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National Rail

BRITAIN RUNS ON RAIL

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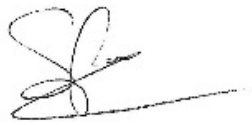
RDG Guidance Note Delivering Good Schemes – ETCS

Written by



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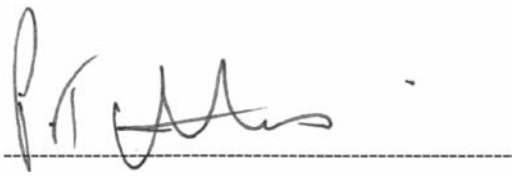

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Synopsis

This Guidance Note draws together good practice and provides advice and prompts for Train Operators dealing with proposals to re-signal the railway, using the European Train Control System.

Applicability

This Guidance Note has been prepared for Train Operators. However, its content may also be of use to others.

Issue record

This Guidance Note will be updated when necessary by distribution of a complete replacement.

After first issue, amended or additional parts of revised pages will be marked by a vertical black line in the adjacent margin.

Issue	Date	Comments
Issue 1.0	December 2017	First issue. Approved by Digital Railway Steering Group.

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Part 1 About this document

1.1 Responsibilities

1.1.1 Copies of this Guidance Note should be distributed by train operators (Operators) within the RDG Digital Railway Steering Group (DRSG) to persons within their own organisations for whom the content is relevant when considering re-signalling of the railway using the European Train Control System (ETCS).

1.2 Explanatory note

1.2.1 The Rail Delivery Group (RDG) produces Guidance Notes for the information of its members. The RDG is not a regulatory body and compliance with its guidance is not mandatory.

1.2.2 These Guidance Notes are intended to reflect good practice. RDG members are recommended to evaluate the guidance against their own arrangements in a structured and systematic way. Some or all parts of the guidance may not be appropriate to their operations. It is recommended that this process of evaluation and any subsequent decision to adopt (or not to adopt) elements of the guidance should be documented.

1.3 Guidance Note status

1.3.1 This document is not intended to create legally binding obligations between RDG members and should be binding in honour only.

1.4 Questions and supply

1.4.1 Any questions concerning the content or supply of this document should be directed in the first instance to your company's DRSG representative who will refer them onto the RDG as appropriate.

1.4.2 Copies of this Guidance Note may be obtained from the members' area of the RDG website or on request from the RDG New Technology Introduction Team.

1.5 Review

1.5.1 This document will be subject to periodic review, timed to align with the review of RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".

Part 2 Purpose and Scope

2.1 Purpose

2.1.1 This document seeks to introduce recommended practice, reflecting current thoughts and expectations, to provide an *aide memoire* to DRSG members on what to look for when considering future proposals to re-signal the railway. As such, it advises members on that recommended practice, providing the opportunity for members to be better informed and to consider aligning their interests. The document also prompts Operators to seek early engagement with the Infrastructure Manager (IM) and to use all opportunities to influence client specification at that early stage, to allow incorporation into the project planning and funding process, and reducing the need to introduce late changes that would involve significant re-work.

2.1.2 It is assumed that the reader will be familiar with RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling". The provisions of that document are sufficiently high level to remain relevant to a proposal involving ETCS. This document does not replicate RDG-GN040 and concentrates on providing supplemental guidance around ETCS, within an identical structure.

2.2 Scope

2.2.1 This guidance applies to employees of Operators who are members of the DRSG and who may be required to interface with an ETCS proposal and those responsible for ensuring their levels of knowledge and competence.

2.2.2 This guidance considers ETCS deployments up to and including Level 2 Signals Away (*i.e.* train location and train integrity supervision continue to rely on trackside equipment such as track circuits or axle counters).

2.2.3 No distinction is made between the various forms of re-signalling that can be proposed – whether renewal, enhancement, life extension, re-control, or re-lock.

Part 3 Definitions

The definitions within RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here, unless otherwise advised. The following additional definitions also apply.

Automatic Train Operation (ATO)	As a term, ATO covers different levels (grades) of automation: • from the driver still maintaining control of most functions; • through semi-automatic train operation where the setting of the train in motion and stopping is automatic, leaving the driver responsible for door operation and intervention if the system fails; • towards increased automation, up to the point where there is no train driver or on-board attendant. It is likely that ATO on Network Rail will require ETCS to be deployed. However, the provision of ETCS does not automatically mean that ATO is a scheme output
Data hole	A temporary loss of GSM-R data connectivity between train and Radio Block Centre. This may form part of the scheme design, especially at locations where there would be rarely a requirement to bring trains to a stand
Depot	A location that permits trains to be stored (awaiting use), stabled, maintained or formed up (changes to consist). Can apply to both passenger and freight. For the purposes of this document, this definition also includes yards and stabling locations (except stations)
Digital Railway Steering Group	Part of the RDG's meeting architecture. DRSG brings together Operator representatives and provides input and direction on their behalf into the Digital Railway Programme
Enhancement	For the purposes of this document, expanding the capability of the infrastructure to advance customer outcomes around one or more of: a) performance (*e.g.* improving punctuality); b) journey time (*e.g.* enabling higher speeds); c) safety (*e.g.* enhanced train protection, speed control); d) capacity (*e.g.* reducing headways or allowing heavier loads); e) enabling efficiencies (*e.g.* smoothing speed profiles); or f) realising latent potential of rolling stock (*e.g.* removing constraints)
European Train Control System	Often abbreviated to ETCS. A train control system that provides Automatic Train Protection and movement authorities via an in-cab signalling system, offering common standards across Europe on main lines in support of interoperability and an open market for rail services. ETCS is also being installed outside Europe. ETCS is one of the four components of European Rail Traffic Management System (ERTMS) – the others being GSM-R, Traffic Management and European Rules. ETCS and ERTMS are often used interchangeably but mean different things
Full Supervision	An ETCS operating mode where the on-board equipment has all train and track data available required for complete supervision of train movements against a dynamic speed profile. This is the normal operation mode for ETCS, affording the highest level of supervision available
Movement Authority	Permission for a train to proceed to a specific location as a signalled move

Network	The main line infrastructure controlled by an Infrastructure Manager in Great Britain, comprising railway tracks, signalling and electrification systems, bridges, tunnels, level crossings and viaducts, together with sidings and connections to third-party controlled infrastructures. Typically, the extent of the Network will be shown in the Sectional Appendix.
No contact time	The length of time that a train can be out of contact with a Radio Block Centre before the movement authority is cancelled and the brakes automatically apply. Within GB, a national value is likely to be applied
Operator	*The definition within RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" is replaced by the following* Any public or private undertaking the principal business of which is to provide services for the transport of goods and/or passengers by rail, with a requirement that the undertaking must ensure traction. This also includes undertakings which provide traction only
Overlay	Section of the conventionally-signalled railway to which ETCS has been added whilst some or all existing fixed signals remain. Trains not fitted with working ETCS on-board equipment or driven by non-ETCS trained personnel can continue to be planned and operated
Packet Switching	A mode of data transmission in which a message is broken into several parts which are communicated independently, over whatever route is optimum for each packet, and reassembled at the destination. Can apply to audio and video, as well as data transmission, and is used to enhance the stability and efficiency of a communications network. Packet switching, an enhanced means of data transmission, has greater capability to support ETCS schemes
Reversible signalling	The provision of signalling on a track to permit train movements in either direction, whether for planned or emergency use, with such movements protected as appropriate. May also be called bi-directional signalling
Signals Away	The removal of all, or the majority of, lineside signals, with information provided to drivers via in-cab displays. Any signals that remain may be provided either to simplify provision around complex layouts or to facilitate local shunting moves
Staff Responsible	An ETCS operating mode which allows the driver to move the train under his/her own responsibility in an ETCS equipped area, *e.g.* where a Movement Authority cannot be received by the train
Standage	The length of the train that can stand on a particular piece of track, without interfering with other train movements, taking into account standback distance from any signal and stopping tolerance
Supervised Location	The position considered by ETCS as the furthest point that a train shall not pass without potentially being in a place of danger
Track Ahead Free	An ETCS function that allows the Radio Block Centre to transmit a Full Supervision Movement Authority from the current position of the train if the driver confirms (by responding to an on-board request) that there is no train/vehicle between the train and the signal or marker board ahead
Transition	The change from one system of train protection to another, usually from systems using AWS or TPWS to ETCS, or *vice versa*, but also the change between full signalling and more manual processes, such as those encountered within depots

Underlay	Section of the railway converted to full ETCS operation, with layouts optimised for ETCS, then fitted with temporary lineside signals to allow for the continued operation of trains not fitted with working ETCS on-board equipment

Part 4 Background

No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".

Part 5 Comparing Renewals and Enhancements

No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".

Part 6 Core Principles

The core principles within RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here, unless otherwise advised. The following additional principles also apply.

ETCS is intended as a standard European framework. In the GB context, a Reference Design has been developed to ensure standardisation of application across the Network, with an expectation that local deployments will not introduce additional training, resource, operational or maintenance requirements or constraints.

Being a software based system, ETCS requires greater precision when considering operational objectives and requirements before scheme design commences. This needs to consider the full range of operational scenarios, placing greater emphasis on early engagement with projects by Operators.

With regard to RDG GN-040 6.2 (d), Operators should consider how competency requirements in ETCS can be identified, developed, delivered and demonstrated to allow staff and suppliers to fulfil their roles. Also, how such individuals might need to be supported through additional training, familiarisation or the provision of additional resource, at least until the provision of ETCS becomes more commonplace.

Part 7 Check-lists

N.B. Very few re-signalling schemes will require detailed deliberation of all items in these lists, or more detailed iteration of every one of the Operational Requirements in Appendix B. Nevertheless, it is recommended that each topic should be examined in turn.

The check-lists within RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here. This section contains additional guidance that should be considered.

Subject area	Summary of items to be considered	Rationale for that consideration
7.1 Scheme Governance	Although no additional guidance is offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling", the importance of active Operator engagement within a properly constituted and robustly applied governance process is reiterated. ETCS schemes, especially early deployments, provide opportunity for thorough examination of the railway operation at a system level and should not be regarded as just the introduction of technology – changes to processes and human factors will be required. Project changes, however and whenever they arise, should always be compared to the outcomes and outputs required to satisfy the problem statement that is being addressed	

Subject area	Summary of items to be considered	Rationale for that consideration
7.2 Problem Statement	1) Do the outcomes and benefits that are being sought reflect what the future railway will be required to deliver? What opportunities to modify or improve the Timetable Planning Rules will be provided? Consider the required balance between (a) quantum of trains (*i.e.* overall numbers, albeit at lower speeds – similar to "managed motorway") or (b) speed (seeking journey time reduction but creating a situation where the range of train speeds will influence overall capacity). Also recognise that a change of focus may be required at different times - peaks, off-peak, night hours, maintenance periods (*e.g.* two-track railway), special events, weekends and bank holidays)	Provides a shared master plan / scheme vision arrived at collaboratively and agreed by industry. Early involvement by Operators should never be considered a bad investment. Effort expended at this stage, to understand (defining and quantifying) the outcomes and benefits and reach agreement on these, will be repaid later in the project. Route Investment Review Groups offer a useful introduction to projects and intentions and permit the collaborative approach to start. Other meetings between Operators and the IM can perform a similar function
	2) In addressing the problem statement, is it necessary for all benefits from the deployment to be realised immediately on commissioning, or is there an opportunity to phase the introduction? [1] [1] This theme is also explored in sections 7.7 Assessments of Operations Risks, 7.8 Permanent Timetable and resourcing effects and 7.10 Performance effects	Depending on the scale of change proposed, a phased introduction may prove beneficial, perhaps over more than one timetable, to allow the reliability curve and front-line staff confidence and familiarity with the new technology to be built up

Subject area	Summary of items to be considered	Rationale for that consideration
7.3 Principles of Project Development (Operator perspective)	RDG GN-040 7.3 (b) is modified as follows: 1) The problem statement should be used to work out what options can be considered to realise the required outcomes and benefits. Whilst some options need not be pursued in any great detail and can be eliminated early, it is recommended that several good-quality options which maximise operations and (ideally) allow some future proofing are developed in detail. Considerations should include: I. opportunities to incorporate or bring forward renewals and other enhancements to achieve greater value for money or support scheme outputs; II. identification of capabilities or assets that are no longer required, *e.g.* redundant crossovers, siding connections, overlays superseded by Signals Away; III. life extension of an asset, with deferral of renewal until such time as future funding opportunities arise or franchise obligations / Operator business plans change; IV. whether scheme outputs are best achieved by Overlay, Underlay or Signals Away; V. the opportunities to phase the realisation of scheme benefits	Operators should be prepared to be open about their priorities but prepared to trade. Realism should be sought from all parties. This recognises that funding or deliverability may be constrained, or come from more than one source, so it might be better to get some improvement rather than none. It may be appropriate to (a) retain some conventional signalling to address areas or movements that would be difficult to replicate effectively under ETCS; (b) continue to control some movements by ground staff; (c) provide an ETCS overlay in advance of infrastructure go-live to aid staff familiarisation and training See Section 7.2 above

Subject area	Summary of items to be considered	Rationale for that consideration
7.4 Commercial	1) A summary of the agreed commercial position for Digital Railway ETCS deployments can be found in the RDG ETCS Handbook	

Subject area	Summary of items to be considered	Rationale for that consideration
7.5 Operations Requirements Specification	[A more detailed list of operational requirements for consideration can be found in Appendix B.] 1) Being a software based system, ETCS requires greater precision when considering operational objectives and requirements before scheme design commences. .	Consider the full range of operational scenarios, *incl.* run-round moves, traction units running in tandem, banking, propelling, any train also on which a driving cab is open in other than the leading vehicle (*e.g.* saloons, snowploughs), degraded operations and failed train recovery
	2) Consider how drivers will react to conflicting information from the lineside and DMI	Where drivers will be able to obtain information from both conventional signals / signage and ETCS, and the information from one source could be at variance with the other
	3) How will train crew experience and gain familiarity with ETCS before go-live?	Provision of ETCS overlay to aid testing and training, complementing use of simulators and/or use of early adopters

Subject area	Summary of items to be considered	Rationale for that consideration
7.6 Signal Sighting	1) Where the infrastructure (lineside) is to be ETCS fitted without signals (known as Signals Away), the need for signal sighting becomes less onerous although similar requirements will be necessary for ETCS marker boards, lineside signage and any remaining locally provided lineside signals	*E.g.* managing distractions and simultaneous information presented by infrastructure design; encountering unlit boards in degraded working
	2) Have signal sighting considerations examined I. whether drivers will receive conflicting information from the lineside and DMI, or will place conflicting demands on their attention? II. the effect of transitions on driver tasks, *incl.* exporting risks to adjoining sections (see also Operations and Control Functionality, Appendix B)?	Where drivers will be able to obtain information from both conventional signals / signage and ETCS, and the information from one source could be at variance with the other. Also examine the points at which drivers are offered the various ETCS operating modes (*e.g.* Staff Responsible, On Sight, Full Supervision) and any conditions that have to be met to allow step-up or step-down between modes. These should be reviewed against other tasks that drivers have to undertake at the same time

Subject area	Summary of items to be considered	Rationale for that consideration
7.7 Assessments of Operations Risks	1) Has a review of system risks been undertaken, into which the Operator has contributed? Has any such review considered the processes whereby components of the system (*e.g.* trackside, air-gap and on-board) are approved[2] for use, either individually or collectively [2] The approvals process should follow "The Practical Arrangements for ETCS Trackside Approvals" (published by EURA, which acts as the ETCS Systems Authority). Approvals should form a part of the trackside procurement	ETCS is a shared system, combining trackside and on-board elements, with an air-gap. Each might work in isolation but how will the railway operate when the elements are put together? What arrangements are in place to test the trackside and train equipment together for functionality and capability (*e.g.* use of a test laboratory)? Will testing inform the scheme design?
	2) Has the IM reviewed telephony capability to ensure that connections can be made with, and maintained with, GSM-R and Radio Block Centres (RBC) to allow reliable, meaningful and timely registration and exchange of data and voice communications? 3) Has any such review included Operators? 4) Has any such review considered degraded operations and the levels of functionality or mitigation required in failure conditions (*e.g.* reduced efficiency of radio systems or packet switching affecting transmission speeds)? Have the results of this consideration been applied to the overall Operational Risks review (as above) and the joint performance plan (section 7.10)? 5) Is there a plan to improve or enhance telephony capability, with milestones, and has this been reviewed to determine changes over time to overall Operational Risks and/or the joint performance plan?	*E.g.* GSM-R registration, multiple registrations in a single location, the management of black spots, data holes and frequency interference, use of packet switching *E.g.* in the absence of an ETCS Radio Block Centre (RBC), local GSM-R cells may require enhanced data capability to allow ETCS on-board equipment to connect to GSM-R and allow brake release. Isolation of ETCS on-board equipment for train movement within depots or yards should not be endorsed as train protection systems are compromised
Continues on next page	6) Is there an agreed process to review the attainability of the route speed / risk profile, post commissioning, with changes made either to timetable values or to the route profile?	Ensuring required scheme outputs are delivered or differences do not affect ongoing timetable performance

Subject area	Summary of items to be considered	Rationale for that consideration
7.7 Assessments of Operations Risks – continued	RDG GN-040 7.7 (b) is modified as follows: 7) Have Operator route risk assessments been reviewed to consider system risk changes, for example: i signal / marker board Passed at Danger risk; ii speeding risk; iii driveability of new signalling and changed layouts, including application of Professional Driving Policies; iv no contact time values; v location and timing of transitions, or levels of supervision (mode), *incl.* other tasks that drivers may be undertaking at the time; vi location and timing of receiving text messages via the DMI (*e.g.* critical routing information, level crossing reminders); vii consequences of and mitigations against failure to receive information from a balise; viii consequences of and mitigations against reduced functionality in degraded working, and management of degraded operations; ix migration from conventional signalling to ETCS; or from Overlay/Underlay to Signals Away; x use of ATO; xi how drivers will react in situations where they can receive information from both conventional signals / signage and ETCS, and the information from one source is at variance with the other; xii driver over-reliance on DMI information; xiii low rail adhesion and mitigation measures	Ensuring continued relevance and identifying new risks. This needs to consider the full range of operational scenarios, both before and after infrastructure go-live, *incl.* arrangements for testing and training, run-round moves, traction units running in tandem, banking, propelling, any train also on which a driving cab is open in other than the leading vehicle (*e.g.* saloons, snowploughs), degraded operations and failed train recovery. (viii) See "An Operators Guide to ETCS" produced by Digital Railway Programme *(xi) E.g.* movement authority available under ETCS but not under conventional signalling *(xii) E.g.* avoiding DMI displaying an overly optimistic braking point / profile, given the adhesion conditions present

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Subject area	Summary of items to be considered	Rationale for that consideration
7.7 Assessments of Operations Risks – continued	8) Where rolling stock has ETCS on-board equipment: I. Have operational publications been amended to include the new equipment? II. Has an assessment been undertaken of the criticality of the new equipment to safe operations, with contingencies identified in the event of failure? III. Will the on-board equipment baseline (*i.e.* software version) be greater than or match the infrastructure baseline? If not, will the on-board baseline be compatible with the infrastructure? IV. Will the on-board equipment support staff assessment and investigation?	 *E.g.* failure of European Vital Computer (EVC) or Driver Machine Interface (DMI) System compatibility *E.g.* accessing JRU or OTDR information

Subject area	Summary of items to be considered	Rationale for that consideration
7.8 Permanent Timetable and resourcing effects	1) Have train crew preparation times been reviewed and revised to allow for changed arrangements for cab awakening, either at start of journey or following crew changeover or following run-round, attachment or detachment? Have changed values been incorporated into rosters, diagrams and timetables (both long- and short-term)?	Ensuring preparation times are accurate and reflected in establishment calculations, crew diagrams and timetable requirements
	2) Is the requirement for rolling stock to be fitted with ETCS on-board equipment and ETCS-competent staff reflected in diagrams?	Consider appropriate use of dedicated diagrams to keep ETCS-fitted rolling stock or ETCS-competent crews available for use on ETCS-fitted infrastructure. Fitment may be many months in advance of infrastructure go-live to allow testing and training
	3) Is the realisation of project benefits phased across more than one timetable?	Depending on the scale of change proposed, consider a phased introduction, perhaps over more than one timetable, to allow the reliability curve and front-line staff confidence and familiarity with the new technology to be built up
	4) Is there an agreed process to review the attainability of the route speed / risk profile, post commissioning, with changes made either to timetable values or to the route profile?	Ensuring required scheme outputs are either delivered or differences do not affect ongoing timetable performance
Continues on next page	5) Do transitions support the Timetable Planning Rules?	Scheme should support the required Timetable Planning Rules

Subject area	Summary of items to be considered	Rationale for that consideration
7.8 Permanent Timetable and resourcing effects – continued	RDG GN-040 7.8 (a) is modified as follows: 6) Has agreement been reached with the IM on: I. required permanent changes to Engineering Access Strategy or Timetable Planning Rules, *incl.* use of values less than ½ minute; II. required permanent changes to the detail required in timetable bids and offers (*e.g.* use of values with greater granularity than ½ minute, addition of new timing points); III. the date at which any changes are to be introduced; and IV. where the agreed date for implementing changes is after commissioning, how changes that impact on the timetable or on performance will be accounted for in the interim?	Comments within RDG GN-040 7.8 remain relevant. Considerable work may be required to identify all required changes to the Timetable Planning Rules
	RDG GN-040 7.8 (b) is modified as follows: 7) Particular attention should be paid to any new, withdrawn or revised application of Conditional Double Red signals, or Approach Controls, or signalling imposed speed restrictions, as well as transitions and the migration between conventional signalling and ETCS, or from Overlay to Signals Away	Comments within RDG GN-040 7.8 remain relevant. Considerable work may be required to identify all required changes to the Timetable Planning Rules

Subject area	Summary of items to be considered	Rationale for that consideration
7.9 Planning and resourcing possessions	*No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".*	

Subject area	Summary of items to be considered	Rationale for that consideration
7.10 Performance effects	1) When considering the reliability curve of any changed infrastructure, radio capability – whether for audio, video or data transmissions – should be included. Also include effects of any degradation to radio systems or packet switching affecting transmission speeds	
	2) Is there an agreed process to review the attainability of the route speed / risk profile, post commissioning, with changes made either to timetable values or to the route profile?	Ensuring required scheme outputs are delivered or differences do not affect ongoing timetable performance
	3) Is there a process to allow front-line IM and Operator personnel to experience each other's working environment? *E.g.* signallers provided with cab rides; driver visits to Rail Operating Centres	Knowledge share and familiarisation, leading to closer working and understanding of performance issues
	RDG GN-040 7.10 (h) is modified as follows: 4) Does the project introduce any changes to existing performance reporting?	*E.g.* I. manual reporting at a remote location replaced by automatic reporting, II. new timing points required, III. greater consideration required of sub-threshold delays, IV. accommodating any timetable changes with use of values less than ½ minute

Subject area	Summary of items to be considered	Rationale for that consideration
7.11 (Operator) Engineering and fleet effects	1) Are changes to depot infrastructure required to support project outputs (*e.g.* higher entry / exit speeds between depot and the Network)?	Avoiding loss of main line capacity due to moves to/from depot
	2) Where the infrastructure (lineside) is to be ETCS fitted: 1. Does the project support continued access onto the Network by depot traction units (*e.g.* shunting locomotives) not fitted with ETCS on-board equipment?	Lineside signals to control movements may still be required.
	2. Are on-board equipment requirements understood with a plan to complete fitment of sufficient traction units in advance of infrastructure ETCS go-live, including any need to fit the latest version of TPWS?	To avoid delaying infrastructure go-live awaiting completion of fleet fitment and to allow any required testing and staff training (which may be required some months before go-live)
	3) Where rolling stock has ETCS on-board equipment: I. Have rolling stock maintenance regimes been amended to include the new equipment?	Availability and reliability
	II. Are critical components easily accessible?	Maintenance and operational staff access
	III. Will the on-board ETCS baseline (*i.e.* software version) exceed or match the baseline of the infrastructure? If not, will the on-board baseline be compatible with the infrastructure?	System compatibility
	IV. Will the OTDR be separate from the JRU, or combined?	Will the inclusion of a JRU lead to the loss of any data currently recorded? Traditional OTDR are unable to cope with the data requirements generated by ETCS or the latest versions of TPWS
	V. Is it possible to remotely download information from the JRU?	Accessing information efficiently
	VI. Has the introduction of new or modified on-board equipment been assessed to identify additional resource or training requirements?	*E.g.* downloading information, whether by operational or maintenance staff

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Subject area	Summary of items to be considered	Rationale for that consideration
7.11 (Operator) Engineering and fleet effects –- continued	4) Does rolling stock require additional cryptographic keys[3] to support EVC communications with RBCs? [3] Cryptographic keys are part of the system software and allow EVCs to communicate securely (handshake) with RBCs. Keys are unique to the RBC.	If a train is required to operate within a RBC area, the necessary key will be supplied to the Operator. Existing keys will be updated over time. Unless keys can be remotely uploaded/ updated, Operators may face costs manually managing keys on EVCs
	RDG GN-040 7.11 (b) is modified as follows: 5) Does the scheme provide any required transition equipment for testing purposes (*e.g.* AWS magnet or local GSM-R cells having enhanced data capability) or for trains entering service from a location?	Required to meet Rule Book requirements
	RDG GN-040 7.11 (d) is modified as follows: 6) Does the project support efficient train movements around the depot[4], trains entering service[5] (*e.g.* from depot at start of day/journey) and leaving the Network (at end of day/journey) at the intervals required by the timetable? [4] To avoid loss of operational flexibility, it is recommended that the level of supervision for movements wholly within depots should be appropriate to the types of movements being made. Options include a. L-NTC (Level – National Train Control); b. Level 2; c. Overlay/ underlay; d. Perpetuating existing methods of working. Higher levels of supervision should not be applied unless clear benefits can be realised. [5] Consider how trains will enter the Network and how permission to enter will be received? Will trains need to stop at the departure signal / marker board to complete registration and receive a movement authority (for which time will need to be allowed) or can this occur before arriving at the departure signal / board (referred to as Level 1 launch which may have implications for other movements within depot)?	Maintenance of existing timetable and resource plans. Factors to consider include cab awakening, system registration, receipt of movement authorities and supervision levels [5] Entry of trains onto the Network whilst in Shunt mode is to be avoided

Subject area	Summary of items to be considered	Rationale for that consideration
7.11A Impacts on Stations	1) Has an assessment been conducted to review the impact of the project on the working of stations?	This section and Appendix B Operational Requirements include factors for consideration
	2) Are changes to station infrastructure required to support project outputs (*e.g.* train despatch)? [6] For ETCS, a guiding principle is that trains should start in the highest level of supervision, wherever possible. This may involve the use of Track Ahead Free or additional balises to achieve Full Supervision as quickly as possible. If contemplating use of Track Ahead Free, consider driver sightlines (*e.g.* platform furniture or curvature)	Consider how station staff will be aware of the train having a movement authority? Options include presence of OFF indicators or changing colour of bodyside door indicators. Examine supervision level on departure[6]
	3) Does the scheme design support efficient station working and train despatch?	*E.g.* closing-up signal berths to minimise re-occupancy time; opening-out signal berths to provide early proceed aspect / movement authority; arrival and departure train speeds; use of intelligent CD to start despatch earlier
	4) Does the project support trains entering / leaving service at the intervals required by the timetable (*e.g.* following cab awakening or headcode change)? [7] For ETCS, a guiding principle is that trains should start in the highest level of supervision, wherever possible. This may involve the use of Track Ahead Free or additional balises to achieve Full Supervision as quickly as possible. If contemplating use of Track Ahead Free, consider driver sightlines (*e.g.* platform furniture or curvature)	Maintenance of existing timetable and resource plans. Consider impacts of GSM-R or RBC registration, including multiple registrations. Ideally all stations should be capable of allowing trains to enter service. Examine supervision level on departure[7]
Continues on next page	5) Does the project change the way in which I. signallers are aware of the identity of trains entering service? II. station staff become aware of the identity of approaching trains? III. station staff and signallers communicate?	*E.g.* changes to radio communications, customer information *incl*. advice of platform changes, delayed trains requiring signal replacement / withdrawal of movement authority

Subject area	Summary of items to be considered	Rationale for that consideration
7.11A Impacts on Stations –- continued	6) Is the Operator undertaking any additional tasks as a result of such changes and have any costs that arise been identified?	Consider changes to working practices or undertaking additional responsibilities, *e.g.* i. interposing headcodes into the signalling system; ii. use of station staff to position incoming trains or confirm train arrived complete; iii. provision of information where previously supplied by local signal box
	7) During project construction and commissioning: I. is any out-stabling of rolling stock required and has that been assessed to understand requirements for tanking, replenishment, cleaning and maintenance? II. if electrical isolations are required as part of the possessions, what is the impact on stabled rolling stock or station supply?	Out-stabling need not be at a location usually used by an Operator Avoidance of in-service failures or the need for Control interventions *E.g.* to allow pre-heating during winter
	8) Is there sufficient telephony capability to permit registration of trains and cab awakening without impacting on train preparation time or timetabled dwells, or requiring isolation of ETCS on-board equipment in order to achieve brake release?	*E.g.* GSM-R registration, multiple registrations in a single platform, the management of black spots / data holes and frequency interference *E.g.* in the absence of an ETCS RBC, local GSM-R cells may require enhanced data capability to allow ETCS on-board equipment to connect to GSM-R and allow self-test
	9) Is there an opportunity to use the project's possessions to undertake station infrastructure changes in parallel?	Possible reductions in cost of making changes within the station

Subject area	Summary of items to be considered	Rationale for that consideration
7.12 Formal Consultation (*incl.* Network Change, Station Change, GE/RT8270 assessments)	*No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".*	

Subject area	Summary of items to be considered	Rationale for that consideration
7.13 Scheme Plans (reading what it is telling you and interpreting what it is not telling you)	RDG GN-040 7.13 (e) is modified to include the following additional considerations: 1) Scheme plans will show the provision of: • Lineside signs and positioning; • Balise / marker board and positioning; • Transition points / balises; • Balise information; • Movements that can be made dependent on ETCS Levels and modes available; • Supervised Locations; • Ends of Authority (both marked and unmarked); • Release speeds where defined by the trackside; • Reversible signalling; • Data holes; • ATO provision and limits; • Level crossings and any technology that is employed to control risk to users, *incl.* indications and information provided to train drivers via the DMI or from the lineside	Scheme plan information will be key to developing any subsequent operational documentation (*e.g.* Sectional Appendix entries) Note that some of these will only be applicable in Overlay or Underlay Note also that no final decisions have been taken on the provision of information within Scheme Plans for ETCS schemes. It is possible therefore that Scheme Plans will look different to those associated with conventional signalling. Indeed, they may not be called Scheme Plans. The list represents a logical extrapolation of the use made of Scheme Plans today

Subject area	Summary of items to be considered	Rationale for that consideration
7.14 Employee and Supply Chain Effects	*No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".*	

Subject area	Summary of items to be considered	Rationale for that consideration
7.15 Operator Resources and Training (*incl.* briefing)	1) Does the project allow non-core activities to be practiced in a planned way, *e.g.* wrong line running (using reversible signalling) or degraded working (*e.g.* manual running in place of ATO), subject to the timetable accommodating this?	Allowing front-line staff the opportunity to practice activities that are not normal in a controlled and planned manner
	2) Have train crew preparation times been reviewed and revised to allow for changed arrangements for cab awakening, either at start of journey or following crew changeover or following run round, attachment or detachment? Have changed values been incorporated into establishments, rosters, diagrams and timetables (both long- and short-term)	See also section 7.8 Permanent Timetable and Resourcing Effects
	3) Has the introduction of new or modified on-board equipment to rolling stock been considered to I. Determine changes to competency or assessment regimes? II. Identify additional resource or training requirements?	 Ongoing relevance *E.g.* downloading information, whether by operational or maintenance staff
	4) Does the training needs analysis and properly conceived training plan (see RDG GN-040 7.15) include consideration of I. train crew route knowledge requirements (*incl.* acquisition and retention)? II. any changes to location-specific methods of working?	Ongoing relevance *Incl.* provision of limited ETCS functionality in advance of go-live to permit testing, training and familiarisation

Subject area	Summary of items to be considered	Rationale for that consideration
7.16 Review	*No further guidance offered beyond RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling".*	

Part 8 References

The references within RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here, unless otherwise advised. The following additional references also apply.

Digital Railway ETCS Technical Modelling Principles for Timetable Planning Rules
Digital Railway An Operator's Guide to ETCS
RDG ETCS Handbook
RDG-GN040 Delivering Good Schemes – Conventional Re-signalling
RSSB Concept of Operations for ERTMS, Issue 2
RSSB Glossary of Railway Terminology
European Commission 4th Railway Package
EURA The Practical Arrangements for ETCS Trackside Approvals

Part 9 Abbreviations

The abbreviations shown in RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here, unless otherwise advised. The following additional abbreviations also apply.

APCO	Automatic Power Changeover (*e.g.* bi-mode switching between a power supply drawn from an electrification system and that generated on-board)
ATO	Automatic Train Operation (see Definitions)
DMI	Driver Machine Interface (the on-board display of ETCS information for the driver that allows: a) the entry of information (*e.g.* driver identity, train data); b) the triggering of driver actions (*e.g.* selection of driving mode, confirmation, acknowledgement); c) the display of driving information (*e.g.* speedometer, planning area))
DRSG	Digital Railway Steering Group (part of the RDG's meeting architecture)
ERTMS	European Railway Traffic Management System (see Definitions)
ETCS	European Train Control System (see Definitions)
EURA	European Union Agency for Railways
EVC	European Vital Computer (an on-board computer connected to external data communication, internal controls to regulate the speed and braking of the train, balise sensors and other cab instruments and devices)
IM	Infrastructure Manager (*e.g.* Network Rail)
JRU	Juridical Recording Unit (an OTDR dedicated to the recording of ETCS information and data)
L-NTC	Level – National Train Control (a level of movement supervision)
OTDR	On-Train Data Recorder – also known as OTMR (On-Train Monitoring Recorder) (a recording unit offering similar functionality to an aircraft flight recorder)
RBC	Radio Block Centre (computer controlling all train movements within a geographic area, receiving position information from trains within that area and providing movement authorities to those trains as required)
RDG	Rail Delivery Group
TRTS	Train Ready to Start (use of platform control box to provide visual indication to signaller that a train's station duties are complete. Where Automatic Route Setting is employed by the signalling, operating TRTS can cause the route from a platform to be set and a movement authority to be granted or the associated signal to clear to a proceed aspect)

[Appendices follow]

Appendix A (Not Used)

Appendix B (see next page)

Appendix B Operations Requirements Specifications detailed check-list

The suggestions within Appendix B of RDG-GN040 "Delivering Good Schemes – Conventional Re-signalling" also apply here, unless otherwise advised. The following modifications apply.

Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Operations & Control Functionality (continues overleaf)	Consideration of degraded operations and the levels of functionality or mitigation required in failure conditions; For ETCS, a guiding principle is that trains should start in the highest level of supervision, wherever possible. This minimises operations with Staff Responsible mode but may involve the use of Track Ahead Free or additional balises to achieve Full Supervision as quickly as possible. Consider Start of Mission / obtaining first Movement Authority / train awakening. If contemplating use of Track Ahead Free, consider driver sightlines (*e.g.* platform furniture, curvature or likely presence of another train), both by day and at night; Consider transitions – functionality and location; also extent of overlap between systems, *incl.* exporting risks to adjoining sections and human factors considerations, *e.g.* a. where drivers can receive information from both conventional signals / signage and ETCS, and the information from one source is at variance with the other; b. other tasks that drivers may be undertaking whilst the train is making the transition (a need to undertake conflicting tasks should be designed out wherever possible);

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Operations & Control Functionality (continued)	Examine how the scheme supports run round moves, attaching & detaching and propelling moves, including shunting, with levels of supervision provided that are appropriate for the intended movements and any hazards these introduce. This should include consideration of the effects of berth sharing and subsequent issuing of Movement Authorities in the correct order to the correct train, or the benefits / risks associated with movements being controlled by ground staff; Is Overlay, Underlay or Signals Away, or a mixture of these, the most appropriate? What is needed to allow training, knowledge acquisition and familiarisation, whether considering changed infrastructure, ways of working and equipment? Is the proposal part of a phased approach to deployment with more than one step before reaching the desired end-state? Is there a requirement for ATO? Will the on-board equipment baseline (*i.e.* software version) be greater than or match the infrastructure baseline?
Means of train detection, *e.g.* axle counters, track circuits	Compliance with RIS-8217-TOM (2016), Introduction and Use of Axle Counters – Managing the Risk Use of closing-up or opening-out signal berths, or altered train detection lengths, to increase number of trains that can be accommodated in a given section of track or to smooth the operation of services, either where speed restrictions apply or around stations to reduce chances of non-stopping trains coming to a stand when following stopping services

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Appendix B Operations Requirements Specifications detailed check-list - continued

Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Track Layout Changes	Effect on functionality (in both normal and degraded conditions), signalling, Timetable Planning Rules, standage and platform lengths and performance monitoring Optimising the layout to meet requirements, both projected and aspirational. Signals and marker boards should serve the layout and be positioned accordingly; layouts should not be led by signals
Line Speeds Changes to speed profiles Driveability of a route in its post-scheme altered form, with smooth speed profiles and minimise acceleration and braking	Identification of risks where train speeds are artificially kept low, only to have to accelerate towards a further lower speed PSR Application of closing-up or opening-out signal berths to smooth services, either where speed restrictions apply or around stations to reduce chances of non-stopping trains coming to a stand when following stopping services ETCS provides opportunities to review and potentially relax/remove PSRs, given a) greater certainty over train speed (reduced likelihood of overspeed), reducing overspeed tolerances required by asset engineers; b) reduced need to restrict train speed to meet constraints caused by signal spacing, signal sighting, approach control or flashing aspects; c) the opportunity to apply a greater range of differential speeds depending on individual braking characteristics; d) an ability to apply intelligent PSRs (where the PSR might alter under different traffic conditions, *e.g.* managing air pressure in tunnels); and e) use of ATO

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Timetable Planning Rules (*incl.* both current & aspirational) Train lengths Frequencies Effect of running under cautionary aspects Changes to TIPLOCS, STANOX, STANME Sectional Running Times Additional timing points Changes required to support ETCS Changes required to support transitions Impact of ATO	Headways and signal positioning drive signal / marker board spacing Determining which Timetable Planning Rules (conventional or ETCS) should support Overlay, Underlay, or transitions Changes required to support short-distance ad-hoc moves, run round moves, attaching & detaching and propelling moves, including shunting
Headways Services planned to run under cautionary aspects as a rule during peak hours and/or planned to run on green aspects Junction margins Platform re-occupancy	Professional driving policies differ across Operators Headways and signal positioning drive signal / marker board spacing ETCS is expected to lead to reduced junction margins
Comprehensive Approach Locking	ETCS is expected to ease the effect of Conditional Double Red signals, Approach Controls, or signalling imposed speed restrictions,
Provision of Warner controls (that operate from a fixed point in advance of a signal or via a timer linked to actuation of a treadle or track circuit occupancy)	ETCS is expected to ease the effect of Conditional Double Red signals, Approach Controls, or signalling imposed speed restrictions,

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Reversible Signalling	For ETCS, there is an identified requirement, as part of reference design, for reversible signalling readiness functionality to be provided on all lines to allow operations to continue in degraded conditions or to facilitate maintenance. This acknowledges that the capital cost of additional signalling is negligible, when compared to both the scheme itself and whole life costs avoided. Most schemes will be able to use train detection sections provided for movements in the "right" direction and to configure these for movements in the "wrong" direction at marginal cost, through the provision of signalled routes in interlockings and RBCs and through providing additional marker boards. Whilst individual local deployments may be unable to justify a business case for the broader expenditure to enable them to make best use of the inherent functionality, *e.g.* additional crossovers or wrong direction level crossing controls, this does not preclude providing ETCS reversible signalling readiness functionality on all lines from the outset. Considerations around business cases and how best to use reversible signalling functionality include: I. The capability (headways and speed of movements) required if and when trains are run reversibly; II. Minimising operational risks when trains are run reversibly, *e.g.* pilot working; III. The ease with which trains can be run using reversible signalling, *e.g.* additional staff requirements if trains have to be set back over trailing points; IV. Frequency of likely use, *e.g.* access for routine or unplanned maintenance; V. Requirement for operational flexibility to be maintained, *e.g.* coping with train or infrastructure failure; VI. Protection arrangements for staff working lineside; VII. Effects on station and depot operations, *incl.* customer information; VIII. Incorporating the use of reversible signalling into timetables to allow front-line staff to regularly experience its use

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Banner repeaters & preliminary route indicators	Form and location Under Signals Away, the absence of lineside signals removes positive indications of the route to be taken at junctions - alternative information may need to be provided to the driver
Required Routes Main Shunt Call on / Permissive Working Concurrent parallel moves required to deliver the timetable both when operating correctly and when in perturbation Provision of flashing yellow signal sequences and mitigations (*e.g.* additional PSRs) where flashing yellow sequences might apply to more than one route Use of Free Greens where line speeds and turnout speeds are consistent	Allows consideration of the trade-off between short overlaps and effect of any consequent mitigations Under Signals Away, the absence of lineside signals removes positive indications of the route to be taken at junctions - alternative information may need to be provided to the driver
Tilt Activation Speed Supervision (TASS)	Incorporation of TASS authority into ETCS; changes to balise positioning; new balises; rationalisation of balises
Occupational Safety Systems	How lock outs are intended to be used and their impact on engineering access; opportunities to use technology to reduce need for “boots on the ground” Changes to protection arrangements for staff working lineside

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Level Crossings Manual vs. automatic; vehicle vs. foot-user; public vs. user worked or footpath) Technology to be applied to change or control level crossing risk	How are the risks associated with level crossings to be controlled? Ideally, opportunities to close crossings should be taken but these can be out of scope for a re-signalling scheme. Increased train speed or frequency of trains will change level crossing risk profiles so any project looking to increase capability, or provide passive provision for future increases, needs to examine the effects on such risks. Information to drivers on approach to level crossings and, where applicable, their status
Radio systems System capability Cell coverage User set-up effects Multiple registrations in a location / berth	In axle counter areas, will additional lineside telephones be provided to support inability to use GSM-R for REC calls (Secondary Collision Communication)? Multiple registrations needed to support entry into service following detachment or closely spaced services, *incl.* effects of berth sharing and subsequent issuing of Movement Authorities in the correct order to the correct train; Use of packet switching to allow greater volume of data transmission Upgrading of radio system coverage or provision to cater for increased demands arising from ETCS

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Stations, with consideration of	See also section 7.11A RIS-3703-TOM: Rail Industry Standard for Passenger Train Dispatch and Platform Safety Measures (2013), and any additional measures required by the Station Manager, *incl*.
Station operations / footfall management	Additional or changed station staffing requirements or responsibilities
Platform extensions / alterations	Platform width and pinch points during peak times impacting despatch
Additional selective door opening, *incl.* balise positioning where ASDO to be deployed	Passenger with Reduced Mobility access position for rolling stock and provision of appropriate stop marks; alignment of ASDO balise positioning with ETCS or rationalisation of balises; how does balise positioning affect stop marks and stopping points?
Effects on Customer Information provision or station furniture, *incl.* TRTS or CD/RA/OFF indicators	Consideration of Customer Information if adjacent signal box is closed
Changes to despatch procedures, *incl.* new or altered TRTS or CD/RA/OFF indicator provision	Position of CIS or other information systems in potential conflict with CD/RA/OFF indicators or Banner repeaters for Train Despatch staff or drivers of short trains or locomotives starting from the buffer stops. Also consider how station staff will know when a Movement Authority has been granted to a train
Compatibility with platform awning design and structures that might affect signal / marker board sighting	Influences on passenger behaviour during all weather conditions (*e.g.* wind, rain)
Split platform occupancy	Issuing of Movement Authorities in the correct order to the correct train
Cab awakening and registration with GSM-R or RBC (including multiple registrations at the same time)	

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Suggestions of items to be considered (neither exhaustive nor prioritised)	Points to consider include
Rolling Stock Depot / Stabling Locations Advice to depot/siding shunting staff of approaching trains Advice to signallers of train ready to enter the Network Shunters acceptance arrangements Interface with Depot / siding signalling or internal shunting Cab awakening and registration with GSM-R or RBC (including multiple registrations at the same time)	See also section 7.11
Automatic Power Change Overs (APCO)	Alignment of any APCO balise positioning with ETCS or rationalisation of balises
Provision for Future Development, *incl*. passive provision	*E.g.* new train types, line speed increases, electrification, timetable enhancements, digital enabling of interlockings, future alterations to the physical railway to overcome constraints, preparing for ETCS deployment (including creation of Underlay or Overlay), moving from Underlay or Overlay to Signals Away

Appendix C (Not Used)