in different ways. A single method is needed for the combined TSI.
- E.1.4 Unique features of “third rail” systems
- If the scope of the TSI is extended to include lower voltage “third rail” systems, then some unique features need to be considered.
- a) DC railways operate in the “fault range” where normal traction current level is similar to fault current.
 - b) Trains are often fitted with inter-car bus-lines that convey traction current from car to car.
- E.1.5 “Tethered Test”
- A revision of EN 50317 has now been drafted to include a “Tethered Test”. This can now be referenced as a method of demonstrating compliance in the TSI.
- E.1.6 System fault level
- The compatibility of all vehicles used on electrified railways to the system fault levels permitted by the ENE TSI needs to be considered.
- EN50388 specifies the maximum fault current at as 15 kA. The maximum fault level is noted to ensure that the fault clearance capability of the train circuit breaker is not exceeded. This now helps to clarify that although nominal levels may vary, but the maximum will not be exceeded
- In addition to breaking capacity, the other essential compatibility characteristics are:
- a) making capacity of the breaker when closed onto a fault,
 - b) the max DC component that the breaker can withstand,
 - c) the opening time from detection of fault (coordination between the sub. breaker/control and train breaker/control).
- Both the peak make current and DC component of current at contact separation (both of which can damage the circuit breaker) are related

to the X/R ratio of the in-feed and the total opening time of the breaker. Note that train-borne earthing switches could be subjected to substantial making currents and must likewise be compatible.)

E.1.7 Other electrical parameters

A number of other electrical parameters that are required by rolling stock engineers in order to design vehicles are not covered in the TSI. These include

- a) overhead line impedance;
- b) X/R ratio

Should TSI (or EN50388) specify a maximum X/R ratio of 9.95 at in-feed points (to align it with EN60077 (and IEC) 60077-4: Railway applications. 'Electric equipment for rolling stock. Electrotechnical components. Rules for AC circuit-breakers', clause 5.3.5 which specifies a power factor of 0.1 for short circuits which equates to an X/R ratio of 9.95).

E.1.8 Harmonic compatibility.

Some work is being done in revising clause 10 of EN50388, but this is an interface poorly defined, and which is known to cause an issue.