



**Rail Safety & Standards Board**

**Published by**

**Rail Safety and Standards Board  
Evergreen House  
160 Euston Road  
London NW1 2DX**

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## GE/GN8623

### Guidance on the Change Process for Projects Affecting Compatibility Between Electric Trains and Electrification Systems

Issue One: April 2007

Railway Group Guidance for GE/RT8023



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# Guidance on the Change Process for Projects Affecting Compatibility Between Electric Trains and Electrification Systems

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## Issue record

| Issue | Date       | Comments          |
|-------|------------|-------------------|
| One   | April 2007 | Original document |

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# Guidance on the Change Process for Projects Affecting Compatibility Between Electric Trains and Electrification Systems

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## Part 1 Introduction

### 1.1 Purpose and structure of this document

This document has been published by Rail Safety and Standards Board to give guidance for the change process associated with projects that affect operation between electric trains and an electrification system. It does not constitute a recommended method of meeting any set of mandatory requirements. It specifically addresses the introduction of new or modified electric trains or changes to train operations that affect power requirements on a route-by-route basis and to ascertain the compatibility between electric trains and electrification systems, for both railway undertakings and infrastructure managers. It supports the work of railway undertakings, infrastructure managers and, by inference, train manufacturers, rolling stock companies, infrastructure contractors and project managers acting for any of these organisations.

This document assists in the understanding of responsibilities in relation to GE/RT8023 Compatibility between Electric Trains and Electrification Systems, and in relation to the electrification related issues in GE/RT8270 Route Acceptance of Vehicles including Changes in Operation or Infrastructure, but does not constitute a recommended method of meeting mandatory requirements. It also supports the railway undertakings and infrastructure managers in complying with their 'duty of co-operation' under the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) and the Railways Infrastructure (Access and Management) Regulations (2005) in relation to those issues relating to the use of electric traction.

Technical guidance has been provided by a cross-industry drafting group, the members of which utilised the knowledge they had gained from the introduction of new vehicles and services onto Southern Region in the first few years of the 21st century.

The full text of the mandatory requirements of GE/RT8023 is reproduced in Appendix A of this Guidance Note. It was not considered appropriate to reproduce that standard clause-by-clause with the guidance associated with each clause because of the format of the information provided in this Guidance Note.

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### 1.3 Approval and authorisation of this document

The content of this document was approved by:

Energy Standards Committee on 11 January 2007.

This document was authorised by RSSB on 12 February 2007.

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## Part 2 Guidance on the change process for projects affecting compatibility between electric trains and electrification systems

### 2.1 Project development

#### 2.1.1 Project initiation

2.1.1.1 The project development process should facilitate three key points:

- a) The identification of the extent of the changes affecting the electrification system
- b) The assembly of a suitable project team, if required
- c) The identification of the expected impact on the infrastructure.

2.1.1.2 When proposing to introduce new rolling stock or to make operational changes, the railway undertaking should initiate early discussions with the infrastructure manager in order to prevent abortive work by either party.

#### 2.1.2 Identification of the extent of changes

2.1.2.1 A process to identify the extent of changes should start at the very early concept stage of the project, when formal and informal discussions should be instigated to evaluate the various options prior to or as part of the formal change process. The initial discussions should indicate the scale of the changes being proposed.

2.1.2.2 **Minor changes.** These are changes that are considered unlikely to necessitate Electrification and Plant infrastructure changes, and are dependent upon the spare capacity built into the existing Electrification and Plant infrastructure. These small increases in electrical demand may include minor alterations to the timetable and changes to rolling stock that do not significantly increase the demands placed on the Electrification and Plant infrastructure. If the change is designated 'minor', the streamlined process set out in sub-section 2.1.3 should be followed.

2.1.2.3 **Major changes.** These are changes that are considered likely to necessitate Electrification and Plant infrastructure changes; these include the introduction of new rolling stock, and major timetable changes that increase the train frequency or rolling stock formation changes. If the change is designated 'major', such as the introduction of a new fleet, then the process set out in sub-section 2.1.4 should be followed.

#### 2.1.3 Minor changes

2.1.3.1 The following tasks should be considered:

- a) Assessment of the existing power supply capability from the infrastructure capability model (for further information see section 2.2)
- b) Assessment of the new power demand following the change
- c) Comparison of the new power demand against existing system capability and recording of the differences
- d) Identification, review and risk assessment of the changes, including definition of the mitigations required for risks identified
- e) Carrying out of a cost benefit analysis for proposed mitigation measures
- f) Update of the infrastructure model to ensure that knowledge is maintained as current, as set out in section 2.2.

The issues listed above are discussed in more detail in section 2.2.

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## 2.1.4 Major changes

- 2.1.4.1 For major changes, such as the introduction of a new fleet, the process should be similar to that required for minor changes, but much greater in detail and extent. When a need is identified for a major change, the railway undertaking should take the lead in setting up a project team to oversee and progress the project.
- 2.1.4.2 The impact of the proposed change upon the existing Electrification and Plant infrastructure should be considered from the concept stage to allow ample time for option assessment, identification and implementation of reinforcement work that may be required to support the proposed change. In many cases, only the railway undertaking is aware of all aspects and the size of the change to the train services, and only the infrastructure manager is in a position to fully evaluate the effect of these changes on the infrastructure. This is particularly important in the very early stages of a project and before a potential vehicle owner and potential manufacturer have been identified, and any substitution should only be by a suitably qualified expert.
- 2.1.4.3 The project team should comprise the railway undertaking, potential vehicle owner, potential manufacturer and the infrastructure manager(s). It should be noted that, although the fleet being introduced may be new to the area or location, it may already be in operation elsewhere, which should therefore enable the involvement of the vehicle manufacturer to be reduced, provided that the required information is available to the project team.
- 2.1.4.4 In all aspects of the project there should be an open exchange of information, and the representatives should be either able to supply answers to questions themselves or they are adequately resourced within their parent organisation to supply answers in a timely fashion.
- 2.1.4.5 The following actions should be considered as part of the proposed change. This list should not be considered to be exhaustive and should be used in conjunction with Appendix A of GE/RT8023, and any other items identified by the project team to facilitate consideration of most issues early in the project. If additional issues are identified, then the railway undertaking, as lead for the project team, should ensure these additional issues are recorded and incorporated into the project:
- a) Define the business specification for the change
  - b) Assess service type / pattern
  - c) Consider vehicle types
  - d) Review previous similar projects to confirm process used, success and risk areas
  - e) Consider power requirements depending on service pattern. Define dependencies and sensitivities, and confirm power demand in absolute terms and in time bands
  - f) Create a cross-functional project team to develop the project. Specific issues to be defined by the project team should include:
    - i) Vehicle mass, with a balance between initial cost and whole life cost
    - ii) Auxiliary power requirements, in service and berthing conditions
    - iii) Dwell / point-to-point time balance

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- iv) Power supply characteristics, confirmation of which may require the running of test trains to identify any unusual parameters of voltage, frequency, harmonic emission etc
- v) The case for regenerative braking (for further information see section 2.4)
- vi) External interfaces (for further information see section 2.5)
- vii) Normal and degraded mode operating (for further information see section 2.6)
- viii) Foul weather operation (for further information see section 2.7)
- ix) System interfaces diagnostics (for further information see section 2.8)
- x) Timetable data processes and format to ensure all parties have suitable software to use the information supplied
- xi) Planned infrastructure renewals managed throughout the duration of the project to avoid abortive costs
- xii) Environmental issues considered at the project specification stage to enable the most cost effective environmental performance to be achieved for the whole life of the train
- xiii) Electromagnetic compatibility
- xiv) Methodology for demonstrating system compatibility (project verification plans).

2.1.4.6 If new trains are being procured, the items listed above should be considered by the railway undertaking developing the specification for the new vehicles, and reflected, as appropriate, in the vehicle procurement specification.

## 2.1.5 Project plan

2.1.5.1 An accurate realistic project plan should be developed and should incorporate:

- a) Train design completion
- b) Power supply completion
- c) Berthing and maintenance
- d) Staffing and training of both fleet and operations
- e) Fleet size during transition (delivery, storage, commissioning, introduction, withdrawal, transfer / disposal)
- f) Project verification plans and associated testing
- g) Standards compliance and compatibility verification plan.

## 2.1.6 Project team

2.1.6.1 When convening a project team, the following should be considered:

- a) The project team members should be suitably qualified and experienced
- b) If the owner of new trains is not the same as the owner of the trains being displaced, then both should be represented on the project team.

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- 2.1.6.2 The project team should make decisions upon the following, for incorporation into the overall project plan:
- a) Definition of timescale, resource and cost arrangements between the relevant parties
  - b) Identification of areas of non-compatibility in technical, timescale, resource and cost
  - c) Identification of project dependencies, and the review processes needed to identify key programme risks to determine appropriate mitigation.

## 2.2 Electrification and Plant infrastructure capability

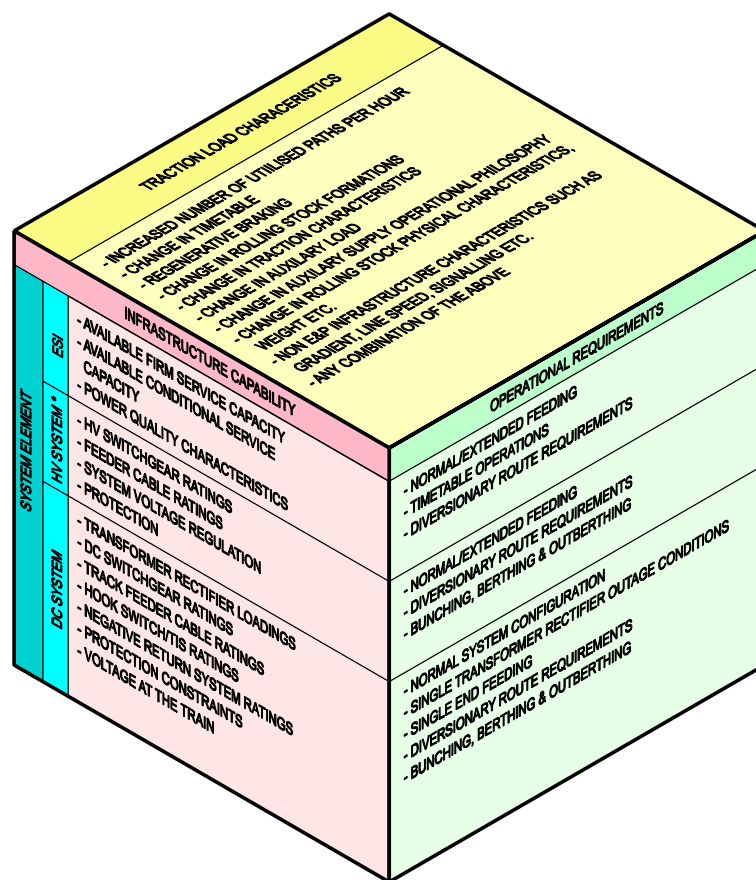
### 2.2.1 Establishing capability

- 2.2.1.1 There is a requirement resulting from the Railways Infrastructure (Access and Management) Regulations (2005), for infrastructure managers to be able to state the capacity of the system to facilitate the provision of services by railway undertakings. However, measuring the electrification load elements derived from the train service against the available infrastructure capacity presents a complex problem comprising a large number of variables inherent to both the load characteristics and infrastructure.
- 2.2.1.2 To understand and document the limitations and extent of utilisation of the Electrification and Plant infrastructure, a system capability model has been prepared. The Electrification and Plant infrastructure capability model is a system design tool that captures the capability of the Electrification and Plant infrastructure and the power requirements of the train service, based on a set of operational requirements along a specified route or route section.
- 2.2.1.3 Diagrams depicting traction system capability (see example at Appendix C) have been prepared to support the process of making changes on an electrified railway.
- 2.2.1.4 The available capacity may be affected by the proposed plans of several parties. The infrastructure manager may need to consult with other stakeholders on the proposed change. All known plans need to be considered by the infrastructure manager in determining available capacity. Plans of other parties may be commercially sensitive, and will need to be handled with appropriate confidentiality. The process set out in this document will assist in making the appropriate decisions for proposed changes to the system.

### 2.2.2 Infrastructure capability model

- 2.2.2.1 The model is used and updated by the infrastructure manager, and within Network Rail this is generally undertaken by the Major Projects and Investment Department Electrification and Plant System Design Team.
- 2.2.2.2 The relationships between infrastructure capability, traction load characteristics and operational requirements are very complex and dynamic. The various elements that interact are illustrated by the following diagrams for DC and AC traction systems.
- 2.2.2.3 The three sides of each cube represent the attributes of the train, the infrastructure system, and the operation methodology, all of which are variable and interactive.

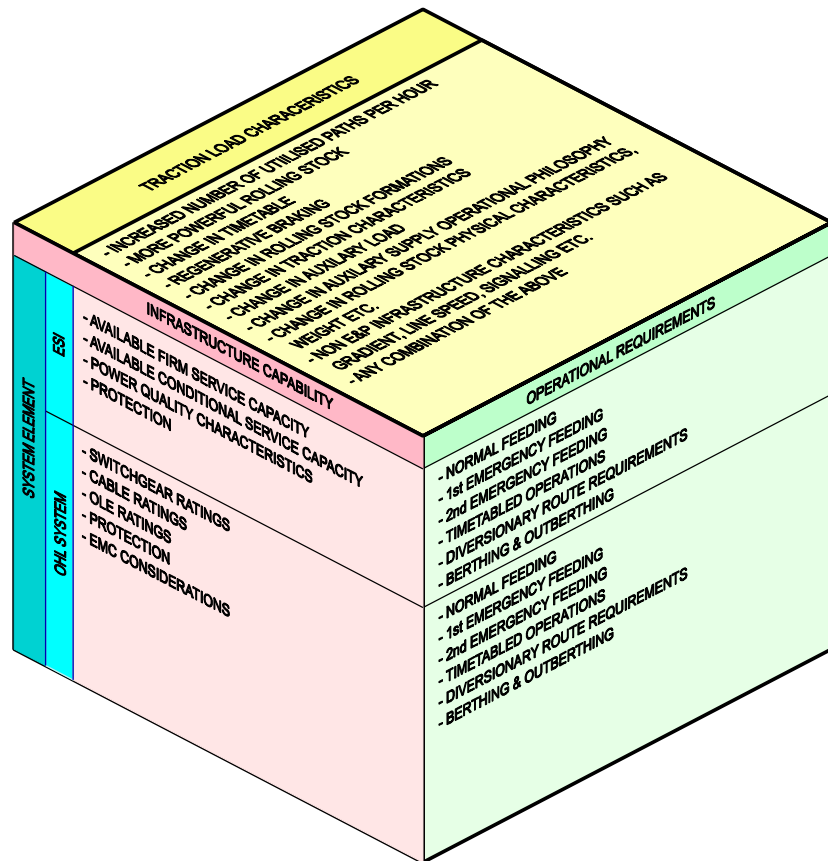
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ESI Electricity Supply Industry  
HV High voltage

Figure 1 DC traction system

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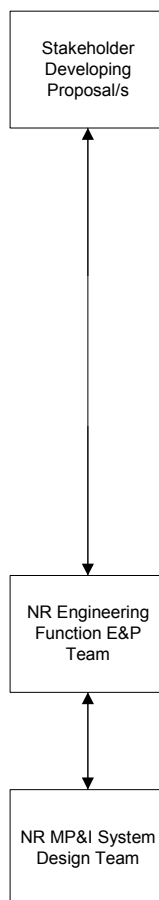
ESI Electricity Supply Industry  
OHL Overhead line (also referred to as overhead contact line (OCL))

Figure 2 AC traction system

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## 2.2.3 The Electrification and Plant traction load modelling process

- 2.2.3.1 The modelling process should ideally be split into three stages, comprising two informal stages (Figure 3) and (Figure 4) and a final formal stage (Figure 5):
- Initial concept stage (an informal information exchange between the railway undertaking and infrastructure manager)
  - Feasibility and design assessment stages
  - Assessment of infrastructure capability.
- 2.2.3.2 Because of the complexity of the system, and the subsequent workload in producing the initial computer simulation model, these models should generally only be produced when a major change is proposed on a specific route or route section.
- 2.2.3.3 The following flow diagrams illustrate each stage, showing the Network Rail Electrification and Plant engineering support to other parties and the communications required.

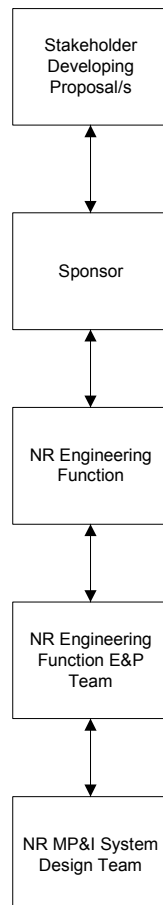


E&P      Electrification and Plant  
 NR MP&I      (Network Rail) Major Projects and Investment  
 NR      Network Rail

**Figure 3 Initial concept stage**

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E&P       Electrification and Plant  
NR MP&I   (Network Rail) Major Projects and Investment  
NR       Network Rail

**Figure 4 Feasibility and design assessment stages**