RAIL SAFETY AND STANDARDS BOARD

DRAFT

Rail Industry Guidance Note
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Operation of Urban Rail Vehicles on or adjacent to GB Mainline Infrastructure

This document gives guidance for the introduction and operation of trams, light rail and metro vehicles on or adjacent to the GB mainline railway. This guidance is intended to assist infrastructure managers and railway undertakings in understanding their responsibilities. It does not constitute a recommended method of meeting any set of mandatory requirements.

Published by **Rail Safety and Standards Board**

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Issue: Two **Draft:** 3
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Synopsis

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Issue record

Issue	Date	Comments
One	February 1999	Original document.
Two	December 2025 [proposed]	Replaces issue one. The document has been redrafted throughout to reflect the current legislative environment.

Revisions have not been marked by a vertical black line in this issue because the document has been revised throughout.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GEGN8502 issue one Operation of Trams and Light Rail or Metro Vehicles over Railtrack Controlled Infrastructure	All	December 2025 [proposed]

Supply

The authoritative version of this document is available at www.rssb.co.uk/standards-catalogue. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/

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Part 1 Purpose and introduction

G1.1 Purpose

G1.1.1 This document gives guidance on the introduction and operation of urban rail vehicles on the GB mainline rail network. Urban vehicles include rail vehicles such as trams, tram-trains, light rail vehicles including very light rail vehicles and metro vehicles.

G1.1.2 This document does not set out requirements.

G1.2 Background

G1.2.1 The operation of urban rail vehicles on the GB mainline network provides opportunities for the cost effective expansion of rail services, for example by:

a) The extension of existing urban rail services beyond their dedicated network;
b) The linking of heavy rail stations with services to locations on an urban rail network;
c) The reinstatement of unused lines on the GB mainline network using urban rail vehicles at lower cost than would be the case if heavy rail vehicles (HVs) were employed.

G1.2.2 In such scenarios of limited operation of urban rail vehicles on the GB mainline network, the full application of all requirements that apply to HVs, in order for them to be authorised for operation on the GB mainline network, would likely be disproportionate and negate the benefits being sought via the use of urban rail vehicles.

G1.2.3 This guidance note is intended to support the user to effectively and proportionately introduce and operate urban rail vehicles on the GB mainline network.

G1.2.4 This document draws on the output of RSSB research project T1049 (2015), but the findings of T1049 have been updated to reflect the different legislative environment following the United Kingdom's (UK) departure from the European Union (EU).

G1.2.5 RSSB research project T1049 (2015) also considered the operation of other non-mainline vehicles, primarily heritage rail vehicles, on the GB mainline railway. Other non-mainline rail vehicles, besides urban rail, are not explicitly covered by this guidance note, though the content can be applied. Specific requirements and guidance on the operation of heritage rail vehicles on the GB mainline railway are set out in RIS-2003-RST, RIS-3440-TOM and RIS-4472-RST.

G1.2.6 Definitions of urban rail, light rail, metro, tram and tram-train vehicles are set out in BS EN 17343:2023 and in CEN-CENELEC Guide 26, although these definitions may not fully align with their use on existing urban rail systems or in domestic legislation.

G1.3 User's responsibilities

G1.3.1 Industry experts representing railway industry stakeholders are involved in the process for setting the content of documents that are prepared in accordance with the procedures set out in the Railway Standards Code and Manual.

G1.3.2 Users of documents published by RSSB are expected to be competent or should take specialist advice before following or applying any practices or principles contained within them and are reminded of the need to consider their own responsibilities to ensure safe systems of work and operation, health and safety at work and compliance with their own duties under health and safety legislation. While documents published by RSSB can be used to help inform and devise safe practices and systems of work, their content has not been designed or prepared for:

a) Reliance by any specific person or organisation; and
b) Application or use in all possible operational or working environments.

G1.3.3 No representation, warranty, guarantee, confirmation or other assurance is given or made (whether expressly or implicitly) that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

G1.3.4 Users and duty holders remain responsible at all times for assessing the suitability, adequacy and extent of any measures they choose to implement or adopt and RSSB does not accept, and expressly disclaims, all and any liability and responsibility except for any liability which cannot legally be limited.

G1.4 Structure of this document

G1.4.1 Guidance is provided as a series of sequentially numbered clauses.

G1.5 Approval and authorisation of this document

G1.5.1 The content of this document will be approved by Rolling Stock Standards Committee on 11 September 2025 [proposed].

G1.5.2 This document will be/was authorised by RSSB on 31 October 2025 [proposed].

Part 2 Setting the Scene

G2.1 Regulatory framework

Guidance

G 2.1.1 The regulatory framework relating to the operation of rail vehicles on mainline infrastructure is largely determined by:

a) The Railways (Interoperability) Regulations (RIR) 2011 (as amended); and
b) The Railways and Other Guided Transport Systems (ROGS) (Safety) Regulations 2006 (as amended).

G 2.1.2 Between ROGS and RIR, there is a fundamental regulatory separation between the mainline railway and non-mainline transport systems. Additionally, there is a regulatory separation between:

a) Placing in service, being the authorisation or approval of new and altered vehicles and infrastructure before they are used; and
b) Putting into use, which is using the vehicles and infrastructure in day-to-day operation under the safety management systems of railway undertakings and infrastructure managers.

Note: The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended) uses the term 'placed in service' which refers to when a vehicle or infrastructure, having been constructed, upgraded or renewed, is first operated in the provision of a transport service. It does not include trials or testing that takes place before the service starts. Therefore, 'placed in service' in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 and 'put into use' in the Railways (Interoperability) Regulations 2011 broadly have the same meaning.

G 2.1.3 RIS-8270-RST gives guidance on placing in service and putting into use as they apply to the GB mainline network. Section 2.2 and 2.3 of this document contain supplementary guidance to complement the application to urban rail vehicles operating on the GB mainline network of the concepts of placing in service and putting into use.

G 2.1.4 Placing into service and putting into use are two distinct concepts, and responsibility for them falls to two different roles. These roles, of the project entity and duty holder or transport operator, are closely linked. As the ability to successfully both place into service and put into use, for any rail vehicle, is influenced by decisions made concerning the design of the vehicle, it is important for both concepts to be considered at an early stage in any project to reduce the risk of difficulties in achieving either.

G2.2 Exclusion of urban rail vehicles from the mainline regulatory framework

G2.2.1 The Railways and Other Guided Transport Systems (Safety) Regulations 2006

Guidance

G 2.2.1.1 The mainline railway is defined in ROGS to be any railway that is not either:

a) Excluded from the mainline railway by the Office of Rail and Road (ORR); or
b) Privately owned infrastructure used exclusively for the freight operations of the infrastructure owner.

G 2.2.1.2 The ORR can exclude a railway or part of a railway from the mainline railway if it determines that is:

a) A metro or other light rail system;
b) Functionally separate from the rest of the mainline railway and intended only for the operation of local, urban or suburban passenger services, as well as transport undertakings operating solely on these networks; or
c) A heritage, museum or tourist railway that operates on its own network.

G 2.2.1.3 Only the first exclusion category given in *G 2.2.1.1* is considered in this guidance note. It is assumed that urban rail vehicles operating on the GB mainline railway have been determined to fall within the category of 'a metro or other light rail system' and are therefore excluded from the mainline railway.

G 2.2.1.4 The ORR produces and publishes helpful guidance on ROGS that can be downloaded from the ORR website. A list of railways that are excluded from the scope of ROGS and are therefore non-mainline are also published by the ORR on their website.

G2.2.2 The Railways (Interoperability) Regulations (2011) (as amended)

Guidance

G 2.2.2.1 RIR applies to the 'rail system', including its subsystems and interoperability constituents, but specifically does not apply to any part of the rail system determined by the Secretary of State to fall within one or more of the categories of:

a) Metros, trams or other light rail systems;
b) Functionally separate from the rest of the mainline railway and intended only for the operation of local, urban or suburban passenger services, as well as transport undertakings operating solely on these networks; or
c) Infrastructure and vehicles reserved for a strictly local, historical or touristic use.

G 2.2.2.2 The Department for Transport (DfT) publishes a list of exclusions to RIR.

G 2.2.2.3 Throughout this guidance it is assumed that urban rail vehicles operating on the GB mainline network have been determined to fall within the category of 'metros, trams or other light rail systems' and are therefore excluded from RIR.

G2.3 Determination of exclusion from scope of regulations

Guidance

G 2.3.1 A determination of the applicability of an urban rail vehicle operating on the GB mainline railway can be made against both ROGS and RIR. This will help identify if the vehicles are to be excluded from their respective scopes. This determination is to be made by the ORR and Secretary of State for transport for the respective regulations.

G 2.3.2 If the published lists of determined exclusions do not already cover the vehicles in question and, if relevant, their route of operation, a new determination is necessary to achieve exclusion from the scope of the regulations.

G 2.3.3 Exemption from ROGS is sought through an application directly to the ORR who will make this determination. The application links can be accessed through the ORR website.

G 2.3.4 Exclusion from the scope of RIR means that the vehicles do not need an authorisation for placing into service and are not required to comply with the National Technical Specification Notices (NTSNs) and National Technical Rules (NTRs).

G 2.3.5 Conversely, vehicles which fall within the scope of ROGS and RIR will be subject to the same requirements as apply to GB mainline rail vehicles. Such requirements could be incompatible with operation of the vehicles as urban rail vehicles away from the mainline network.

G2.4 Roles

Guidance

G 2.4.1 ROGS defines the following three roles:

a) Transport operator;
b) Transport undertaking; and
c) Infrastructure manager.

G 2.4.2 On the GB mainline network, the railway undertaking (RU) replaces the role of transport undertaking.

G 2.4.3 When operating urban rail vehicles on the GB mainline network, an organisation will be taking on the role of RU, and will be under the same obligations as apply to all other RUs operating on the GB mainline.

G 2.4.4 Non-mainline operators normally hold licenses under the Railways Act 1993 (as amended). Mainline railway undertakings hold a license under the (Railway Licensing of Railway Undertakings) Regulations 2005 (as amended).

G 2.4.5 Operators must satisfy a number of different criteria to have a license granted by the ORR. License holders will be subject to the conditions laid out within the license type to bring consistency within the rail industry across GB.

G 2.4.6 Operators of urban rail services on their own network typically fulfil the roles of both transport undertaking and infrastructure manager (IM). However, when operating services on the GB mainline railway, an urban rail transport operator is only fulfilling the role of RU with a mainline rail organisation being the IM. For most of GB the IM is Network Rail, but in some networks other organisations are the IM. It is therefore possible that urban rail services operated on the mainline network could cross between areas managed by different mainline IMs in addition to the urban rail network. Therefore reference in this document to 'the IM' includes more than one IM.

G2.5 The role of standards

Guidance

G 2.5.1 The role of standards play a crucial role in ensuring the safety, efficiency, and sustainability of railway systems. The establishment of standards helps to lower costs in several ways: by reducing errors, streamlining processes, simplifying compliance, and leveraging economies of scale through standardised products.

G 2.5.2 NTSNs define the technical and operational standards which must be met to satisfy the 'essential requirements', and provides for interoperability of the mainline railway system. This allows the GB mainline railway to run as a whole system, providing benefits for our customers and our society.

G 2.5.3 NTRs support NTSNs by setting out requirements which are 'open points' within NTSNs, specific cases or other technical compatibility.

G 2.5.4 This ensures that the essential requirements specified in RIR are met.

G 2.5.5 Railway Group Standards (RGSs) set out requirements for the GB mainline railway. These are specified as the NTRs for the GB mainline by the Secretary of State for Transport, and a list of these requirements is published on the DfT website.

G 2.5.6 Rail Industry Standards (RIS) capture industry-agreed best practice in meeting a range of technical and functional requirements. It is a condition of licence for operating companies to comply with all applicable Rail Industry Standards or have an equally effective measure in place that is agreed with affected stakeholders. Rail industry standards use can present the most effective way for a company to demonstrate key legal, functional and contractual obligations to support their SMS.

Note: License conditions require compliance to RGS and RIS on the mainline railway, with the additional applicability of NTSNs through compliance to RIR. Established standards are useful in managing risks but may not be sufficient to reduce risks so far as is reasonably practicable in all circumstances, to meet the required legal responsibilities under the UK health and safety law.

G2.6 The GB mainline network

Guidance

G 2.6.1 The GB mainline railway, to which this guidance note and other RSSB standards apply, is not the same as the mainline railway as defined in ROGS which includes Northern Ireland.

G 2.6.2 Whilst the mainline railway includes any railway in the UK that is not excluded from it, the GB mainline network is a subset of the mainline railway and does not include:

a) Any railway in Northern Ireland;
b) The HS1 railway; and
c) Any part of the Channel Tunnel.

G 2.6.3 This Guidance Note is not intended to provide guidance to support the operation of urban rail vehicles on any parts of the mainline railway other than the GB mainline network.

G 2.6.4 An annual network statement publication issued by the IM provides essential information for current and future train operators who wish to run services on the GB mainline railway network. The statement includes details about the infrastructure, the conditions for access, and the procedures for capacity allocation. This document ensures that all operators have access to the same information on a fair and non-discriminatory basis.

G 2.6.5 This statement is produced in accordance with The Railway (Access, Management and licensing of Railway Undertakings) Regulations 2016.

G2.7 The difference between placing in service and putting into use

Guidance

G 2.7.1 RIR introduces the two concepts of 'placing in service' and 'putting into use', to separate the process of designing and building rolling stock for the mainline railway from that of operating it on the mainline railway.

G 2.7.2 The two concepts are also applied to other structural subsystems of the mainline railway, but this Guidance Note only considers these concepts in the context of rolling stock.

G 2.7.3 As urban rail vehicles are excluded from the scope of RIR there is no requirement for the same concepts to be adopted when introducing these vehicles, either to their own network or to the GB mainline network, so long as the vehicles in question have been confirmed to be excluded from the regulations; see *G 2.2.1.1*. However adopting the concepts of 'placing in service' and 'putting into use' is likely to aid users when introducing urban rail vehicles to the GB mainline network. This is due not only to the fact that experience on the mainline railway has shown it to be an effective method of working, but also because it is a familiar way of working for colleagues on the GB mainline network with whom users will be interacting when introducing urban rail vehicles.

G 2.7.4 Further guidance is set out in RIS-8270-RST.

G2.8 Placing in service and putting into use explained

G2.8.1 Placing in service

Guidance

G 2.8.1.1 Placing in service of a rail vehicle is the responsibility of the project entity responsible for the manufacture, upgrading or renewal of the vehicle. This could be the vehicle manufacturer or another organisation, and does not need to be a railway undertaking.

G 2.8.1.2 For the mainline railway, the process of placing in service results in authorisation of the rolling stock by the ORR. Vehicles which are within the scope of RIR are not permitted to be put into use without this authorisation.

G 2.8.1.3 For urban rail vehicles which are excluded from the scope of RIR, no authorisation is required from the ORR, but a letter of no objection may be issued if requested. No

other third-party acceptance or approval of urban rail vehicles is required for their use on the mainline railway either. Nonetheless the work done to support placing in service of the vehicles will help with the process of putting into use and any approvals required for the transport operator's revised operations.

G 2.8.1.4 Placing in service is not concerned with the use in operational service or other intended use of the rolling stock, which is addressed by putting into use.

G2.8.2 Putting into use

Guidance

G 2.8.2.1 Putting into use of a rail vehicle is the responsibility of the railway undertaking or transport undertaking that will operate the vehicle for its intended use.

G 2.8.2.2 For the mainline railway, there is no formal output of the process of putting into use, in the form of an approval, certificate or similar, although going through the process of putting into use might result in formal outputs being generated in support, as a reference or in case changes to certificated or approved processes or systems are required. Instead, putting into use is about the RU assuring themselves that the vehicles in question can, and will, be safely operated on the particular routes of operation.

Part 3 Focus on putting into use

G3.1 Introduction to putting into use

Guidance

G 3.1.1 Putting into use is the term for the process the RU employs to assure themselves that a vehicle can be safely operated on its intended routes of operation under the RU's safety management system (SMS).

G 3.1.2 Figure *1* sets out the activities involved in the putting into use of a rail vehicle.

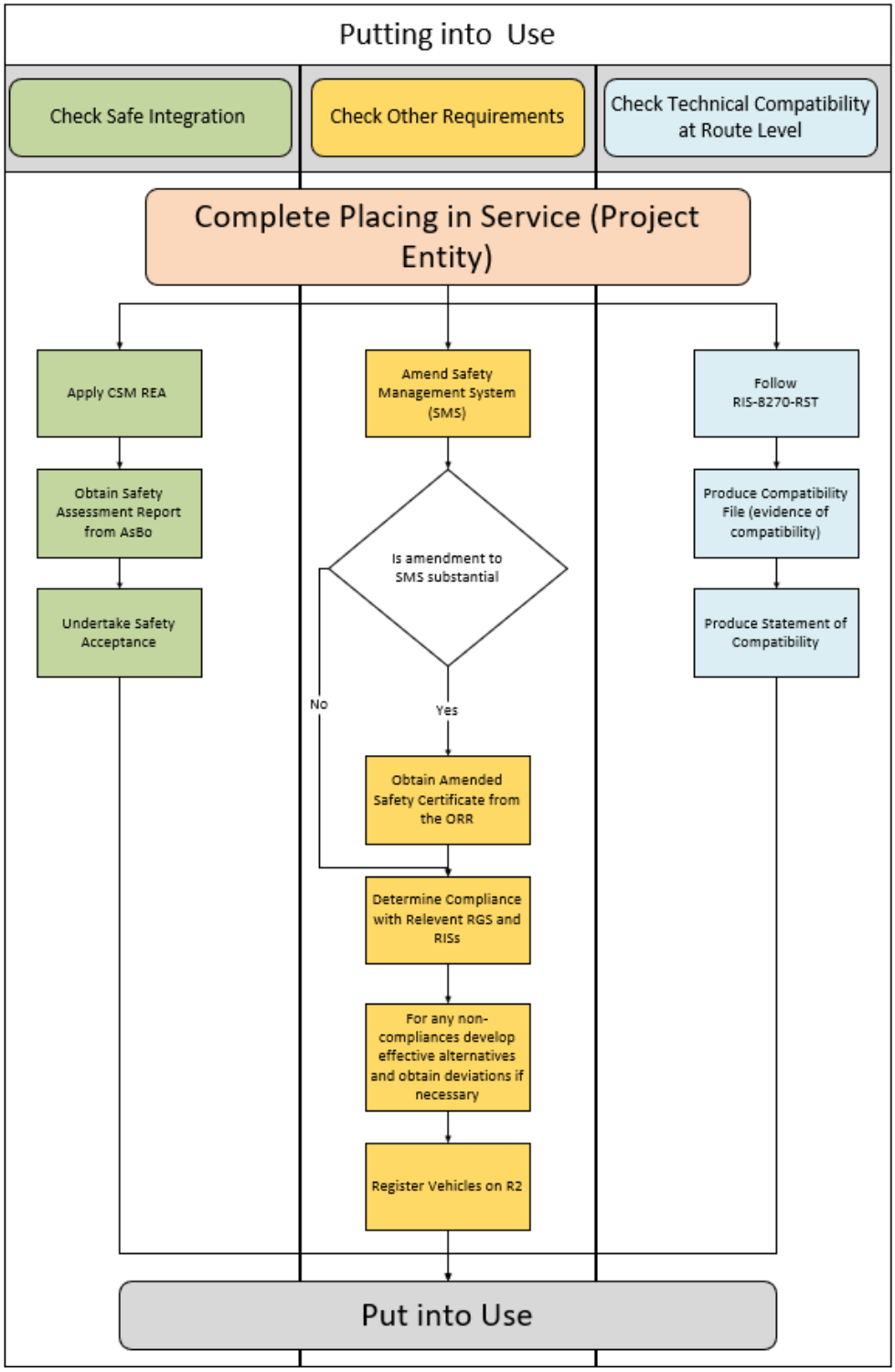

Figure 1: Overview of activities involved in the putting into use process

G3.2 Safe integration

Guidance

G 3.2.1 ROGS requires that the SMS of a non-mainline transport operator controls the risks relating to the placing in service of new or altered vehicles or infrastructure. Such an alteration could be to the design or construction, incorporating significant changes to any vehicles or infrastructure already in use on the transport system.

G 3.2.2 This includes changes that:

a) Can create a significant safety risk;
b) Can significantly increase an existing risk;
c) Can be affected by the operation of another transport operator or operators, taking into account the other operators' SMS.

Note: The term 'placing in service' in ROGS does not have the same meaning as in RIR, or used throughout this document. The meaning of 'placing in service' in ROGS is broadly, but not exactly, equivalent to 'putting into use' in both RIR and this document.

G 3.2.3 Safe integration is the process by which the relevant transport operator controls the risks described above. In the case of introduction of new rolling stock, the RU that will be operating that rolling stock is responsible for the safe integration. Whilst the RU may contract out the work involved to another organisation (which could be the Project Entity which placed the vehicle in service), the RU remains responsible for its completion.

G 3.2.4 The purpose of safe integration is to ensure that the rolling stock can be used safely on the particular route of operation, accounting for that route's specific characteristics and affected parties, and, if necessary, to identify appropriate mitigation measures. Safe integration includes the technical compatibility of the rolling stock with the other structural subsystems, its compatibility with other rolling stock using the route and also its 'suitability' for the operational procedures employed on the route.

G 3.2.5 Further guidance on the technical compatibility element of safe integration is provided in *G3.5*. The guidance is also applicable for cases where other rolling stock using the route is the responsibility of an RU or RUs other than the proposer.

G 3.2.6 As part of the safe integration process the RU is required to consult with the IM and any other RUs for whom risk levels potentially could be impacted, or by whom changes might be required to ensure risks are manged to an acceptable level. The IM and other RUs have a responsibility to co-operate with the RU seeking to integrate a change.

G 3.2.7 The guidance in clauses *G 3.2.1* to *G 3.2.6* considers safe integration in the context of the introduction of new or different rolling stock to an existing rail system, but the equivalent is also true for the introduction of new fixed infrastructure. When putting urban rail vehicles into use on the GB mainline network there might also be associated fixed infrastructure simultaneously being put into use to support operation of the urban rail vehicles. Examples of this could include:

a) Energy infrastructure, such as a dc contact line;

b) CCS infrastructure, such as track-mounted balises;
c) Rail infrastructure, such as check rails.

Any such fixed infrastructure is also required, by ROGS, to be safely integrated with existing GB mainline infrastructure and rolling stock. The putting into use and safe integration of such fixed infrastructure is beyond the scope of this guidance note, but non-mainline transport operators could adapt the contents to support the putting into use of fixed infrastructure.

G 3.2.8 If new fixed infrastructure is introduced to the GB mainline network, it is important to consider which organisation will take on the responsibility of IM for that infrastructure. To support ongoing management and maintenance of the infrastructure the most appropriate arrangement is likely to be for a single organisation to be IM for all infrastructure at a given location. This could involve the mainline IM, for example Network Rail, becoming the IM for fixed infrastructure associated with operation of urban rail vehicles, or the urban rail IM becoming the IM for the mainline fixed infrastructure at some or all locations where the urban rail vehicles are operated. The role of the IM however might transfer depending on the type of new fixed infrastructure and its permanency. The preferred arrangement could depend on factors such as:

a) The relative levels of mainline and urban rail traffic using the infrastructure; or
b) The physical location of the infrastructure.

G 3.2.9 The organisation which is the IM for any fixed infrastructure is responsible for its safe integration.

G3.3 Risk assessment to support putting into use

Guidance

G 3.3.1 Mainline duty holders that operate on a non-mainline network use the Common Safety Method for Risk Evaluation Assessment (CSM REA) as stipulated by ROGS.

G 3.3.2 Non-mainline operators use the method of safety verification stipulated by ROGS, to identify the change in risk as a consequence of any significant changes.

G 3.3.3 The process of safe integration from a non-mainline railway to the mainline railway is supported by a suitable and sufficient risk assessment, which can be achieved by following the principles set out in CSM REA.

G 3.3.4 Commission Implementing Regulation (EU) 402/2013 requires that CSM REA is applied to any change assessed to be significant according to criteria set out in the regulation. It is considered highly likely that any change to introduce urban rail vehicles onto the GB mainline network would be assessed to be significant and so require the application of CSM REA. The transport operator can also choose to apply CSM REA to a change which is assessed to not be significant according to Regulation (EU) 402/2013.

G 3.3.5 Guidance on application of the CSM REA is available in GEGN8646.

G 3.3.6 A non-exhaustive list of hazards for consideration within a suitable and sufficient risk assessment are provided in *page 41*.

G 3.3.7 Specific hazards that were identified, or assumptions about the risk management of these specific hazards might have been made, by the project entity during the placing in service phase of the introduction of the rolling stock. It would be expected that any such hazards and assumptions are reviewed as part of a suitable and sufficient risk assessment.

G 3.3.8 CSM REA applies to the railway system in the UK and to subsystems within the scope of RIR. As such, urban rail systems and their vehicles might be expected to be excluded from the scope of CSM REA if excluded from the scope of RIR; see *G 2.2.1.1*. However this is not the case if urban rail vehicles are to be introduced to the mainline railway, because the mainline railway itself is within the scope of CSM REA.

G 3.3.9 Regulation (EU) 402/2013 continues to apply in GB as retained and corrected EU law following the UK's departure from the EU by the Rail Safety (Amendment etc.) (EU Exit) Regulations 2019 (as amended).

G3.4 Safety Assessment

Guidance

G 3.4.1 If CSM REA is required to be applied to the change, this requires an independent assessment of the correct application of the risk management process by an Assessment Body (AsBo), to recognise that CSM REA may be being applied voluntarily, in which case the applicant can choose whether they use an AsBo. The AsBo produces a safety assessment report, which provides evidence that the requirements for safe integration have been met.

G 3.4.2 Safety acceptance is defined in CSM REA as the '*status given to the change by the proposer based on the safety assessment report provided by the assessment body*'. In the case of introduction of new vehicles to the GB mainline network, the proposer is the RU under whose SMS the vehicles will be operated. It is good practice for safety acceptance by the RU to be formally recorded.

G3.5 Technical Compatibility

Guidance

G 3.5.1 Confirmation of the technical compatibility between a vehicle and the infrastructure on its routes of operation is a critical element in the process of putting into use of any rail vehicle. Requirements and guidance for the management of technical compatibility are set out in RIS-8270-RST, which also provides further guidance on the relationship between technical compatibility and safe integration.

G 3.5.2 The process set out in RIS-8270-RST can also be used to assess compatibility between rolling stock operated on the same route by different RUs.

G 3.5.3 Confirmation of technical compatibility is the responsibility of the organisation introducing the change; in the case of introduction of an urban rail vehicle to the GB mainline network, responsibility for management of technical compatibility would rest with the RU that will operate the vehicle. The RU will have arrangements for the management of technical compatibility in its safety management system (SMS).

G 3.5.4 RIS-8270-RST sets out three methods of determining technical compatibility, in order of increasing complexity:

a) By demonstration that both sides of the interface (that is, vehicle and infrastructure) conform to an integrated suite of standards. For the purposes of putting into use of a vehicle on the GB mainline network, the integrated suite of standards used is NTSNs, RGSs containing NTRs, and RISs;
b) Where a) is not the case, by using an RGS that defines criteria by which technical compatibility can be confirmed (GERT8006 is an example of such an RGS); or
c) Where b) is not the case, by conducting suitable technical analysis to assess the compatibility of the proposed change with existing assets.

G 3.5.5 RIS-8270-RST requires that, as part of the process of confirming technical compatibility, a '*compatibility file*' is assembled, containing or referencing '*all the evidence and supporting information used to assess technical compatibility*'. If a technical file exists, the compatibility file forms part of the technical file.

G 3.5.6 RIS-8270-RST also requires the proposer to produce '*a written notification of compatibility between assets, known as the Statement of Compatibility*'. A copy of the Statement of Compatibility is to be held in the compatibility file.

G3.6 Other considerations for Safety Management Systems

G3.6.1 Certification of Safety Management System

Guidance

G 3.6.1.1 In order to operate a rail vehicle on the mainline railway, an RU is required by regulation 3 (1) of ROGS to have a safety certificate for its safety management system. Regulation 7 of ROGS sets out the process for obtaining a safety certificate. A safety certificate is issued by the ORR.

G 3.6.1.2 In the application for the safety certificate, it will require demonstration that the RU safety management system, is sufficient to allow them to operate on the mainline railway safely.

G 3.6.1.3 A transport undertaking that currently operates urban rail vehicles on a network that is not part of the mainline railway and is excluded from the requirement to hold a safety certificate by virtue of regulation 4 (3) of ROGS will need to obtain a safety certificate for its safety management system before it can operate on mainline railway.

G 3.6.1.4 A transport undertaking which already holds a safety certificate and is intending to make a change to its operations, such as the introduction of urban rail vehicles to the mainline railway, might need to obtain an amendment to its safety certificate to reflect that change. An amended safety certificate is required by regulation 8 of ROGS if the change to operation is determined to be substantial.

G 3.6.1.5 A substantial change relates to the change of 'type' or 'extent' of the operation, infrastructure, maintenance principles or energy supply. The change in operation will be of interest to the safety certificate whereas the infrastructure, maintenance and energy supply will have more relevance to any safety authorisation held.

G 3.6.1.6 Examples of substantial changes in 'type' include the following changes in operation:

a) From passenger to freight use;
b) From non-dangerous goods traffic to dangerous goods traffic;
c) From non-high-speed to high-speed; and
d) Any of the above changes in the opposite direction.

Note: Any operation over HS1 would be considered high-speed.

G 3.6.1.7 An example of a substantial change in 'extent' could be: a change that relates to volumes of goods or passengers carried; or numbers of employees within the organisation.

G 3.6.1.8 The latest "ROGS Safety Certificate and Safety Authorisation Assessment Manual" can be found published on the ORR website. This can be used to engage with the ORR to review any applications required to amend or provide a new safety certificate.

G3.6.2 Amendments to Safety Management System

Guidance

G 3.6.2.1 It is important for the railway undertaking intending to operate urban rail vehicles on the mainline railway to consider whether their safety management system (SMS) will need to be revised as a consequence of the change to their operations.

G 3.6.2.2 Appropriate changes to the SMS could be identified as risk mitigation measures during the risk assessment process and application of CSM REA.

G 3.6.2.3 If the introduction of urban rail vehicles to the mainline is determined to be substantial, then an application to the ORR will need to be made. Upon the application of the safety certificate through the ORR, they will require demonstration that the RU safety management system is sufficient to allow them to operate on the mainline railway.

G3.6.3 Compliance with National Operations Publications

Guidance

G 3.6.3.1 Establishing a safe operational concept and associated procedures is a key element of safe integration. For the GB mainline railway, this is supported through the use of National Operations Publications (NOPs), the most significant document being the Rule Book.

G 3.6.3.2 The Rule Book provides direct instructions for rail staff for railway operations, including train movements, safety procedures and emergency protocols. The Rule Book is not exhaustive and the RU will require risk assessments to identify any additional processes and procedures that may be required to ensure its legal responsibilities to staff and passengers are met.

G 3.6.3.3 The Rule Book modules provide a link between nine Fundamental Operating Principles and the rules and instructions in the Rule Book. It indicates whether rules and instructions are defined for traffic operation and management on the mainline railway, and the warning and protection arrangements for people who have to work

on or near the line. It provides a means of deciding whether a proposed method of operation would require a change to those rules and instructions, or whether the change is to internal company instructions or competence management systems.

G 3.6.3.4 When operating urban rail vehicles on the GB mainline network, NOPs could be applicable if determined as appropriate by the duty holder, depending on the operational concept and the method of operational separation employed.

G 3.6.3.5 If operation crosses to or from the GB mainline network, it will be a decision for the transport undertaking whether operation management when away from the GB mainline network is also in accordance with NOPs. This decision is likely to depend on the local circumstances of the urban rail network in question. However if local operation management is not in accordance with NOPs, it will be important to also consider the management of the transition between the two operational management concepts as part of safe integration.

G 3.6.3.6 An urban railway may use its own equivalent 'Rule Book' which may include specific modules for its operational requirements that are contained within GERT8000 for the purpose of managing its SMS. This could be further supported by relevant modules if its operation was to expand and include sharing the mainline network.

G 3.6.3.7 Further guidance on operational topics to consider is given in part *10*.

G3.6.4 Compliance with relevant RSSB standards

Guidance

G 3.6.4.1 The Railway (Licensing of Railway Undertakings) Regulations 2005 (as amended) require most organisations who want to operate passenger trains or freight trains in Great Britain to hold an appropriate railway undertaking licence (formerly European licence), and a Statement of National Regulatory Provisions (SNRP).

G 3.6.4.2 In turn, the SNRP requires the holder to comply with '*the Railway Group Standards applicable to its licensed activities*' and '*the Rail Industry Standards applicable to its licensed activities*'. Further information on licences and SNRPs is available from the ORR.

G 3.6.4.3 If an SNRP holder is unable to comply with a requirement in an applicable Railway Group Standard, it is typically required though license conditions to seek approval through a deviation against that requirement from the relevant standards committee(s) via RSSB. A deviation is a permission to comply with a specified alternative to a requirement or requirements in a Railway Group Standard. A deviation has a specified scope and, where relevant, duration. Information on the process of applying for a deviation is available on the RSSB website.

G 3.6.4.4 If the SNRP holder is unable to or chooses not to comply with a requirement within an applicable Rail Industry Standard, it can identify and use an equally effective alternative measure to achieve the purpose of the requirement, after consultation with those who are likely to be affected. It can also voluntarily ask the relevant standards committee(s) for an opinion on the proposed alternative in a similar manner to if applying for a deviation. The holder is encouraged to register an alternative arrangement on the Rail Industry Standards page of the RSSB website,

providing feedback ideas on alternative methods used to achieve the same or better safe practices or complement further risk reduction.

G3.6.5 Cyber security

Guidance

G 3.6.5.1 Cyber security risks are mitigated by the application of legislation, standards and frameworks. The following also describe good practice for operational technology (OT) on the GB mainline railway such as:

a) The Network and Information Systems (NIS) Regulations 2018;
b) IEC 62443 series;
c) PD CLC/TS 50701:2023 ;
d) BS EN ISO/IEC 27001:2023;
e) The National Cyber Security Centre (NCSC) Cyber Assessment Framework (CAF); and
f) The National institute of standards and technology (NIST) framework.

G 3.6.5.2 The Railways Act 1993 and the NIS regulations set out an operator's responsibilities for cyber security, which includes the consideration of design, training and contingency plans for cyberattacks or breaches which are to be reported to the Secretary of State for Transport. Any gaps identified in assessments can have compensating countermeasures put in place to prevent any impact on the safety of passengers and either reduce or remove any risk of disruption across the network because of a cyberattack.

G 3.6.5.3 It is good practice to undertake or review current cyber security and resilience assessments for remote, physical and unauthorised cyber threats to the train and infrastructure systems, so not to have any safety impact to the operation of the network.

G 3.6.5.4 Integration of urban rail vehicles onto the mainline could provide a more attractive target for cybercrime when integrated into mainline operations. An assessment of the transition between mainline and non-mainline using CSM REA could highlight any gaps in cyber protection. Additional mitigation and protection could be put into place to address these additional risks.

G 3.6.5.5 There may be requirements of integrating current trainborne systems into heavy rail legacy systems for interoperability that may need to be considered within the cyber risk assessments.

Part 4 Rolling stock

G4.1 Crashworthiness and vehicle structures

Guidance

G 4.1.1 For heavy rail vehicles, structural requirements are set out in the LOC&PAS NTSN and referenced European standards. Further guidance and requirements are set out in GMRT2100 and RIS-2780-RST.

G 4.1.2 The structural requirements in the LOC&PAS NTSN and referenced European standards may not be appropriate for urban rail vehicles.

G 4.1.3 If it is proposed that urban rail vehicles will not comply with some or all of the requirements for heavy rail vehicles, application of CSM REA or using the safety verification method at an early stage in the development process will help to identify what, if any, alternative arrangements will be necessary to mitigate any reduction in structural integrity before the vehicle can be put into use.

G 4.1.4 The LOC&PAS NTSN calls up the crashworthiness requirements set out in BS EN 15227:2020 for design category C-I. BS EN 15227:2020 also sets out crashworthiness requirements for vehicles in design categories C-II to C-IV, which are intended to cover the different types of urban rail vehicles, including trams, metro vehicles and tram-trains.

G 4.1.5 GMRT2142 sets out guidance and requirements for mainline rail vehicles to meet or exceed a minimum acceptable intrinsic roll-over resistance at high wind speeds, set out in the standard. This might affect urban rail vehicles operating on the mainline. It is good practice to consider if roll-over resistance might be met while operating on the mainline railway. This RGS is supported by GMGN2542 which sets out guidance on methods that can be used to meet the requirements of GMRT2142.

G 4.1.6 GMRT2100 sets out requirements for the ability of rail vehicles to withstand aerodynamic loads. Whilst urban rail vehicles are unlikely to be travelling at high enough speeds to generate significant aerodynamic loads, it may, depending on the routes of operation, be appropriate to consider the effect of other aerodynamic loads on the urban rail vehicles when operating on or adjacent to mainline infrastructure, for example passing freight trains; passing high speed services; or wind loading. Further requirements and examples of good practice are set out in RIS-2780-RST.

G 4.1.7 Whilst limiting or design values contained in RIS-2780-RST might not be appropriate for use in the context of urban rail, many of the concepts are likely to be relevant to the design of an urban rail vehicle.

G4.2 Wheel Rail Interface

Guidance

G 4.2.1 The rail profiles used on an urban rail network could be different to those used on the GB mainline network. This is particularly likely to be the case if the urban rail network involves an element of street running using embedded track. Consequently the wheel

profiles of urban rail vehicles are not guaranteed to comply with requirements for the wheel profiles of heavy rail vehicles.

G 4.2.2 When the operational routes of the urban rail vehicles are clearly defined, it could be possible to demonstrate that an existing or planned wheel profile for use on the urban rail network is also suitable for use on the mainline routes that will be operated over, depending on the actual characteristics of the routes.

G 4.2.3 Alternatively it can be possible to develop new tread profiles to enable safe operation on both the mainline and non-mainline routes.

G 4.2.4 GMRT2466 sets out requirements for the development of new tread profiles for use on the GB mainline network. However the requirements in GMRT2466 do not account for requirements that could be necessary for operation on urban rail networks. Current industry research may allow GMRT2466 to be updated with an ideal wheel profile that fulfils the main bulk of technical requirements, for vehicles transitioning from non-mainline rail to mainline railways.

G 4.2.5 The following documents would typically be considered when determining the technical compatibility of the wheel rail interface for urban rail vehicles operated on the GB mainline network.

a) GMRT2466;
b) RIS-2766-RST;
c) LRG 16.0 Wheel Rail Interface Guidance published by the LRSSB.

G 4.2.6 The introduction of new tread profiles might necessitate some changes to the infrastructure on either or both networks. However doing so has the potential to result in further complications that require managing in the future. For example:

a) Raising of check rails, to effectively interact with urban rail vehicles, could impact on the infrastructure's compatibility with other vehicles that can use the route, including maintenance vehicles, such as multi-purpose vehicles (MPVs) and on track plant;
b) Changing of the wheel profile on urban rail vehicles could necessitate changes to wheel lathe equipment, however the continued compatibility of the wheel lathe with any other wheel profiles the equipment will be used, for example if there are multiple types of vehicles in the operator's fleet, that might be affected as a result.

G 4.2.7 When assessing suitability of wheel profiles for use on both mainline and urban rail networks, examples of issues to consider include:

a) Wheel and rail wear rates, for example in tight curves or caused by higher running speeds while operating on the mainline railway;
b) Noise generated at the wheel / rail contact, either by the urban rail vehicles or by heavy rail vehicles due to wear of the rail profile;
c) Wheel / rail contact patch location and size, as well as stresses within the contact patch;
d) Effective wheel guidance, such as at switches and crossings;
e) Avoidance of contact with other track elements, for example check rails, guard rails, within switches and crossings;
f) Dynamic stability, for example hunting;

g) Derailment resistance, for example as a result of flange climb;
h) Performance in degraded modes of both vehicles and infrastructure;
i) Wheelset (or resilient wheels) for bonding and limitations in wear on rubber components;
j) Low adhesion conditions, sanding to increase friction between wheel and rail.

G 4.2.8 Resilient wheels are typically used on urban rail vehicles to absorb vibrations between the wheelset and the running rail. Mainline rail vehicles wheelsets require a monobloc or tyred design, providing an electrical path from the unit to the rail. Resilient wheels require bonds between the tyre and the wheel centre to establish electrical continuity across the viscoelastic rubber inserts used to dampen vibrations. Resilient wheels provide an ideal solution on some urban rail systems to reduce noise and increase ride comfort but are subject to increased wear rates and speed restrictions.

G4.3 Dynamic behaviour

Guidance

G 4.3.1 In assessing the behaviour of vehicle suspensions and their influence on derailment propensity, it is noted that the relevant Railway Group Standard, GMRT2141, permits vehicles to be accepted using a set of static and dynamic tests. GMGN2641 provides guidance on performing static testing; however, these tests have been derived on an empirical basis from many years of experience of the behaviour of existing HVs. This simplified method is therefore restricted in its application to arrangements of which there is appropriate practical experience. Where a vehicle has features such as steering axles, coupled axles, independent wheels, which are untried on mainline infrastructure, it is good practice to undertake a more fundamental analysis of the risks, for example by measurement, such as measurement of wheel / rail forces in track tests.

Note: Network Rail has a generic VAMPIRE model of Tram Train vehicles, developed by the Institute of Transport Studies. This model, which has various configurations of vehicle type, can be used at early stage development to help assess the dynamic behaviour of tram type vehicles.

G4.4 Vehicle gauging

Guidance

G 4.4.1 The assessment of vehicle gauging envelopes outlined in the process described in GMRT2173, and the associated clearances to the infrastructure and to other vehicles (see GIRT7073) will depend on such factors as the relative size of the proposed vehicles and of those already using the routes in question. In some cases, a relatively simple assessment may suffice. Vehicle gauging information set out in RIS-2773-RST, in whatever form, which is supplied to the IM is required to be assessed as part of placing into service by verification from one or more of the following:

a) A Designated Body (DeBo) Certificate;
b) A Approved Body (ApBo);
c) A Notified Body (NoBo) if it's an accepted design from an EU member state.

G 4.4.2 These bodies are to satisfy as to the accuracy of the data which is supplied. The IM can use the certificate of engineering acceptance to generate a statement of compatibility (SOCAT) in accordance with part 3 of RIS-8270-RST.

G 4.4.3 As is the case for HVs, there is no requirement for urban vehicles to be compatible with a standard structure gauge provided that the necessary minimum clearances to the infrastructure and adequate passing clearance to other vehicles on adjacent tracks are available. However, a point to note is that urban rail vehicles may, whilst being of smaller body cross section in the passenger area, be wider than conventional vehicles in the area around the bogies and their under-clearance may also be more restricted.

G 4.4.4 The lower sector gauge described within GERT8073 defines a boundary of the swept vehicle envelope to maintain compatibility between the vehicle and the mainline infrastructure.

G 4.4.5 If LVs are fitted with retractable mirrors to give the driver a view along the side of the vehicle, then it is good practice to consider the following approaches:

a) These are required to be entirely within the swept envelope used for gauging purposes; or
b) A mechanism or process such that the vehicle cannot move off from rest with the mirrors deployed and infringing the swept envelope.

G4.5 Passenger alighting and boarding stepping distances

Guidance

G 4.5.1 GMRT2173 and RIS-8273-RST help support infrastructure stepping distances on the mainline railway.

G 4.5.2 There are various solutions that could be employed within RIS-8273-RST from a infrastructure standpoint or by being installed directly on the rail vehicle to reduce stepping distances when operating urban vehicles on mainline platforms.

G 4.5.3 Urban vehicles could use retractable steps to help reduce risks of passengers and staff falling between the train and the platform when boarding or alighting the train at a station platform.

G4.6 Braking

Guidance

G 4.6.1 General requirements for brake systems of urban rail vehicles are set out in BS EN 13452-1:2003.

G 4.6.2 If, when operating on the GB mainline network, vehicle operation is controlled by the mainline signalling system, requirements for train braking performance to ensure compatibility with the signalling system are set out in GMRT2045. GMRT2045 displays train braking performance requirements as a series of braking curves showing maximum permitted stopping distance against speed. The appropriate braking curve

to apply will depend on which of the signalling regimes, as set out in GKRT0075, has been used on the route of operation.

G 4.6.3 If magnetic track brakes (MTBs) are deployed its likely that they will outperform the "enhanced" braking curves in GMRT2045 so additional assessments may be required.

G 4.6.4 RIS-2710-RST sets out requirements and guidance for the use of MTBs on the GB mainline network. At the date of publication MTBs are not commonly used on the GB mainline network, and the only vehicles operating on the mainline that are equipped with MTBs are urban rail vehicles.

G 4.6.5 Even if the operation of urban rail vehicles is not controlled by the mainline signalling system, it is important that there is no degraded operation by running on the mainline rail. An example might be that the unit still needs to be reliably detectable by the mainline signalling system even though it's not controlled by it.

G4.7 Audibility

Guidance

G 4.7.1 In order to meet the minimum requirements for audibility which are laid down in GMRT2131, whilst achieving a warning which is in keeping with the environment in which Urban train run detailed in LRG 1.0 - Tramway and principles guidance (TPG), it may be necessary to incorporate a switching arrangement to change the volume and character of the warning provided by the horn. Where reasonably practicable, the change over might be automatic or associated with some other driver initiated change, so as to minimise the risk of error.

G4.8 Train visibility

G4.8.1 Visibility

Guidance

G 4.8.1.1 Regulation (EU) 2019/2144 known as the general safety regulations for motor vehicles is no longer mandatory in the UK since leaving the EU. The Road Vehicle Lighting Regulations 1989 (RVLR)(as amended) mandates vehicle lighting requirements for road vehicles in the UK. Therefore, compliance with the RVLR and United Nations Economic Commission for Europe (UNECE) regulations requirements are mandatory for metro, light rail, trams, tram/train vehicles that will be operated wholly or partially 'on-street'.

G 4.8.1.2 GB is a contracting party for the use of UNECE regulations which requirements are set out for both heavy rail and urban rail rolling stock in BS EN 15153 part 1 and part 3 respectively.

G 4.8.1.3 The RVLR defines positioning, alignment, visibility, dimensions, colour of light output and luminous intensity and is required to be complied with on road running operations. There may be differences between the legal requirements provided in the RVLR regulations directly and those requirements included within BS EN 15153-3:2020.

G 4.8.1.4 BS EN 15153-3:2020 sets out requirements for external visible warning devices for urban rail vehicles, including urban rail vehicles operating on heavy rail infrastructure. BS EN 15153-3:2020 refers to such vehicles as 'local rail vehicles'.

G 4.8.1.5 The specifications for heavy rail external lights and audible and visible warning devices are set out in BS EN 15153-1:2020 which are mandated by the LOC&PAS NTSN Appendix J.

G 4.8.1.6 The Operation and Traffic Management (OPE) NTSN includes requirements for train visibility for mainline passenger and freight rolling stock compliant to RIR. This is to optimise train detectability and provide sufficient visibility for a driver.

Note: UNECE regulation 48 defines positioning, alignment and visibility while UNECE 113 defines dimensions, colour of light output and luminous intensity. BS EN 15153-3:2020 addresses the unique needs of urban rail systems.

G 4.8.1.7 BS EN 15153-3:2020 sets out that urban rail vehicles are required to have headlamps that comply with requirements set out in UNECE Regulations, for use when operating on their own networks. The requirements of the UNECE Regulations are not compatible with the requirements for headlamps of HVs that are set out in BS EN 15153-1:2020, for example:

a) Head lamp vertical positioning height
b) Main beam luminous intensity.

G 4.8.1.8 There are two possible approaches that can be taken to resolve this incompatibility:

a) Install two sets of headlamps, one set compliant with the UNECE Regulations and one set compliant with BS EN 15153-1:2020; or
b) Use the headlamps compliant with UNECE Regulations when operating on the GB mainline network.

Note: It is not permitted to use headlamps compliant with BS EN 15153-1:2020 when operating on the urban rail network because there are a number of technical differences between these and the mainline network.

G4.8.1.1 Use of two sets of headlamps

Guidance

G 4.8.1.1.1 BS EN 15153-3:2020 permits headlamps compliant with BS EN 15153-1:2020 to be installed on urban rail vehicles in addition to headlamps compliant with UNECE regulations.

G 4.8.1.1.2 If two sets of headlamps are installed, those compliant with BS EN 15153-1:2020 are for use on the GB mainline network and those compliant with UNECE regulations are for use on the urban rail network. It is good practice for the selection of the appropriate headlamps to be automated as part of the process of transferring from one network to another. This is in order to prevent the wrong type of headlamp being active for the current network of operation.

G 4.8.1.1.3 BS EN 15153-3:2020 does not permit both sets of headlamps to be in use simultaneously.

G4.8.1.2 Use of headlamps compliant with UNECE regulations on the GB mainline network

Guidance

G 4.8.1.2.1 One of the main purposes of the headlamps of HVs is to provide a warning of the approach of a train in sufficient time to allow anyone on the track to move to a place of safety. This warning can be to:

a) Track workers;
b) Users of level crossings;
c) Staff and passengers on trains; and
d) Trespassers.

G 4.8.1.2.2 The specifications for heavy rail headlamps set out in BS EN 15153-1:2020 are mandated by the LOC&PAS NTSN and are intended to provide someone on the railway with at least 45 seconds warning time of an approaching train travelling at 125 mph.

G 4.8.1.2.3 Headlamps on HVs are also intended to provide illumination of trackside signage. However as HVs are not normally driven on line of sight, illumination of the track ahead is of less importance than is the case for urban rail headlamps.

G 4.8.1.2.4 If urban rail vehicles are being operated with headlamps that comply with the requirements of UNECE regulations rather than BS EN 15153-1:2020 it is important to consider how the heavy rail headlamp functions can be achieved.

G 4.8.1.2.5 Meeting mainline visibility requirements and demonstrating safe integration may present challenges due to the differences in design between LVs and HVs. An example of difficulties for a typical windscreen size of an urban rail vehicle to allow line of sight operation which may limit compliance with external lights, height requirements for operating on the mainline to comply with BS EN 15153-1:2020.

G 4.8.1.2.6 Considerations for inclusion to risk assessments and verification by independent assessment bodies to demonstrate safe integration might include some of the contents in Table 1.

ID	Compatibility Issue	Road/ Rail	Risk mitigation using CSM REA	Reasoning
0	General visibility.	Road typically uses line of sight. HVs are operated using signalling.	Road will be compliant with RVLR. Mainline rail is compliant with RIR.	Mismatch of operational use of both rail and road transport methods. Line of sight typically provides the driver with visibility of traffic and pedestrians. Rail vehicles provide visibility to make track workers and other rolling stock aware of them.
1	Centre high marker lamp for rail.	No Road requirement.	Design requirement, compliance to mainline COP (OPE) NTSN, to increase detectability on the mainline railway.	In order to satisfy mainline requirements for detectability.
2	Headlamp colour and intensity (day running).	Road standard conflicts with Rail standard.	(Headlight) High beam used during day running (visibility to track workers).	Unable to achieve the highest level of compliance with GMRT2131 without achieving full compliance with daytime running as road standard has priority over rail standard.
3	Headlamp colour and intensity (night running).	Road standard conflicts with Rail standard.	(Headlight) dimmed beam for night-time running (reducing glare).	Unable to achieve the highest level of compliance with GMRT2131 without achieving full compliance with night running as road standard has priority over rail standard.

ID	Compatibility Issue	Road/ Rail	Risk mitigation using CSM REA	Reasoning
4	Headlight diffusion angle from centre.	Road is asymmetric rail is symmetric, conflicts between standards.	Road uses the code of practice RVLR. Risk assessment and mitigation could be applied for rail acceptance.	This can provide evidence of visibility at distance for other rail users.
5	Main beam luminous intensity for day and night running not meeting GMRT2131.	Unable to meet mainline rail standard GMRT2131 compliance.	Focus group visibility testing using reference system.	Visibility testing through assessment to compliment IDs 2 & 3.
6	Hazard warning frequency	Hazard indicators for road typically are 1.5 Hz. Mainline Rail hazard headlamps are stipulated to approximately 0.65 Hz.	Engagement with all parties that are affected on the route that will require an understanding of this particular frequency difference.	Hazard warning lights are to indicate to other drivers of a potential hazard or emergency situation. Other rail vehicles would require knowledge and understanding of the differences of these units but hazard lights are used in the same manner for both Rail to GMRT2131 and Road to the RVLR.
7	Headlight positioning height.	Road standard conflicts with Rail standard.	A combination of IDs 1,2,3,4,5 could be used.	Measures that could help to manage mitigations for being unable to comply with BS EN15153-1.

ID	Compatibility Issue	Road/ Rail	Risk mitigation using CSM REA	Reasoning
8	Tail lamp positioning height.	Road standard conflicts with Rail standard.	Focus group visibility testing using reference system.	This could provide evidence of visibility at distance for other rail users.
9	Tail lamp colour, intensity.	Road standard conflicts with Rail standard.	Stop lights on at all times to increase visibility.	In the attempt to meet compliance with GMRT2131 as far as possible. To provide suitable visibility to other rail vehicles.
10	Visibility of train to persons on the line.	Road standard typically allows reduce stopping distances, compared to mainline rail vehicles.	Increase braking efficiency.	Whether improved braking performance and shorter stopping distance of urban rail vehicles in comparison to HVs enables the driver to avoid a collision by bringing the train to a halt; also see section *4.6.3* on the use of magnetic track brakes.
11	Train visibility on approach to crossings.	Road standard conflicts with Rail standards.	A combination of 1, 2, 3, 4, 5, 10 will help demonstrate Train visibility and detectability.	Whether there will be any limitations on access to the sections of the GB mainline railway where the urban rail vehicles operate, such as if there are no level crossings to consider.

ID	Compatibility Issue	Road/ Rail	Risk mitigation using CSM REA	Reasoning
12	General compatibility	Could be highlighted by gap analysis between reference system and proposed operation and infrastructure.	Using reference systems with risk assessments of any additional risks identified that might be different from the reference system used.	Valid comparisons between reference system to the proposed operation and infrastructure including any unique risks that might be additional to those used in the reference system.

Table 1: Visibility compatibility between road and rail conflicts

G 4.8.1.2.7 Table 1 is not exhaustive but could help to form a robust risk assessment of the compatibility differences and allow mitigation to be developed.

G 4.8.1.2.8 RSSB Technical Note TN2301 provides guidance on the process of safe integration of the visibility of a new or modified rail vehicle with its route of operation, including where the vehicle does not meet the requirements of the LOC&PAS NTSN.

G 4.8.1.2.9 HVs that are equipped with older headlamps which do not meet the requirements mandated by the LOC&PAS NTSN are required by GMRT2131 to be equipped with a yellow warning panel to assist in making the train visible. Requirements for the size, dimensions and colour of the warning panel are set out in GMRT2131. Operators could choose to implement this warning panel on urban rail vehicles, although on some urban rail vehicles this might be incompatible with the larger windscreens.

G4.8.1.3 Tail lamps

Guidance

G 4.8.1.3.1 HVs tail lamps are required to be compliant to BS EN 15153-1:2020 as identified in Appendix I of the LOC&PAS NTSN. Urban rail can be compliant with the stipulated requirements within BS EN 15153-1:2020 or UNECE regulation 7.

G 4.8.1.3.2 Tram tail lamps are required to comply with UNECE regulation 7 as set out within BS EN 15153-3:2020.

G 4.8.1.3.3 It is good practice to incorporate a switching arrangement to change the stop lamps from a typical road braking arrangement to a solid tail light indication. Where reasonably practicable, the change over might be automatic or associated with some other driver initiated change while transitioning between light and heavy rail networks.

G4.9 Radio systems

Guidance

G 4.9.1 The GSM-R radio system is specified under the control, command and signalling (CCS) NTSN for use on the mainline railway. Guidance and requirements are covered within RIS-0794-CCS.

G 4.9.2 Urban rail vehicles need to maintain normal and emergency communication with the mainline signaller while operating on the mainline infrastructure.

G 4.9.3 Radio systems used on the non-mainline networks may have the capability to communicate to both the non-mainline and mainline control points, ensuring compatibility whilst using mainline infrastructure.

G 4.9.4 It is good practice to incorporate a switching arrangement to change over radio systems between transitions from and to, non-mainline and mainline rail systems. The change over might be automatic or associated with some other driver initiated change, in order to allow permission to pass on or off the mainline infrastructure.

G 4.9.5 The automatic switching between radio systems may use packet 44, RFID, train radio or an alternative control system to allow a safe communication transition between rail

networks. RIS-2795-RST sets out requirements and guidance for the process for managing data structures for new applications and the change control process for existing applications. RIS-0784-CCS sets out requirements and guidance on the management of packet 44 applications through the European Train Control System (ETCS).

G4.10 Software

Guidance

G 4.10.1 Software configuration, testing and introduction both from new and through software upgrades is important in both heavy and light rail environments, to maintain confidence in safety functions and the system's ability to fulfil its design requirements. Software will likely be used in all digital systems used on rail vehicles.

G 4.10.2 Software functions could provide an integral part of the switching between urban vehicle modes to modes required to run on the mainline infrastructure. Software assurance testing can help to confirm that control or switching functionality of modes has not degraded as a result of software changes. This testing is essential and provides a measure of safety assurance if software is used to manage the switching of non-mainline to mainline running operations.

G 4.10.3 The technical note TN2306 provides good practice in managing the introduction of new software.

G 4.10.4 RIS-0745-CCS provides guidance and requirements for procuring high integrity software for mainline operations.

G 4.10.5 *Cyber security* is an important discipline for consideration for an organisation providing that software and systems evolve over each upgrade in software or possibly due to physical modifications.

Part 5 Impact on other heavy rail vehicles

G5.1 Heavy rail vehicles

Guidance

G 5.1.1 During a proposed integration of non mainline rail vehicles to the mainline the operator has a responsibility to engage with the IM and any affected parties operating on the shared infrastructure. This is the same for any change proposal; it is good practice to make this engagement as early as possible, as covered in, RIS-8270-RST.

G 5.1.2 A new safety authorisation will be required for the change by the IM, granted by the ORR. All RUs operating on shared infrastructure will require engagement, in respect of the arrangements necessary to allow continued safe operation. In particular, where there are changes to the infrastructure or to operating procedures as a result of the need to operate particular vehicles, the IM is required to inform all RUs who are potentially affected and to ensure that, where appropriate, each submits a revised route level assessment, including any additional proposed changes.

G 5.1.3 In respect of the operation of LVs, examples of issues affecting operation of HVs could be:

a) Running safety at switches and crossings or other track features where it is proposed to modify to a non-standard design in order to allow compatibility with LV wheelset geometry;
b) Enhancements to the braking system performance of HVs or addition of systems to improve available adhesion;
c) Fitting of SPAD Protection systems to HVs;
d) Operating restrictions on HVs at stations with low platform;
e) Signalling distance may require altering at extended platforms used for both LVs and HVs, as a result of platform modifications; and
f) HVs Traction regeneration maybe affected while operating urban vehicles on the mainline.

Part 6 Infrastructure

G6.1 General Infrastructure

Guidance

G 6.1.1 GCRT5021 sets out requirements for track geometry, track systems and components on the mainline railway.

G 6.1.2 Track loading conditions and design will differ between heavy and light rail track systems. Technical compatibility for proposed shared infrastructure is one of the items that is identified within the route level assessment, RIS-8270-RST.

Note: Assessing the assumed normal vibration rates upon entering the mainline may highlight any high vibrational rates that could potentially lead to premature rolling stock component failures that occur as a result of operating urban rail vehicles on the mainline network.

G 6.1.3 The Wheel Rail Interface see *4.2* suitability of urban rail vehicles is critical to ensuring the compatibility and stability of urban rail vehicles with the mainline rail infrastructure.

G6.2 Stations

G6.2.1 Station design

Guidance

G 6.2.1.1 GIRT7020 sets out GB requirements included within the national technical rules for, platform heights, offsets and widths. RIS-7016-INS also sets out other additional GB requirements for the design and maintenance of station platforms, track, trains, and buffer stops at stations on the GB mainline railway.

G 6.2.1.2 RIS-7700-INS provides guidance on station infrastructure for infrastructure managers responsible for operating and managing stations on the mainline network. It describes emergency lighting and fire detection systems that could be considered when sharing platforms that have a step change in height.

G 6.2.1.3 Where platforms which are significantly lower than the 915 mm above rail height, hazards may be introduced such as:

a) HVs passing low platforms will also add hazards which may not occur on other parts of the route operated by LVs; or
b) Where a low platform is positioned adjacent to tracks carrying HVs, the HVs may overhang the platform. This introduces a new risk in that people on the edge of the low platform may be struck by the HV and it increases the risk of people being swept up by the slip stream of HVs traveling at high speeds.

G 6.2.1.4 There are fundamentally two types of station which may require low platforms on shared track routes:

a) 'Light Vehicle Stations' Stations served by LVs only; or
b) 'Joint stations' Stations served by HVs and LVs.

G 6.2.1.5 Both types of station can be:

a) 'Parallel' The tracks with low platforms are separated for exclusive use by LVs on a loop or;
b) 'Series' Low platforms are situated on tracks which are used by HVs in a track sharing sense (i.e. including interlaced track).

G 6.2.1.6 RIS-3782-TOM includes guidance on the provision of car stop markers. It is good practice to refer to this where LVs are used on mainline infrastructure.

G6.2.1.1 Low platforms

Guidance

G 6.2.1.1.1 GIRT7020 sets out the GB requirements included within the national technical rules for platform heights, offsets and widths.

G 6.2.1.1.2 The following principles can be applied to low platform provision in all cases:

a) Typically low platform design, operations and maintenance are required to consider reducing risk so far as is reasonably practicable considering all the hazards likely to occur at their specific locations;
b) Platform edges are recognised to be danger areas and clearly identified as such to the public. Ample platform width provides an area for people to avoid the need for people to occupy platform edges except when boarding and alighting from LVs;
c) It is good practice to discourage trespass by all reasonably practicable means. It is not practical to prevent trespass at all locations. Any anti-trespass measures dictated by the use of low platforms may have additional safety mitigation to those required by RIS-7700-INS;
d) Measures introduced to avoid passengers becoming confused and behaving in a manner that would put them at risk through not realising that they are at a station used by HVs;
e) It is good practice to consider the following at new pedestrian crossings at shared track stations:
    i) Operation of HVs is confined to night time or rare occasions and special arrangements are made to positively keep people off low platforms at such times or;
    ii) Safety is assured by other means.
f) It is good practice to consider hazards at low platforms where there are exposed top contact conductor rails which might present a danger to people on the platforms or to trespassers in risk assessments. As new or developing charging technologies emerge for traction battery rolling stock charging in stations, good practice would be to consider safety interlock approaches to ensure equipment not in use, remains in a dead state. GLRT1212 outlines safety requirements for the mainline railway; and
g) Low platforms will normally be under recorded CCTV surveillance and a means provided so that the station operator can take action, including public address warnings, if dangerous situations occur. This however may not always be the case, based on individual risk assessment of the platform location.

G6.2.1.2 Specific control measures at platforms

Guidance

G 6.2.1.2.1 The Common Hazards for the management of Industry Safety (CHAMOIS) T1194 research report helps generate a list of key hazards and ontology to help the rail industry improve consistency in identifying hazards when developing risk assessments. This information is downloadable using the RSSB website.

G 6.2.1.2.2 Table 2 provides an indication of some of the control measures which might be applied in order to achieve these principles. Not all of these will apply at specific locations and further measures may be required in some cases. The numbers in brackets indicate the principle(s) to which the measure applies.

Measure	Station Type	Parallel or series
Use parallel rather than series arrangement	Either	-
Interlaced track	Either	Series
Small projections along platform edge at LV doorway positions	Either	Series
Platform edge treatment	Either	Series
Platform surface colouring	Either	Either
Use standard platform treatment (edge and colouring) on rest of LV system	Either	Either
Stagger platforms to minimise joint station risks	Joint	Series
Provide or make use of existing grade separated means of crossing the line and design layout so these are at the 'natural crossing point'	Either	Either
Use arris rail or other "unfriendly" walking surfaces on the track and at the ends of low platforms	Either	Either
Fences between tracks, at back and ends of platforms	Either	Either
Speed limits	Either	Either
Other restrictions on HV operation including a requirement to sound horn	Either	Either
Staffing stations (permanent or temporary)	Either	Either
Public address	Either	Either
Platform signage, warning notices	Either	Either
CCTV	Either	Either
Visual warnings (flashing lights)	Either	Series
Lockable gates on access to platforms	Either	Series

Measure	Station Type	Parallel or series
Inhibit access to edge of low platform when HV passes	Joint	Series

Table 2: List of control measures

G6.2.1.3 Factors for consideration

Guidance

G 6.2.1.3.1 The need for the measures at low platforms see *6.1.1.1* will depend on factors such as:

a) Train service levels;
b) Types of trains;
c) Speed of trains;
d) Electrification systems;
e) Use of a station;
f) Likelihood of trespass;
g) Proximity to existing crossing points and their nature;
h) Urban service characteristics;
i) Extent of overhang of platforms;
j) Visibility;
k) Site constraints; and
l) Mainline platform gap.

G 6.2.1.3.2 Where this is different from the non-mainline platform gap, it is good practice to provide a means of mitigating this to ensure safe access to and egress from the train; see *heavy rail vehicles*. Examples of mitigation could include warning signage, retractable steps.

G 6.2.1.3.3 The responsibility for the implementation of suitable arrangements will lie with all the LV operators concerned, with the station operator and with the IM.

G6.2.1.4 Passengers with restricted mobility

Guidance

G 6.2.1.4.1 The mainline railway falls under The Persons with Reduced Mobility National Technical Specification Notice (PRM NTSN). Under the Railways Act 1993 (as amended) section 71B there are also responsibilities to ensure accessibility for disabled passengers.

G 6.2.1.4.2 Accessible Train Station Design for Disabled People: Code of Practice (November 2011) is available to use in the UK.

G 6.2.1.4.3 Non-mainline railways typically fall under the Rail Vehicle Accessibility (Non-interoperable rail system) Regulations 2010 (RVAR) which set out the accessibility standards to which new non-mainline (and older rail vehicles as and when they are refurbished) are required to comply.

G 6.2.1.4.4 There is no legal requirement for vehicles to be brought into compliance with RVAR or the PRM NTSN, unless they undergo refurbishment; however, adopting improvements towards RVAR or NTSN compliance will benefit an RUs customers.

G 6.2.1.4.5 All measures take into account people with mobility impairments and disabilities. In many cases this will require duplication so that, for example, a warning is given by audible, visible and touch sensitive means.

G6.3 Switches and crossings

Guidance

G 6.3.1 Mainline switches and crossings requirements are provided in RIS-7707-INS, which includes additional requirements to those national technical rules (NTRs) included within GCRT5021.

G 6.3.2 Mainline sprung point operating forces may need to be identified through a route assessment to ensure compatibility with urban rail stock permitted on the shared mainline railway routes.

G 6.3.3 This could be identified through route compatibility assessments carried out in RIS-8270-RST.

G6.4 Trackside remote condition monitoring equipment

Guidance

G 6.4.1 RIS-2714-RST sets out requirements and guidance for axle bearing condition monitoring. When operating on the mainline railway compatibility, with existing lineside hot axle bearing condition monitoring systems can support the safe operation of light rail vehicles if they do not have axle bearing condition monitoring systems on board.

G 6.4.2 Several remote condition monitoring systems used for monitoring HVs on the mainline could require some understanding on how they might respond while an urban rail vehicle was to travel through that location. Systems might include some of the following:

a) Hot axle box detection (HABDs); and
b) Wheel impact detection (WILDs).

G 6.4.3 RIS-8270-RST can help identify through assessment fixed infrastructure equipment that could be potentially impacted by the integration of urban rail vehicles that have interactions with this equipment while on the mainline.

G6.5 Check rails

Guidance

G 6.5.1 Check rails run in parallel to the main running rails, principally to prevent the wheels from climbing the rail, leading to derailments typically in areas of high risk.

G 6.5.2 Check rails are typically found in areas such as:

a) Sharp curves;
b) Track with uneven or unstable ground;
c) Inclines; and
d) Points and crossings, to guide the wheel to follow the correct path.

G 6.5.3 Check rail heights may require alteration for LVs wheel profiles on shared mainline track in order to maintain compatibility with the urban vehicles wheel profiles see *4.2*.

G 6.5.4 There may also be compatibility issues with raised check rails and emergency recovery equipment like wheel skates. This would require identifying on the mainline infrastructure that could be considered within recovery plans of rail vehicles in this manner.

G 6.5.5 Raised check rails can be identified within the national electronic sectional appendix to identify routes that might present an operational issues and require consideration.

G6.6 Trespass

Guidance

G 6.6.1 Urban rail systems tend to have more open access to parts of their network systems, either by tram, road running or on older metro systems, which are normally enclosed. The mainline has limited access for the operator and is restricted to passengers and the general public not using the rail system.

G 6.6.2 The Rule Book contains operational guidance on preventing trespass, reporting and operational management process during a trespass incident and are also included within their respective modules to help operate safely while on the mainline rail system.

G 6.6.3 RIS-3786-TOM provides guidance on carrying out trespass risk assessments on the mainline railway. This includes several control measures that help reduce identified risks highlighted by an assessment.

G 6.6.4 Low platforms may make trespass easier with passengers that may assume it is safe to cross the tracks since this may be permitted elsewhere on the route operated by LVs.

Part 7 Level crossings

G7.1 Level crossing considerations

Guidance

G 7.1.1 RIS-0793-CCS sets out requirements for level crossing systems to reduce the risk of a collision of a train and a level crossing user.

G 7.1.2 Contact wire height requirements are set out in GLRT1210. The appropriate standards for minimum safe distance requirements between level crossing users and the contact wire are included within RIS-0793-CCS which can be used when assessing compatibility between urban rail vehicles sharing routes with mainline crossings.

G 7.1.3 Metros and tramways could operate different strategies on their network while using full, half or open barrier crossings. This could include stopping at each crossing and then taking power to reduce risks of collision if no barriers are present.

G 7.1.4 Engagement with the IM is crucial to understand the risks and requirements in operating LVs through any identified crossings and having the appropriate mitigation in place to satisfy any additionally identified hazard risks to LVs or to G5.1 as a result of incorporating a change to established processes.

Part 8 Control command and signalling

G8.1 Movement authority

Guidance

G 8.1.1 RIS-0737-CCS sets out the requirements for carrying out a signal sighting assessment for mainline vehicle operation. The assessment provides confirmation of compatibility of lineside signalling systems and train operations. This assessment is typically carried out alongside route compatibility assessments RIS-8270-RST and signal overrun risk assessments, RIS-0386-CCS, before putting a vehicle into use.

G 8.1.2 A urban rail vehicle may have to integrate into a different signalling system used on the mainline. The urban vehicle might have to operate within a shared route using ETCS for its movement authority as an example, or by lineside signalling.

G 8.1.3 Consideration to integrating with the current mainline signalling system initially would be ideal, if possible, otherwise a separate solution affecting all transport operators might be considered.

G 8.1.4 RIS-0707-CCS management of control command and signalling (CCS) subsystem failures, faults and defects sets out the management process requirements to safety related failures of the onboard and trackside CCS equipment while on the mainline railway.

G 8.1.5 Operational rules for reporting equipment failures to the IM are included within module TS11 in GERT8000.

G 8.1.6 Movement authority will be given by the following methods:

a) Lineside signals, colour light signals, position light signals; or
b) In cab signalling, ETCS; or
c) Other methods like Direct Traffic Control (DTC), Wireless Train Control (WTC), token systems might be used if authorised by the IM under its safety authorisation.

G8.2 Misrouting

Guidance

G 8.2.1 Misrouting scenarios on the mainline railway are included in module M1 of the Rule Book. It is good practice to identify and understand the impact of these hazard scenarios on shared infrastructure. Understanding the impact and consequences of running an urban vehicle on an incompatible mainline route is helpful to understand the consequences and to identify methods of prevention.

G 8.2.2 Automatic Vehicle identification (AVI) systems used on urban rail vehicles like trams could be utilised to control risks of misrouting between mainline and non-mainline rail systems. RIS-2795-RST sets out guidance and requirements of the use of radio frequency identification on the mainline railway to ensure there is a standard approach to the data construction for the purpose of communication between the train reader and the track RFID tag.

G 8.2.3 RIS-0796-CCS sets out guidance and requirements of the use of radio frequency identification on the mainline railway when the reader is mounted on the infrastructure and an RFID tag is fitted to the rail vehicle. Either of these approaches could be used to control the risk of misrouting by controlling the vehicles or infrastructure response to prevent or minimise the impact of it.

G 8.2.4 Misrouting risks could also be identified using training and route knowledge in part, while complemented by configuring train transition points to non-compatible route exits with protection systems to a permanent danger aspect if non-compatible routes are offered by a signaller. This might be possible if train protection schemes are overlaid on the mainline network but similar methodologies could be adopted to achieve a similar system.

G8.3 Train Protection

Guidance

G 8.3.1 Train protection systems fitted on track and train are required on the mainline railway under the Railway Safety Regulations (RSR)1999.

G 8.3.2 RSR 1999 requires urban rail vehicles to have a compatible train protection system with mainline traction protection systems such as; AWS, TPWS, ATP or ETCS with the mainline infrastructure, or a system that can facilitate the same level of protection without degrading any HVs protection system. This protection system helps to reduce the risk or prevent rail vehicles passing signals passed at danger (SPADs) leading to serious accidents from occurring.

G 8.3.3 Train protection reduces the risk of:

a) Overrun;
b) Overspeed; and
c) Misrouting into an incompatible running line.

G 8.3.4 Local instructions to mitigate risk scenarios could be agreed upon with all affected parties and the IM. This could help reduce risks while sharing the mainline with urban rail vehicles like:

a) Reduced heavy vehicle speeds during urban rail operations; or
b) Double blocked schemes; or
c) A combination of both a) and b) or additional mitigation processes that will support train protection.

G8.4 Train Detection

Guidance

G 8.4.1 RIS-0728-CCS sets out guidance and requirements on Infrastructure Based Train Detection Systems used on the mainline railway. The RGS GKRT0028 sets out guidance and the interface requirements between rail vehicles and infrastructure based train detection systems, including the track section parameters needed for their compatibility.

G 8.4.2 If light rail vehicles are to be operated where track circuits, axle counters or treadles are employed to establish train detection on the mainline network, it is good practice to establish the ability of the light rail vehicle to correctly operate these devices as part of the assessment of route compatibility.

G 8.4.3 Areas for consideration include:

a) The effect of low axle load on electrical continuity between wheel and rail and on the ability to reliably operate treadles;
b) Any features, such as resilient elements in wheels or the absence of an axle in independent wheel designs, which could interrupt electrical continuity between wheel treads;
c) The influence of wheel profile and geometry, including flange depth, thickness, on electrical continuity between wheel and rail and on the ability to reliably operate axle counters and treadles;
d) The effects of very short or long inter-axle spacings which could cause loss of detection by track circuits;
e) Vehicle front or rear overhang from bogie position.
f) To determine the adequacy and compatibility of train detection equipment used with proposed rail vehicle traction modes, like battery traction as an example, which might be technically incompatible with specific train detection methods or equipment

G 8.4.4 This is likely to be relevant also in situations where train detection is used for purposes other than signalling, such as the activation of lineside equipment.

Part 9 Energy

G9.1 General electrification

Guidance

G 9.1.1 Where there is an electrification system specifically for use by an urban rail vehicle operator only, on the mainline infrastructure, then safety authorisation would be required. If the electrification system was used by heavy rail rolling stock on the mainline railway it would fall under the scope of RIR and require compliance to the ENE (NTSN) to ensure compatibility.

G 9.1.2 A clear understanding of responsibilities for the maintenance, electrical isolation and emergency processes that will need to be understood for operation of either a single power system or the transition between different power networks. Responsibilities between a non-mainline IM and the mainline IM are required to be fully understood by all parties for normal and emergency scenarios.

G 9.1.3 Discontinuous electrification on the mainline may impose different operational risks to urban rail vehicles with power changeover as referenced in RIS-2713-RST if the urban rail vehicle is compatible with the mainline power system. However discontinuous charging zones or emerging battery charging technologies might be utilised by urban rail vehicles in order to charge traction batteries during their operation. Safe integration of this energy infrastructure is still required by the IM with all route users and mainline rail vehicles.

G9.2 Electrification modes

Guidance

G 9.2.1 There are several electrification interface scenarios between the non-mainline and mainline energy sub systems:

a) 750V dc or 1.5 kV dc overhead electrification segregated on non-mainline and mainline infrastructure as its own subsystem; or
b) 25 KV ac OHL on mainline infrastructure; or
c) 750 V dc third rail on mainline infrastructure; or
d) Ground based conductor bar charging; and
e) Internal power while on mainline infrastructure.

G 9.2.2 The standards listed below determine the requirements for both ac and dc systems on the GB mainline network:

a) GLRT1212 sets guidance and requirements for both the 750 V dc conductor rail energy subsystem, using top contact ground level contact line (conductor rail) and the safety of the 750 V dc conductor rail energy subsystem;
b) GMRT2113 sets out guidance and requirements for all rolling stock operating over the 750 V dc conductor rail energy subsystem;
c) GLRT1210 sets out guidance and requirements for a new, renewed or upgraded (ac) energy subsystem, which includes its interfaces with the rolling stock subsystem. These requirements also supplement those in the Energy (ENE) NTSN;

d) GMRT2111 sets out guidance and interface requirements to the ac energy subsystem for rolling stock operating over the GB mainline 25 kV ac electrified railway; and
e) RIS-1853-ENE which sets out guidance and requirements which can be used on a new, renewed or upgraded ac energy subsystem to supplement GLRT1210.

G 9.2.3 RIS-1854-ENE provides requirements and guidance for 750 V and 1.5 kV dc and the interface between energy and rolling stock subsystems for light rail and tram train overhead line systems.

G 9.2.4 If mainline electrification is used by urban vehicles which is separate from the non-mainline network like 25 kV ac OHL as an example, then a safe process can be put in place to switch rolling stock to the correct power supply mode.

G 9.2.5 The use of internal traction power sources maybe used to traverse sections of mainline infrastructure before recharging or refuelling at designated charging or refuelling points on the non mainline network to overcome operational constraints.

G9.3 Electrical bonding

Guidance

G 9.3.1 Protective electrical and vehicle bonding is important to ensure that electrical circuit integrity is maintained for traction return currents, potential fault currents and dangerous touch potentials for the safety of passengers and staff.

G 9.3.2 GMRT2113 and GMRT2111 include GB mainline requirements and guidance for bonding. These standards help support the safe transitioning between different electrification schemes used between non-mainline and mainline railways.

G 9.3.3 RIS-1854-ENE provides further guidance for 750V and 1.5KV dc overhead supply systems and includes vehicle bonding requirements.

G9.4 Current leakage protection

Guidance

G 9.4.1 Urban rail vehicles that have the design capability to use the mainline 25 kV ac OHL would still rely on commissioning testing activities for validation to ensure system compatibility, interoperability to identify levels of current leakage from occurring that may lead to a detrimental effect on other rail infrastructure or signalling systems.

G 9.4.2 Leakage currents between ac and dc systems in close proximity can be demonstrated through assessment to place in mitigation to prevent the premature structural failures of infrastructure assets.

G 9.4.3 RIS-1855-ENE low voltage power supplies in electrified areas provides a good reference source on the control of stray currents to minimise the current transfer between different electrical power systems. This standard considers the dangers of stray currents between ac and dc traction supplies and low voltage station circuits to prevent hazardous touch voltages.

G9.5 Energy metering

Guidance

G 9.5.1 The LOC&PAS NTSN includes a requirement for an onboard energy measurement system (EMS), to record energy usage under the scope of the RIR and send compiled energy usage data wayside to the IM for billing purposes.

G 9.5.2 GMRT2132 sets out GB practice for the measurement and recording of energy data, for the IM.

G 9.5.3 A clear understanding towards the energy data required when transitioning onto the mainline infrastructure would be helpful in recognising the responsibilities when sharing power systems or for billing and the accuracy of energy use, if exempt to the scope of RIR and compliance with NTSNs.

G 9.5.4 If the electricity supply used by an urban rail operator transitions onto the shared mainline network for use only by a singular RU of which they are the owner then all energy can be billed directly to them for traction powered used.

G 9.5.5 Any power supply that is shared through multiple transport operators is likely to enter into an agreement through the owner of the supply to determine accurate records for billing purposes, which may require a metering system to facilitate accurate billing, for example:

a) Non-mainline network power supply infrastructure that is overlaid onto the shared mainline infrastructure and used by multiple RUs; and
b) Non-mainline network power supply infrastructure transitioning to 25 kV ac OHL.

Part 10 Operations

G10.1 Signalling systems or methods of operation

Guidance

G 10.1.1 The Track Access Agreement that provides access to the mainline network is subject to the times as defined in the Train Planning Rules and Engineering Access Statement for an operator. It is good practice to engage with the IM to understand the requirements and constraints of operating urban rail vehicles on the shared mainline infrastructure.

G 10.1.2 Where HVs and LVs operate over the same route there are three approaches to controlling the operations of both traffic types:

a) Segregated traffic operation (see *G10.2*); or
b) Partially segregated traffic operation (see *G10.3*); or
c) Fully integrated traffic operation (see *G10.4*).

G 10.1.3 If the area of shared operation contains legacy heavy rail standard signalling assets then these would normally be used to control the operation of light rail non-interoperable vehicles, unless an alternative system providing an equivalent level of safety compliance is used. This is to ensure that the level of protection afforded by existing systems is not reduced, and to retain the flexibility of operation for HVs.

G 10.1.4 It might be decided to install fixed equipment specific to light rail operation on the mainline network, for example to enable higher traffic volumes or flexible regulation of light rail traffic. If this is the case, it is good practice for such equipment to be clearly denoted as specific to light rail operations, in order to reduce the likelihood of possible confusion for operators of heavy rail services. Possible examples of equipment specific to light rail infrastructure include:

a) Track;
b) Switches and crossings; and
c) Signalling assets.

G 10.1.5 It is good practice not to overlay light rail signalling control systems directly onto shared infrastructure used by both modes, This might create a risk of confusion between service operators. This might be considered as practical depending on the use of the network and appropriate risk assessments for a proposed project.

G 10.1.6 It is good practice that where local conditions require greater flexibility for light rail operations, heavy rail compatible signalling enhancements are considered initially.

G 10.1.7 Where heavy rail operations would not be unduly affected, the extended capabilities of light rail vehicles (LVs) (such as enhanced braking) can be considered for use with legacy heavy rail operating provisions. This could include forms of enhanced permissive working utilising subsidiary signalling aspects, such as Proceed on Sight Authority (PoSA). A specific example would be an overlay light rail service on a freight only branch line, where subsidiary aspects are provided for extended sections under heavy rail operation. Light rail services could utilise such indications as a line of sight

authority similar to tram signalling, subject to risk based assessment of local technical/operational infrastructure conditions.

G10.2 Segregated traffic operation

Guidance

G 10.2.1 Segregated traffic operation is a method of separating light rail or non-interoperable vehicles from standard heavy rail rolling stock on a shared route. This would normally involve shared use of a section of legacy heavy rail infrastructure suited to the overlay of a metro, light rail or tram service operation. Such arrangements require operational provisions for providing a residual heavy rail service on specific parts of the route in question. Such residual services may include overnight or off-peak freight paths which would require limited access to a section of railway normally occupied by light rail or non-interoperable vehicles. Some common types of segregated traffic operation are:

a) Temporal separation; or
b) Infrastructure scheduling; and
c) Full segregation.

G10.2.1 Temporal separation

Guidance

G 10.2.1.1 Temporal separation describes when a track section has specified time allocated for the operation of light rail services, with corresponding time allocated to heavy rail operation on the same track section. Each mode only operates when the other is not operating. Physical capacity for each mode remains unaffected due to the independent hours of operation.

G 10.2.1.2 A specific example could be an overlay light rail service on a freight only branch line, where the freight services are only operated at night. In this example operation of LVs would be allocated to daytime hours, with specified access periods for overnight freight to serve facilities on the full length of shared route.

G 10.2.1.3 Temporal separation is not suited for the interoperation of heavy rail passenger services with light rail services due to passenger demand for both services coinciding in the same time periods.

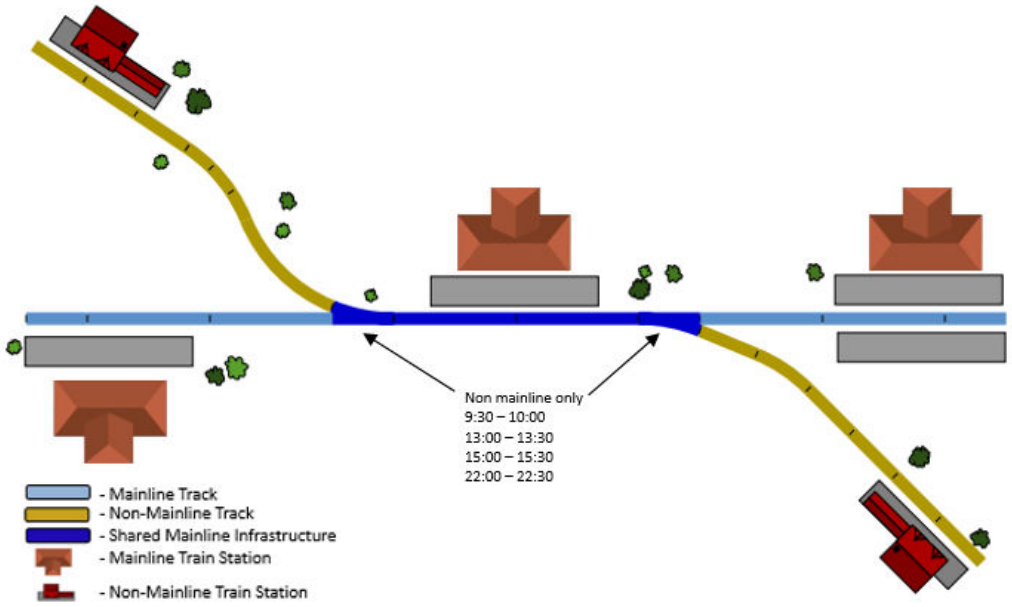

Figure 2: Temporal separation

G10.2.2 Infrastructure scheduling

Guidance

G 10.2.2.1 Infrastructure scheduling is a means of achieving concurrent operation of both heavy and light rail modes on the same infrastructure, or on infrastructure used by heavy and light rail services that is physically connected. Specified route sections can only be utilised by one traffic mode during periods when the other traffic mode is prevented from accessing the sections concerned. This is often achieved through some form of physical lockout capability, enabling a portion of route to be physically protected against incursion by the non-operating traffic mode. This might include through the use of trap points, derailers or other means. Physical capacity for one or both modes is reduced at suitable times to enable temporary concurrent operation.

G 10.2.2.2 A specific example could be an overlay light rail service on a freight only branch line, where daytime access is required for freight to serve local facilities on the route. Double track light rail service could be provided during peak hour operation, but one track allocated for freight services during off-peak hours with single-track working for light rail services continuing on the other track. Alternatively light rail service to a portion of route could be curtailed while heavy rail operations are undertaken at intermediate freight sites.

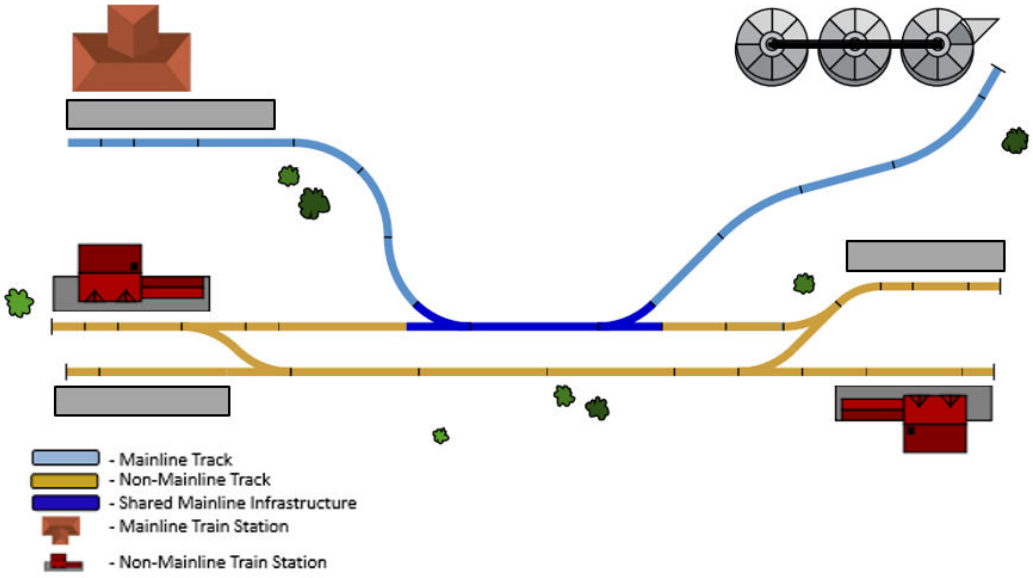

Figure 3: Infrastructure scheduling

G10.2.3 Full segregation

Guidance

G 10.2.3.1 The infrastructure used by heavy and light rail services may share the same alignment, but are not physically connected for the purpose of normal service operation. Physical demarcation could be provided, however limited clearances might prevent this at certain locations. The two modes operate adjacent to but independently of each other. Physical capacity for each mode is permanently reduced for the length of the affected area, to enable concurrent light/heavy rail operation sharing this kind of alignment.

G 10.2.3.2 Whilst the two modes operate independently of each other, there is still likely to be some interaction. For example there is likely to be some form of joint infrastructure management to enable operational access and routine or reactive maintenance and a physical connection might be provided for use in non-routine situations or for maintenance vehicle access. Depending on the detail of the operation there might also be a need for interaction in normal service operation, for example if there are any level crossings spanning the alignment.

G 10.2.3.3 A specific example could be a segregated light rail service operating a single-track service in the same corridor as a single-track heavy rail line, on a former double-track heavy rail alignment.

G 10.2.3.4 As there is no operation of heavy rail rolling stock on the light rail infrastructure, under full segregation it might not be appropriate to utilise legacy heavy rail signalling assets on the light rail infrastructure for the control of light rail operations (see *G 10.3.1*), for example where this would differ from the control and signalling equipment on the rest of the light rail network. Factors to consider include:

a) Drivability

b) Management of asset maintenance.

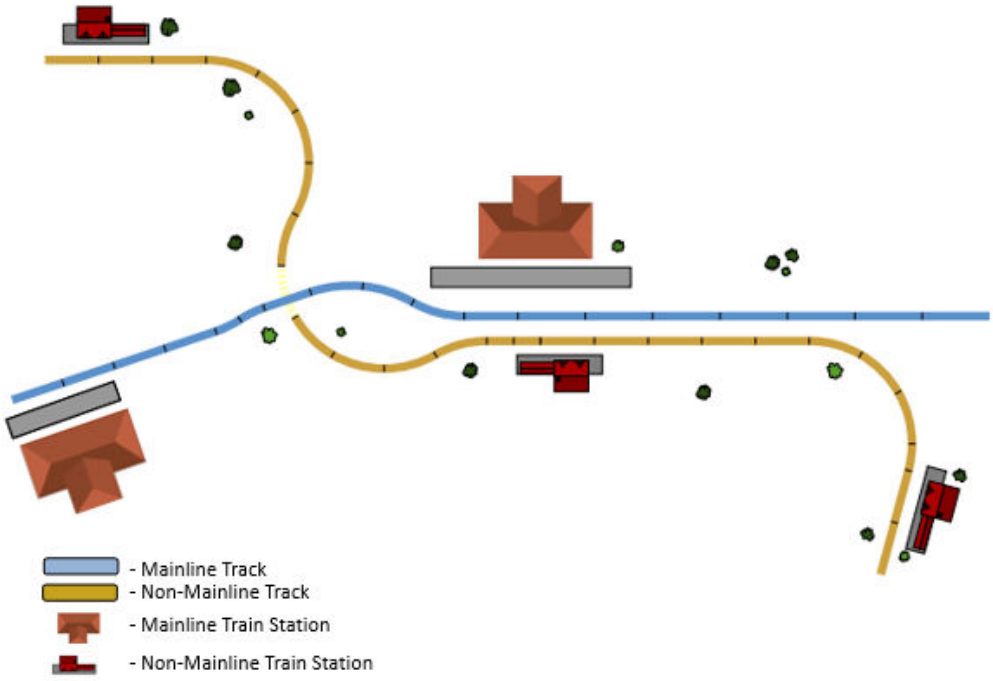

Figure 4: Full segregation

G10.3 Partially segregated traffic operation

Guidance

G 10.3.1 Partially Segregated Traffic Operation is a method of separating light rail or non-interoperable vehicles from standard heavy rail rolling stock on shared infrastructure assets in service. This would normally involve shared use of a section of legacy heavy rail infrastructure, suited to the overlay of a metro, light rail or tram service operation. Such arrangements require infrastructure provisions for operation of both heavy and light rail services concurrently during normal traffic hours. In this case positive protection between HVs and LVs encroachment is provided by physical infrastructure separation at local control points or remote interlockings.

G 10.3.2 Although signalling appropriate to each mode may be used to enable access to the affected section when it is available, the other mode requires excluding by physical means when the section is occupied. In such cases section occupation and clearance would be determined by application of suitable train detection systems, or operational reporting methodologies dependent on local circumstances or nature of physical infrastructure. This would include scenarios applicable to both the normal and degraded operating conditions, and require robust operational processes to cover traffic separation in the event of infrastructure failures or incidents.

G 10.3.3 A specific example would be a short section of shared route where a heavy and light rail alignment intersect, for example due to a lack of physical space or available capacity to permit full segregation of independent lines through a defined area. In

such cases local interlockings at the convergence and divergence points would be configured with additional safety mitigations for traffic segregation. These could take the form of signalling interventions, revised track configuration layout and overlay protection systems, or a combination of all three dependent on the level of assessed site specific risk. Any movement authority issued would need to ensure that the applicable route was set between entry and exit points, with infrastructure mitigations preventing access to the same route by another mode. Vehicles of a similar type may be permitted to operate concurrently, but heavy and light rail modes would be effectively segregated through shared interlocking.

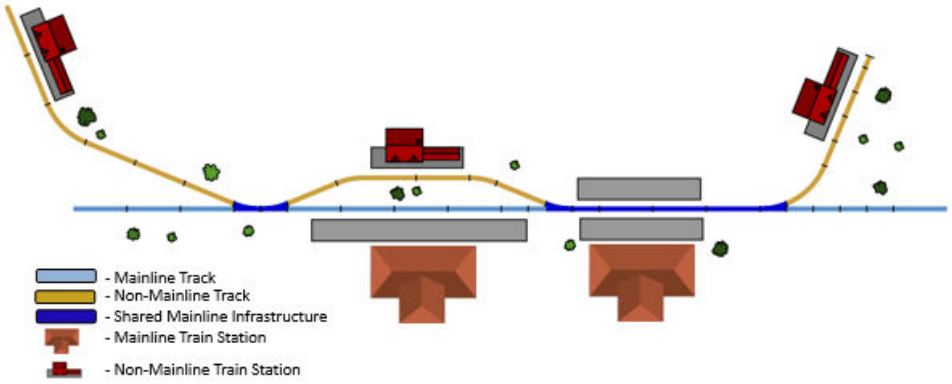

Figure 5: Partial segregation

G10.4 Fully integrated traffic operation

Guidance

G 10.4.1 Fully integrated traffic operation is a method of providing route availability to both light and HVs under normal service conditions. This is achieved through application of a combination of mitigation measures intended to reduce the likelihood and consequences of a potential collision between light and heavy rail rolling stock. The consequences of a collision under such circumstances would potentially be worsened by incompatibility of vehicles from each mode, even at relatively low speeds.

G 10.4.2 Reliance on signal observation alone in mixed traffic conditions is unlikely to provide sufficiently low collision probability to reduce the risk as far as is reasonably practicable, and additional mitigations are likely to be applied.

G 10.4.3 These can include in no hierarchical order:

a) Signalling interventions, such as extended overlaps, conditional route setting based on vehicle identification; or
b) Revised track configurations; such as the use of trap points, derailers, auto-restore systems; or
c) Signalling protection systems, such as TPWS, ATP, ETCS, Indusi, tripcocks; or
d) Infrastructure restrictions, such as speed restrictions, double block working; and
e) Enhanced vehicle compatibility, such as improved crashworthiness.

G 10.4.4 When determining suitable protection measures to support fully integrated traffic operation, the following scenarios are likely to be relevant:

a) Head on collision between LVs and HVs; or
b) Rear end collision between LVs and HVs; or
c) Head on collision between similar vehicles; and
d) Rear end collision between similar vehicles.

G 10.4.5 The list above is not exhaustive, and the measures listed are not mutually exclusive. New variants can be overlaid alongside legacy infrastructure where required.

G 10.4.6 It is important for the protection arrangements provided for each mode to be compatible with those of the other mode and be appropriate to the performance characteristics of the vehicles concerned (particularly their braking performance), noting that these could differ significantly from each other.

G 10.4.7 Additionally, compliant and interoperable LVs may assume legacy protection systems as a mitigation, if already installed on the shared infrastructure in question.

G 10.4.8 If, in order to support shared running, protection systems are to be introduced to rolling stock and networks where those protections are not otherwise employed. This is the case on the Tyne and Wear metro where tampers and other OTP have the Indusi train protection system fitted to travel on the light and heavy rail network safely. Chiltern Railways operates trains with tripcocks for compatibility with London Underground infrastructure that uses trainstops.

G10.5 Trailable points

Guidance

G 10.5.1 If the mainline infrastructure includes trailable points, a compatibility assessment will consider whether the LVs can drive the points fully to the reverse position. Issues to be considered include:

a) Axle loading; or
b) Flange profile; and
c) Return spring pressure, noting that the return spring pressures used on mainline infrastructure may be higher than those on light rail networks.

G 10.5.2 Trailable points include:

a) Train operated points; or
b) Run-back catch points; or
c) Spring points; and
d) Hydraulic auto-restoring points.

Note: Hydraulic auto-restoring points are in use on the Esk Valley line.

G10.6 Degraded modes

Guidance

G 10.6.1 The process of safe integration of light rail operation with mainline operation will include assessment of the method of operation when the signalling or protection systems are in degraded mode. This will consider the potential consequences of a collision, as set out in clause *G 10.4.1*, and identify appropriate control measures to be implemented so that the associated risk is reduced so far as is reasonably practicable.

G10.7 Recovery of rail vehicles

Guidance

G 10.7.1 It is good practice to have recovery plans in place to respond to a failed rail vehicles operating on the mainline network. This could be for some of the following scenarios:

a) Derailment;
b) Collision;
c) Damaged wheels; or
d) Failed rail vehicle.

G 10.7.2 These plans can provide a process of emergency vehicle recovery methods in the described scenarios.

G 10.7.3 RIS-2780-RST sets out guidance and requirements on recovering vehicles on the mainline in respect to wheel damage and lifting and jacking of rail vehicles.

G 10.7.4 Having the capability to recover urban rail vehicles that might not be compatible with typical mainline rail vehicles is essential for developing recovery plans in the event of an incident. Typically recovery manuals and process are supplied by a vehicle manufacture, which may need tailoring to fit the operational environment while running on the mainline.

G 10.7.5 The Rule Book GERT8000 module TW5 sets out instructions for preparation and movement of defective and isolated vehicles including on train equipment in the event of a train failure. This good practice and process can support and help shape a recovery document for an organisation to safely and quickly manage incidents in service.

G 10.7.6 RIS-3437-TOM gives requirements for RUs to manage defective on train equipment and whilst targeted at mainline operation, it could be at least partially relevant to other operations.

G10.8 Signage

Guidance

G 10.8.1 The rail standards for signage on the mainline are identified below.

a) RIS-3413-TOM, provides guidance, requirements and information on signs for access to the railway;

b) RIS-3784-TOM, provides guidance and requirements for signage for power changeover locations;
c) RS521, provides information on signals, hand signals, indicators and signs handbook; and
d) RIS-0733-CCS, provides guidance and requirements on operational lineside signs.

G 10.8.2 It is good practice that lineside signage be designed in such a way as to minimise driver confusion, given the different types of traffic using a route. Unless the layout or operating arrangements are so complex that it will lead to an over proliferation of signs, consideration of this may be given to a system in which all signs apply either to LVs alone or to HVs alone, with each type of sign being distinctively identified.

G 10.8.3 RIS-0733-CCS contains a list of requirements and guidance on signs provided on the GB mainline railway. This standard also lists the industry agreed process to introduce new or existing lineside signs. LVs and metros might use different signs on their network for driver familiarity. Good practice for the potential use of these signs for train operations on the mainline would be through engagement and acceptance with the IM and other affected RUs.

G 10.8.4 If signs are required for light rail operation on the mainline, it is the responsibility of the LV operator to engage with other affected parties and the IM to agree these arrangements. It is good practice for the LV operator to ensure that other affected train operators and freight operators are fully involved, as required by RIS-8270-RST.

G10.9 Safety of people on or near the line

Guidance

G 10.9.1 For all forms of shared running and for parallel running in a situation where the LV and HV routes are not separated by a fence or other barrier, the risk to trackside workers and to passengers detrained in emergency might be assessed with measures put in place to reduce the risk so far as is reasonably practicable.

G 10.9.2 The risk assessment might consider, as a minimum the following:

a) Electrification systems, in situations where the equipment has characteristics which differ from those of the standard equipment used on the mainline or where an adjacent system is electrified but the mainline IM controlled infrastructure is not;
b) The availability of places of safety and in particular how the safe use of these may be affected by traffic on an adjacent system;
c) Variations in the speed and character of trains; and
d) The effectiveness of trackside warning systems for both HVs and LVs vehicles.

G 10.9.3 Briefing staff and training would be essential for staff affected by any new operations or introduction of new vehicles operating on or running adjacent to the mainline.

Part 11 Electromagnetic compatibility

G11.1 Electromagnetic compatibility

Guidance

G 11.1.1 RIS-0725-CCS sets out a standard on electromagnetic immunity levels of infrastructure-based train detection systems, to provide a generally acceptable level of electromagnetic compatibility (EMC) with emissions from trains. This allows designers and operators of trains to demonstrate technical compatibility.

G 11.1.2 GMGN2694 provides guidance on EMC between rolling stock and some control, command and signalling (CCS) trackside systems. This guidance identifies possible risks and locations of induced couplings between the current drawn by an electric train and control, command and signalling (CCS) trackside subsystems on the mainline railway.

G 11.1.3 The BS EN 50121 is a series of standards that covers EMC limits, levels and measurement techniques that help manage EMC, covered by the European EMC directive 2014/30/EU. EN 50121 Railway applications. Electro-magnetic compatibility is broken into the following parts:

a) Part 1: Generalities
b) Part 2: Issuance of the entire rail system to the outside world
c) Part 3-1: Rolling stock. Train and complete vehicle
d) Part 3-2: Rolling stock. Devices
e) Part 4: Issuance and immunity of signalling and telecommunication devices
f) Part 5: Issuance and immunity of fixed power supply installations and associated equipment.

G 11.1.4 This suite of standards provide a means of testing and complying to maximum EMC limits in the various interfaces required within the rail environment and its proliferation into the external environment outside the boundary of the mainline railway.

G 11.1.5 Electromagnetic compatibility is a key part of demonstrating safe integration when introducing urban rail vehicles into the mainline system.

Appendices

Appendix A Sheffield Supertram case study

A.1 Case study

Guidance

G A.1.1 The Sheffield to Rotheram tram-train scheme was the first transport service in the UK to use both street tramway and the national rail network.

G A.1.2 In 2009 the DfT announced this pilot project to trial the technology in the UK and assess the potential to extend similar schemes to other cities in the UK. The idea was to demonstrate the cost benefits of this style of integration while encouraging passenger growth and access by safely adapting this technology in developing a more connective transport system. In May 2012 ministers approved the program which was expected to cost around £18.7 million and was to be completed by December 2015. The cost had quadrupled by December 2016 which had pushed the projected completion date back to May 2018.

G A.1.3 This trial wanted to test the operational challenges and costs of running tram-trains from the national rail system (mainline railway) to help develop new industry standards.

G A.1.4 This was the first project of its kind in the UK which required Network Rail to test and secure industry approvals for several technical components, including track, signalling, and power configurations.

G A.1.5 The Sheffield to Rotheram program involved modifying existing national rail infrastructure by modifying the tram network and depot, and the purchasing of new Class 399 rolling stock capable of operating on both the mainline railway and the tram network.

G A.1.6
a) Network Rail was responsible for the infrastructure project to modify the national railway part to allow tram-trains to run. This included designing and managing works required to modify the national rail tracks, signalling and stations.
b) The DfT was responsible for overseeing the project and setting requirements for the tram-train service. Funding was largely provided through two capital grants from government to part fund some of Network Rail's infrastructure modifications and funding towards the procurement of the tram-train vehicle and to modify the tram network.
c) South Yorkshire passenger transport executive was responsible for modifying the tram network and buying the new tram-train vehicles. It also contributed towards the funding for both of these projects.

G A.1.7 South Yorkshire Mayoral combined Authority (SYMCA) was the operator that introduced the new rolling stock into service.

G A.1.8 *The Sheffield to Rotheram tram-train project: investigation into the modification of the national rail network* published by the National Audit Office is a helpful document which looks at the reasoning behind the increases in cost of the schemes which helps provide some learning from these key findings.

G A.1.9 The project was to help understand true costs and provide industry learning in this area, here are some of the learnings from the project.

A.2 Design and implementation phase

Guidance

G A.2.1 Increased costs were due to some of the following factors:

a) Future proofing rail power supplies;
b) Work that was more complex than initially assumed;
    i) The design stage had to be further extended because of the complex integration of national rail and tramway technologies
    ii) The electrification design and safety case work was more complex than expected
    iii) The technical innovation demanded by the project's objectives needed more time and expert resources than the original estimate. Network Rail had to deviate from 12 industry infrastructure design standards to accommodate the tram-train service.
c) Initial assessment was not accurate of the asset condition which lead to increased cost through renewals;
d) Changes that were made to detailed project specifications, such as signalling and traction power;
e) The confirmed tram-train vehicles differed from the agreed vehicle design assumptions used to inform infrastructure designs, leading to redesigns and delays.

A.3 Project management

Guidance

G A.3.1 The DfT requested UK Tram conduct a review of the whole tram-train program which was reported in 2015 which made recommendations on how to improve the management of the program.

G A.3.2 Some of the findings that were identified by the review:

a) Project design: The initial project specification under-estimated the complexity of the project. Change control was not well managed and contributed to additional costs.
b) Project management: The early involvement of a company in the design process did not work well due to planned milestone dates drifting.
c) Specialist expertise: The project lacked the necessary expertise and suffered from high staff turnover, which meant that complex technical issues were not sufficiently understood.
d) Poor design integration: Design integration was not managed well, especially for the interfaces between light and heavy rail systems and technologies.

e) The funding arrangement: This drove high-risk 'value' engineering decisions but these did not achieve expected savings when looked at in detail.

A.4 Technical infrastructure challenges

Guidance

G A.4.1 The DfT and Network Rail used the pilot to test the viability of running a new service on both street tramway and the national rail network.

G A.4.2 The main technical challenges tested in this pilot included:

G A.4.3
a) The safe operation of lightweight tram-trains when running on heavy rail and the additional signalling protection needed to safeguard them;
b) Signalling and operating the interface between the unregulated light rail and the fully signalled heavy rail route;
c) Track alterations needed to address vehicle derailment risk caused by the different wheel profiles needed to run on light and heavy network;
d) Traction power supply required to run on both systems;
e) Tram-trains' ride quality – the smaller light rail bogies and lower travel on their suspension can make tram-based vehicles more susceptible to problems with heavy rail tracks that are in a worn condition;
f) The need for low platforms to match those on the Sheffield tram system and the consequent potential for trespass and possible hazard from exposed running gear of heavy rail trains next to low platforms; and
g) Various problems relating to the different loading gauges (maximum height and width for railway vehicles) of tram-trains and normal trains.

A.5 Technical challenges and evidence gathering for the Introduction of rolling stock

Guidance

G A.5.1 A number of different commissioning tests were conducted to support evidence of safe integration before the introduction of the Class 399 into passenger service. Some of the testing uncovered issues which allowed confidence in the subsystem and allowed defects or software functions to be fixed and retested to provide evidence for the Notified Body (NoBo) review. These tests included the following:

G A.5.2
a) Wheel rail interaction with S2 tram wheel profiles
b) Signal sighting testing
c) GSM-R coverage testing at all signals at stations on route with signaller to passenger broadcasts
d) Visibility testing which included both factory and site testing for maximum vehicle speed instead of the proposed speed
e) Brake tare and crush loading tests including stopping distances
f) Ride quality testing
g) Audibility of AWS and detonators at maximum rolling stock speeds
h) Dynamic running tests

i) PRM compliant stations could support disembarking wheelchairs and mobility scooters
j) Traction power testing
k) Network Rail signalling testing
l) EMC and RFI testing
m) Automatic Vehicle Location AVL testing
n) Recovery testing of class 399 unit by locomotive
o) Possession process testing
p) Isolation procedure testing
q) Emergency scenarios.

A.6 Lessons learned

Guidance

G A.6.1 Carrying out all tests for the maximum rolling stock speed instead of the operating speed was proposed. This will prevent the requirement for future repeat testing to achieve the maximum vehicle speed if it is changed later in the vehicles life.

G A.6.2 If vehicle testing is broken down into sub sections or phases using items listed in the 17 items shown above, driver training can commence after each round of testing to gain training and competency as the project evolves. This could help provide competent drivers once testing is complete without further reliance on facilitating route access to deliver this training.

G A.6.3 Even though the rolling stock and infrastructure may be exempt from RIR compliance, where possible it may save time and cost benefits of not having to demonstrate safe non-compliance to RGS. This will have to be weighed against the requirements especially for a tram-train to remain compliant with all relevant legislation when not operating on the mainline railway network.

A.7 Project deviations

Guidance

G A.7.1 The project included 21 deviations from RGS in Table 3. These can be accessed through the RSSB website looking at the specific RGS issue for proposed alternatives to the requirements within the RGS.

G A.7.2 This is not necessarily an exhaustive list but provides an understanding of issues faced and measures used within this project to identify technical challenges and help demonstrate safe integration.

G A.7.3 If the railway operation is determined to be exempt from RIR then an entity does not have to seek a deviation through the RSSB standards committee. However, if an entity plans to do something that does not comply with a requirement in a RGS, it can ask a Standards Committee opinion on the proposed alternative. Advice and guidance on using alternative requirements can be found on RSSB's website. This may help while compiling evidence into the technical file ready for placing in service.

Title	RGS	Issue	Deviation number
Requirements for Rail Vehicle Structures	GMRT2100	5	15-038-DEV, 18-018-DEV
Vehicle Fire, Safety and Evacuation	GMRT2130	4	15-039-DEV, 18-019-DEV
Requirements for Defining and Maintaining the Size of Railway Vehicle	GMRT2149	3	15-094-DEV, 18-022-DEV
Visibility Requirements for Trains	GMRT2483	1	14-070-DEV
Sanding Equipment Fitted to Multiple Units and on- track Machines	GMRT2461	1	14-120-DEV
Compatibility Requirements for Braking Systems of Rail Vehicles	GMRT2045	3	18-020-DEV
Railway Wheelsets	GMRT2466	3	18-071-DEV
Power Operated External Doors on Passenger Carrying Rail Vehicles	GMRT2473	2	18-021-DEV
Hot Axle Bearing Detection	GERT8014	2	14-065-DEV
Requirements of Driving Cabs for Railway Vehicles	GMRT2161	1	14-122-DEV
Design Requirements for a Driver's Reminder Appliance (DRA)	GMRT2491	2	14-064-DEV
Air Quality and Lighting Environment for Traincrew Inside Railway Vehicles	GMRT2176	1	14-121-DEV
Braking Principles for Rail Vehicles	GMRT2045	3	15-050-DEV
On-board Energy Metering for Billing Purposes	GMRT2132	1	15-036-DEV
Overhead Line Equipment (OLE) Warning Line on Traction and Rolling Stock	GMRT2181	3	15-019-DEV
Requirements for Data Recorders on Trains	GMRT2472	2	15-051-DEV
Power Operated External Doors on Passenger Carrying Rail Vehicles	GMRT2473	2	15-057-DEV

Title	RGS	Issue	Deviation number
Braking System Requirements and Performance for Multiple Units	GMRT2044	4	15-035-DEV

Table 3: Table of project deviations

Appendix B TfW Core Valley Lines case study

B.1 Transformation of the core valley lines

Guidance

G B.1.1 The South Wales Metro initiative was approved in October 2013 which looked to transform public transportation in South East Wales by integrating heavy and light rail to create a more cohesive transportation network for the public.

G B.1.2 Network Rail transferred the Core Valley Lines (CVL) network over to Transport for Wales in March 2020 which allowed electrification projects to start on the CVL routes. The project decarbonised the routes with the intention of replacing diesel Class 15x fleets with electric traction.

G B.1.3 This set of projects were was part-funded by the European Regional Development Fund (ERDF) through the Welsh Government. The main aim was to refresh and modernise the rail network in south east Wales to provide improved connectivity to stimulate economic growth opportunities to communities within south Wales. This group of projects would also help deliver a better, more reliable and cleaner rail services for passengers.

G B.1.4 Railway lines to Aberdare, Coryton, Merthyr Tydfil, Rhymney and Treherbert all underwent improvement programs to meet the requirements of the project and new rolling stock that would be required to deliver these improvements. The operator for the CVL is Transport for Wales Rail Ltd (TfWRL) and the Infrastructure Manager (IM) is Amey Infrastructure Wales (AIW).

G B.1.5 Some of the challenges in refreshing infrastructure were finding technical solutions to reducing the time required and cost in removing listed structures across the route through areas of natural beauty and historic structures such as bridges and tunnels along these routes. Electrification capacity and new or modified infrastructure were also required as part of the overall project.

G B.1.6 Electrification solutions were required to allow cleaner alternative traction power sources to be utilised, challenges in incorporating discontinuous over head line (OHL) electrification through the route and sensitive structures within the routes. The reliance on multi-mode trains and the number of power change over locations (PCO) that were associated with discontinuous electrification.

G B.1.7 The discontinuous OLE required Catenary Free Sections (CFS) and Permanently Earthed Sections (PES). This helped drive the requirement for bi-mode electric/battery rolling stock to travel areas of non-electrification.

Definitions

Assessment Body	The independent and competent external or internal individual, organisation or entity which undertakes investigation to provide a judgement, based on evidence, of the suitability of a system to fulfil its safety requirements. Source: *CSM REA*
Automatic Train Protection (ATP)	A system using information of signal aspects, track speed limits, train speed supervision and driver reactions to prevent automatically a train passing a danger point (such as a signal at danger) or exceeding speed restrictions.
Automatic Vehicle Identification (AVI)	A system that uses technology to automatically identify and track vehicles.
Automatic Warning System (AWS)	Permanent magnets and electromagnets in the four foot of the track which generate magnetic fields which are detected and interpreted by the trainborne AWS receiver.
Common Safety Method for Risk Evaluation and Assessment (CSM REA)	Commission Regulation (EU) 402/2013 - Common Safety Method for risk evaluation and assessment.
Direct Traffic Control (DTC)	This method allows train movements to be controlled by direct instructions from a signaller. The signaller communicates directly with the driver to authorise train movements to ensure safe operation of train movement.
European Train Control System (ETCS)	The signalling, control and train protection part of the European Rail Traffic Management System designed to provide interoperability and standardisation across European railways.
good practice	A process or method that has been shown to work well; succeeds in achieving its objective(s); is widely accepted; and therefore can be recommended as an approach.
Heavy rail vehicle (HV's)	Heavy rail vehicles compliant to the GB mainline railway regulations, including commuter, intercity, high-speed, regional rail and freight services.
Indusi system	Indusi is an intermittent cab signalling system and train protection system.
infrastructure manager (IM)	Has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended), but is limited to those infrastructure managers who hold a safety authorisation issued in respect of the mainline railway. Source: *ROGS*
Light Rail Vehicle (LVs)	Including urban rail vehicles which is a modern equivalent of a tram vehicle and are often coupled vehicles as opposed to a singular tram vehicle.

Limited inter-working	System of operation in which heavy rail vehicles and urban rail vehicles each operate on distinct routes but the routes interact, for example by crossing or merging for a short distance.
LOC&PAS NTSN	Locomotive and Passenger Rolling Stock National Technical Specification Notice.
Metro vehicle	urban rail vehicle designed to run on network segregated from any other rail system and from road and pedestrian traffic
National Operations Publications (NOP)	The Rule Book is a series of documents that contain direct instructions for railway staff. They are termed as National Operations Publications within the Group Standards Code.
National Technical Rule (NTR)	A technical rule used for implementing the essential requirements in the circumstances listed in *RIR*.
National Technical Specification Notice (NTSN)	Document published by the Secretary of State pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 (as amended) which sets out the standards, technical specifications and technical rules in use in the United Kingdom as amended or varied from time to time. These may be standards to be complied with in relation to the design, construction, placing in service, upgrading, renewal, operation and maintenance of the parts of the rail system. For the purposes of these Regulations, the essential requirements for a project subsystem conforms with applicable National Technical Specification Notices and National Technical Rules. Source: *RIR*
Office of Rail and Road (ORR)	The independent safety and economic regulator for Britain's railways.
On or near the line	Within 3 m of the nearest rail of any line, and on the line itself. On a platform the term 'on or near the lie' applies only to the part of the platform within 1.25 m of the platform edge and only when an engineering or technical activity is taking place.
Parallel Running	System of operation in which heavy rail vehicles and urban rail vehicles operate on separate but adjacent routes, which could have different infrastructure managers.
Persons with Reduced Mobility (PRM)	No definition.
placing in service	All the operations by which a subsystem or a vehicle is put into its design operating state. Source: *RIR*
project entity	As defined in the Railways (Interoperability) Regulations 2011 (as amended): 'project entity' means, in relation to a project, a contracting entity or manufacturer or the authorised representative of a contracting entity or manufacturer.
put into use	Using vehicles in day-to-day operation under the safety management systems of railway undertakings.

Radio Frequency Identification (RFID)	A method of storing and retrieving data via electromagnetic transmission to a radio-frequency-compatible integrated circuit.
Rail Vehicle Accessibility Regulations (RVAR)	The Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010.
railway undertaking (RU)	Has the meaning given to the term 'transport undertaking' in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended, but is limited to any private or public undertaking the principal business of which is to provide rail transport services for goods and/or passengers, with a requirement that the undertaking must ensure traction. Source*: ROGS*
safe integration	The action to ensure the incorporation of an element (for example, a new vehicle type, network project, subsystem, part, component, constituent, software, procedure, organisation) into a bigger system, does not create an unacceptable risk for the resulting system.
safety acceptance	Status given to the change by the proposer based on the Safety Assessment Report provided by the assessment body. Source: *CSM REA*
Safety certificate	All mainline operators need a certificate or authorisation. Some 'lower-risk' non mainline operators do not need one. However, these operators must still have a safety management system.
Safety Management System (SMS)	The organisation and arrangements established by a transport operator to ensure the safe management of its operation. Source*: ROGS*
Shared Operation	System of operation in which heavy rail vehicles and urban rail vehicles operate over the same tracks. Also known as inter-working and joint running
signal passed at danger (SPAD)	Any occasion when any part of a train proceeds beyond its authorised movement to an unauthorised movement; 'unauthorised movement' means to pass: a) A trackside colour light signal or semaphore at danger, order to STOP, where an Automatic Train Control System (ATCS) or train protection system is not operational b) The end of a safety related movement authority provided in an ATCS or train protection system c) A point communicated by verbal or written authorisation laid down in regulations, or d) Stop boards (buffer stops are not included) or hand signals, But excludes cases in which:

	e) Vehicles without any traction unit attached or a train that is unattended run away past a signal at danger, or f) For any reason, the signal is not turned to danger in time to allow the driver to stop the train before the signal.
statement of compatibility (SOCAT)	Written notification by a railway undertaking of compatibility between the rolling stock and infrastructure. This notification specifies the equipment, the equipment configuration, operational requirements and limitations, route constraints and network factors within which compatibility has been assessed for network operations.
Statement of National Regulatory Provisions (SNRP)	Statement of National Regulatory Provisions
technical compatibility	An ability of two or more structural subsystems or parts of them which have at least one common interface, to interact with each other while maintaining their individual design operating state and their expected level of performance.
The Road Vehicle Lighting Regulations 1989 (RVLR)	Outline the rules and requirements regarding the lighting arrangements used on commercial and private road vehicles in the UK
The United Nations Economic Commission for Europe (UNECE)	UNECE is one of the five regional commissions under the jurisdiction of the United Nations Economic and Social Council
Train Protection and Warning System (TPWS)	A system mitigating Signals Passed At Danger and non-respect of permissible speeds.
tram-train	rail vehicle designed to run both on the mainline (heavy) rail network and on a network with some infrastructure shared with road or pedestrian traffic
tram	urban rail vehicle designed to run on a network segregated from any other rail system and not segregated from road or pedestrian traffic
transport operator(TO)	Any transport undertaking or infrastructure manager. Source: *ROGS*
transport undertaking	Any person who operates a vehicle in relation to any infrastructure but shall not include a person who operates a vehicle solely within an engineering possession. Source: *ROGS*
Wireless Train Control (WTC)	WTC uses wireless communication technologies to manage and control train movements.

References

The Standards catalogue gives the current issue number and status of documents published by RSSB: http://www.rssb.co.uk/standards-catalogue.

The governance arrangements for Railway Group Standards, Rail Industry Standards, National Operations Publications, and industry recommendations for revisions to National Technical Specification Notices are set out in the Railway Standards Code. Detailed management arrangements are in the complementary Standards Manual. Both documents are available on the RSSB website.

RGSC 01	Rail Safety and Standards Board (2024), Railway Standards Code
RGSC 02	Rail Safety and Standards Board (2024), Standards Manual

Documents referenced in the text

Railway Group Standards

GCRT5021	Track System Requirements
GERT8000	The Rule Book
GERT8073	Application of Standard Vehicle Gauges
GIRT7020	GB Requirements for Platform Height, Platform Offset and Platform Width
GIRT7073	Requirements for the Position of Infrastructure and for Defining and Maintaining Clearances
GKRT0028	Infrastructure Based Train Detection Interface Requirements
GKRT0075	Requirements for Minimum Signalling Braking and Deceleration Distances
GLRT1210	AC energy subsystem and interfaces to rolling stock subsystem
GLRT1212	DC conductor rail energy subsystem and interfaces to rolling stock subsystem
GMGN2542	Determination of Aerodynamic Rolling Moment Coefficient
GMGN2641	Rail Industry Guidance Note on Vehicle Static Testing
GMRT2045	Compatibility Requirements for Braking Systems of Rail Vehicles
GMRT2100	Rail Vehicle Structures and Passive Safety
GMRT2111	Rolling Stock Subsystem and Interfaces to AC Energy Subsystem
GMRT2113	Rolling stock subsystem and interfaces to DC conductor rail energy subsystem
GMRT2131	Audibility and Visibility of Trains
GMRT2132	On-board Energy Metering for Billing Purposes
GMRT2142	Resistance of Railway Vehicles to Roll-over in Gales

GMRT2173	Size of Vehicles and Position of Equipment
GMRT2466	Railway Wheelsets
GERT8006	Route Availability Number for Assessment of Compatibility between Rail Vehicles and Underline Bridges
GMRT2141	Permissible Track Forces and Resistance to Derailment and Roll-Over of Railway Vehicles

RSSB documents

GEGN8646	Guidance on the Common Safety Method for Risk Evaluation and Assessment
GMGN2694	Guidance Note on Rolling Stock Electromagnetic Compatibility with Trackside CCS Subsystems
RIS-0386-CCS	Rail Industry Standard on Signal Overrun Risk Evaluation and Assessment
RIS-0707-CCS	Management of Control Command and Signalling (CCS) Subsystem Failures, Faults and Defects
RIS-0725-CCS	Electromagnetic Compatibility of Train Detection Infrastructure with Rail Vehicles
RIS-0728-CCS	Infrastructure Based Train Detection Systems
RIS-0733-CCS	Lineside Operational Signs
RIS-0737-CCS	Rail Industry Standard for Signal Sighting Assessment Requirements
RIS-0745-CCS	Client Safety Assurance of High Integrity Software-Based Systems for Railway Applications
RIS-0784-CCS	The Management of Packet 44 Applications
RIS-0793-CCS	Level crossing systems
RIS-0794-CCS	GSM-R Train Voice Radio Systems.
RIS-0796-CCS	Train to Infrastructure RFID Compatibility
RIS-1853-ENE	AC energy subsystem and interfaces to rolling stock subsystem
RIS-1854-ENE	750 V and 1500 V DC Overhead Lines and corresponding Rolling Stock requirements
RIS-1855-ENE	Low Voltage Power Supplies in Electrified Areas
RIS-2003-RST	Certification and Registration of Heritage Rail Vehicles Operating on the GB Mainline Railway
RIS-2710-RST	Magnetic Track Brakes
RIS-2713-RST	System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock

RIS-2714-RST	Axle Bearing Condition Monitoring
RIS-2715-RST	Rolling Stock Subsystem and Interfaces to AC Energy Subsystem
RIS-2766-RST	Rail Industry Standard for Wheelsets
RIS-2773-RST	Format and Methods for Defining Vehicle Gauging Data
RIS-2780-RST	Rail Vehicle Structures
RIS-2795-RST	Track to Train RFID Compatibility
RIS-3413-TOM	Provision of Information and Signs for Access on the Railway
RIS-3437-TOM	Defective On-Train Equipment
RIS-3440-TOM	Operation of Heritage Trains
RIS-3782-TOM	Car Stop Markers Provision on Station Platforms
RIS-3784-TOM	Provision of Signage at Power Changeover Locations
RIS-3786-TOM	Trespass Risk Assessment
RIS-4472-RST	Engineering Requirements for Steam Locomotives and other Heritage Rail Vehicles
RIS-7016-INS	Interface between Station Platforms, Track, Trains and Buffer Stops
RIS-7700-INS	Rail Industry Standard for Station Infrastructure
RIS-7707-INS	Switches and Crossings
RIS-8270-RST	Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure
RIS-8273-RST	Assessment of Compatibility of Rolling Stock and Infrastructure - Gauging and Stepping Distances
RS521	signals, handsignals, indicators and sign handbook
TN2301	Train front-end visibility requirements and safe integration
TN2306	Engineering change (software and firmware)

Other references

Accessible Train Station Design for Disabled People: Code of Practice (November 2011)	A joint publication by the Department for Transport and Transport Scotland.
BS EN 15153-1:2020	Railway applications - External visible and audible warning devices - Part 1: Head, marker and tail lamps for heavy rail
BS EN 15153-3:2020	Railway applications - External visible and audible warning devices - Part 3: Visible warning devices for urban rail
BS EN 15227:2020	Railway applications. Crashworthiness requirements for rail vehicles

BS EN 17343	Railway applications — General terms and definitions
BS EN 50121	Railway applications. Electromagnetic compatibility Emission and immunity of the signalling and telecommunications apparatus
BS EN 50122-1:2022	Railway applications — Fixed installations — Electrical safety, earthing and the return circuit
BS EN ISO/IEC 27001:2023	Information security, cybersecurity and privacy protection. Information security management systems. Requirements
IEC 62443	Security for industrial automation and control systems
LRG 1.0	Tramway Principles and Guidance (TPG)
LRG 16.0	Wheel Rail Interface Guidance
PD CLC/TS 50701:2023	Railway applications. Cybersecurity
PRM NTSN	The Persons with Reduced Mobility (PRM) National Technical Specification Notice (NTSN)
Rail Safety (Amendment etc.) (EU Exit) Regulations 2019 (as amended)	These regulations correct inoperabilities in the railway safety regime in GB and northern Ireland following the UK's exit from the EU
Railway (Interoperability) Regulations 2011 (as amended) (RIR)	The Railways (Interoperability) Regulations 2011, Statutory Instrument 2011 No. 3066 (as amended)
Railway (Licensing of Railway Undertakings) Regulations 2005 (as amended)	The Railways (Licensing of Railway Undertakings) Regulations 2005 ("the 2005 Regulations") have defined the regime for licensing the operators of passenger and freight trains on the mainline railway in Great Britain.
Railway Safety Regulations 1999 (RSR99)	SI 1999/2444
Regulation(EU)402/2013	Commission Implementing Regulation (EU) No 402/2013 of 30 April 2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009
ROGS Safety Certificate and Safety Authorisation Assessment Manual	It provides guidance on the assessment process for applications under the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended)
ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
T1049	Safe integration: Operating Non-mainline Rail Vehicles on Mainline Infrastructure Guidance
T1194	RSSB research on Common Hazards for the Management of Industry Safety (CHAMOIS)
The National Institute of Standards and Technology (NIST) framework	This is a comprehensive guide designed to help organizations manage and reduce cybersecurity risks

The Network and Information Systems (NIS) Regulations 2018	Regulations to enhance the security of network and information systems critical for the provision of essential services and digital services in the UK
The Railway access management and license of railway undertakings regulations 2016	SI 2016/645
The Railways Act 1993 (as amended)	
The Road Vehicle Lighting Regulations 1989 (RVLR)(as amended)	The regulations set out the requirements for the fitting, maintenance, and use of lamps, reflectors, rear markings, and devices on road vehicles in the UK.
The Sheffield to Rotherham tram-train project: investigation into the modification of the national rail network	National Audit Office (NAO) published 4th of July 2017
The National Cyber Security Centre (NCSC) Cyber Assessment Framework (CAF)	It provides a systematic approach to evaluating how well cyber risks to essential functions are being managed

Other relevant documents

CEN-CENELEC guide 26	Railway applications – Preparation of standards for urban rail systems design, construction, manufacture, operations and maintenance
ERA 1209/063	European Union Agency for Railways (ERA) Clarification note on safe integration
Rail Vehicle Accessibility (Non-interoperable rail system) Regulations 2010 (RVAR)	set out accessibility standards for passenger vehicles used on non-mainline rail systems, such as light rail, trams, and certain heritage railways in the UK
Regulation (EU) 2019/2144	The regulation sets out type-approval requirements for motor vehicles, their trailers, and related systems, components, and separate technical units.
UNECE Regulation No 113	Uniform provisions concerning the approval of motor vehicle headlamps emitting a symmetrical passing beam or a driving beam or both and equipped with filament, gas-discharge light sources or LED modules
UNECE Regulation No 48	Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light-signalling devices