

Railway Group Standard**GE/RT8026****Issue One****Date December 2000**

Safety Requirements for Cab Signalling Systems

Synopsis

This document defines the safety requirements for the provision and use of rail traffic management and control systems which make use of **cab signalling**.

Signatures removed from electronic version

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Railway Group Standard
GE/RT8026
Issue One
Date December 2000

Page 1 of 1

Contents

Section	Description	Page
Part A		
	Issue Record	2
	Technical Content	2
	Responsibilities	2
	Compliance	2
	Health and Safety Responsibilities	2
	Supply	2
Part B		
1	Purpose	3
2	Scope	3
3	Definitions	3
4	Introduction	4
5	General Safety Requirements	10
6	Modes of Operation	10
7	Authorising and Protecting Train Movements	11
8	Control of Overrun and Excessive Speed	14
9	Driver's Interface (MMI)	16
10	Non-Driver Interfaces	18
11	System Management	21
References		24

Railway Group Standard**GE/RT8026****Issue One****Date** December 2000**Page** 2 of 2

Safety Requirements for Cab Signalling Systems

Part A

Issue Record

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

Issue	Date	Comments
One	December 2000	New Standard. Supersedes GK/RT0040 and sections of GK/RT0036 as follows: 4.2 part, 4.4.1 part and 4.4.2 part.

Technical Content

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Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group * and apply to all relevant activities that fall into the scope of each individual's Railway Safety Case. If any of those activities are performed by a contractor, the contractor's obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

* The Railway Group comprises Railtrack and the duty holders of the Railway Safety Cases accepted by Railtrack.

Compliance

The provisions of this Railway Group Standard are mandatory for design and implementation work on new Rail Traffic Management and Control Systems projects which use **cab signalling**, and which commence on or after 03 February 2001.

In addition, the provisions are also mandatory upon current projects that intend to use the forms of train control which are within the scope of this document.

Any Railway Group member deviating from the requirements set out in this document shall ensure that the situation is regularised in accordance with the requirements of [GA/RT6001](#), [GA/RT6004](#) or [GA/RT6006](#).

Health and Safety Responsibilities

In issuing this document, Railtrack PLC makes no warranties, express or implied, that compliance with all or any documents published by the Safety & Standards Directorate is sufficient on its own to ensure safe systems of work or operation. Each user is reminded of its own responsibilities to ensure health and safety at work and its individual duties under health and safety legislation.

Supply

Controlled and uncontrolled copies of this document may be obtained from the Industry Safety Liaison Dept, Safety and Standards Directorate, Railtrack PLC, Evergreen House, 160 Euston Road, London, NW1 2DX.

Safety Requirements for Cab Signalling Systems

Part B

1 Purpose

The purpose of this document is to mandate the core safety requirements for rail traffic management and control systems which make use of **cab signalling**.

2 Scope

The overall scope of Railway Group Standards is as specified in Appendix A of [GA/RT6001](#).

This document contains requirements which are applicable to the duty holders of the following categories of Railway Safety Case:

- a) Infrastructure Controller;
- b) Train Operator;
- c) Station Operator.

Specifically, the contents of this document apply to both the train control **system** itself (the fixed infrastructure and train-borne elements which perform high integrity safety functions) and the control centre systems. Together, these systems are referred to throughout this document as the "**System**".

The 'train control **system**' as stated does not refer to existing 'conventional' systems located on the train which are for the control and operation of the train.

The contents also apply to transitions between conventionally signalled areas and areas under the control of the **System**, and to dual signalled lines.

The document also addresses the life management of the **System** after initial commissioning.

The document does not address the processes by which the **System** is initially designed, constructed, tested and accepted. The key elements of these processes are documented in prEN50126, prEN50128 and ENV50129

The scope of the document excludes radio electronic token block systems.

3 Definitions

Cab Signalling

A **system** of **signalling** whereby a set of visual display devices, fitted in the driving **cab** of the train, conveys instructions and information regarding the driver's authority to proceed.

Degraded Modes

Any **mode** of operation which is used to keep trains moving under **System** failure conditions, when normal operational modes are not available.

Dual Signalled Lines

Parts of the railway where lineside signals are provided for controlling the movement of conventional trains and the **System** controls the movement of **cab**-signalled trains in the same geographical area.

End of Movement Authority

End of Movement Authority (EoA) is the location to which the train is permitted to proceed and where the target speed of the train is zero.

European Rail Traffic Management System/European Train Control System

European Rail Traffic Management **System**/European Train Control **System** (ERTMS/ETCS) is the Functional Requirements Specification and the UNISIG **System** Requirements Specification, reference Subset-026.

Railway Group Standard**GE/RT8026****Issue One****Date** December 2000**Page** 4 of 4

Safety Requirements for Cab Signalling Systems

Exposed Groups

Groups of persons whose safety may be affected by the **System**. This includes passengers, railway workers, neighbours, users of level crossings, etc.

Fixed Infrastructure Element (of the System)

Those elements of the train control **system** which are located at the trackside and which perform high integrity safety functions. These elements are controlled by, and provide information back to, the interlocking and movement authority sub-systems.

Movement Authority

Movement Authority (MA) is an instruction given to a train or driver (usually by the **System**) which allows a train movement to be carried out, under the conditions of that MA (eg, speed, direction, etc).

Man Machine Interface

Man Machine interface (MMI) is the interface device which indicates information to the operator (user) and which is used by the operator for the purpose of operating the associated **system(s)**.

Overlap

A protected length of track ahead of an EoA provided to mitigate the consequences of a train exceeding its EoA.

System

This refers to the rail traffic management and control **system**, which comprises both the train control **system** and the associated control centre systems.

Variable Operational Data

Data which can be directly changed by operators and drivers during the day to day operation of the **System**. It includes data such as temporary speed restrictions, temporary prohibitions on the setting of routes, train length, train braking capability, etc.

Note: All technical terms and abbreviations contained in this document, other than those listed above, are defined in [GK/RT0002](#).

4 Introduction

4.1 Overview

This section of the document provides a descriptive overview of the **System. The mandatory requirements of the document are provided in sections 5 to 11 inclusive.**

This document mandates the core safety requirements for train control systems which utilise **cab signalling**. The train control **system** requirements are based upon ERTMS/ETCS levels 2 and 3 functional requirements, but make few assumptions about the **system** architecture or technology.

Guidance and explanation of the requirements of this document are set out in [GE/GN8526](#).

4.2 Structure of this Document

The structure of this document is based upon six key areas associated with rail traffic management and control systems, namely:

- a) Modes of Operation;
- b) Movement Authorities;
- c) Train Speed Control;
- d) Driver's Man Machine Interface (MMI);
- e) Non-Driver Interfaces; and
- f) **System** Management.

Safety Requirements for Cab Signalling Systems

Railway Group Standard

GE/RT8026

Issue One

Date December 2000

Page 5 of 5

For each of these key areas, a number of principal safety requirements have been developed, together with a number of more detailed requirements. A diagram of the Safety Requirements Structure and Hierarchy is provided on page 8.

The safety requirements are specified in a manner which is intended to facilitate compliance with the EC Directive on Interoperability, 96/48/EC, and all associated derivative specifications.

4.3 Main Functions of the System

The main functions of the System are to:

- a) facilitate the efficient use of the track for the purposes of moving trains;
- b) facilitate achievement of the timetable and recovery from train service perturbations;
- c) ensure safety in the significant accident scenarios (see section 4.4).

4.4 Accident Scenarios Controlled by the System

The significant accident scenarios controlled by the System are:

- a) collisions between trains (rear end, head on, same direction converging);
- b) buffer stop collisions;
- c) derailments and overturning of trains;
- d) accidents at level crossings; and
- e) accidents involving personnel working on the railway.

4.5 Hazards Mitigated by the System

The System has the potential to reduce the level of risk in some key areas compared with conventional signalling systems, notably:

- a) passing the EoA (via Automatic Train Protection [ATP]);
- b) overspeeding (via ATP);
- c) exposure of trackside workers to hazards (less lineside equipment and better warning/access control); and
- d) vandalism (less lineside equipment).

The System also provides the potential for mitigating the effects of other hazards which are not directly within the scope of the System's purpose. This arises largely because of the potential for revoking a MA and stopping a train more promptly than is possible with conventional lineside signalling.

For these purposes, the System will be provided with inputs from other detection mechanisms (which are outside the scope of the System), to which it then responds accordingly.

4.6 Hazards Potentially Introduced by the System

The System has the potential for introducing new hazards or increased levels of risk compared with conventional signalling systems, including:

- a) difficulties of proving train complete where train detection systems are not track-based;
- b) potential errors in, or lack of knowledge about, train position information, particularly following catastrophic System failure where track circuits are not used;
- c) the need for extensive input and modification of safety-critical data as part of the routine operation and use of the System;

Safety Requirements for Cab Signalling Systems

- d) greater difficulties in managing train movements in the event of a catastrophic **System** failure;
- e) lack of broken rail detection where track circuits are not used;
- f) controlling the movements of trains leaving possessions;
- g) loss of trackside telephones; and
- h) cultural changes and other human factors associated with changing from a lineside **signalling system**.

This document contains safety requirements that address these hazards.

4.7 System Description

A diagram of the outline **System** architecture is provided on page 9. This diagram, and the description given in sections 4.7.1 to 4.7.6 below, are not definitive or mandatory. The mandatory safety requirements, set out in Sections 5 to 11 of this document, make few assumptions about the **System** architecture. However, the diagram serves to illustrate the general scope/boundaries of the **System** and the broad partitioning of the safety functions between the main sub-systems. The **System** comprises:

4.7.1 Interfaces for the Signaller and Others who Operate the **System**

These will typically include:

- a) visual display units showing the movements of trains and status of the infrastructure, in pictorial and/or tabular form;
- b) push-button control panels, keyboards and other devices for controlling the infrastructure and the train movements, controlling access for engineering work, etc; and
- c) other interfaces such as Closed Circuit Television (CCTV) monitors for controlled level crossings and hot axle box detection reporting systems.

The signallers and other operators are considered to be a key element in the safe operation of the **System**, and therefore the likelihood of human error, the development of procedures, ergonomic issues and competency requirements are addressed by the requirements.

4.7.2 Train Routing and Regulation Sub-Systems

It is envisaged that normal train running will be handled automatically by the **System**, with relatively little need for the signaller to intervene. Typically, sub-systems will be provided for:

- a) the automatic setting of routes in accordance with timetable data and decision-making criteria; and
- b) regulating the flow of trains (eg, for energy-efficiency purposes or optimisation of throughput).

In addition to facilities for automatic train routing and routing initiated by the signaller, facilities may also be provided for trains to initiate route requests automatically (eg before they reach their EoA, or when waiting to depart from a station).

Where trains are following closely in moving block operation, the EoA for each train can be advanced incrementally, with reference to the rear of the train in front (allowing a suitable margin for safety). The giving of a MA, whether by the signaller or automatically, is based on the assumption that any train ahead is stationary, whether or not it is moving in practice.

Safety Requirements for Cab Signalling Systems

Railway Group Standard

GE/RT8026

Issue One

Date December 2000

Page 7 of 7

4.7.3 Interlocking and Movement Authority Sub-Systems

These sub-systems perform the core safety functions of the fixed infrastructure. They comprise:

- a) interlockings, which set, lock, prove and hold routes for the passage of trains in response to commands from the signaller and train routing and regulation sub-systems;
- b) sub-systems which generate and receive/process data messages transmitted to/from the trackside equipment, the control centre, other interlockings and the trains.

These sub-systems have access to data about the fixed infrastructure and the trains which is necessary in order for correct MA and speed-related information to be given to the trains.

4.7.4 Trackside Equipment

The trackside equipment comprises items such as:

- a) point operating mechanisms;
- b) balises/loops (for train position determination and/or passing supplementary information to trains);
- c) level crossings;
- d) in dual-signalled areas, other conventional equipment such as signals, train detection equipment; Automatic Warning **System** (AWS), Train Protection and Warning **System** (TPWS); and
- e) track-based train detection systems.

These items are controlled by, and/or provide information back to, the interlocking and MA sub-systems.

4.7.5 Train-Borne Sub-Systems

The train-borne equipment comprises:

- a) the driver's MMI;
- b) sub-systems which receive/process and generate data messages transmitted from/to the fixed infrastructure;
- c) automatic train protection sub-**system**; and
- d) train position and train integrity equipment.

As with the interlocking and MA sub-systems, the train-borne sub-systems need to possess, or have access to, data about both the train and the fixed infrastructure. It should be noted that the safety requirements do not make assumptions about where in the **System** this data is held, nor which part of the **System** uses the data for calculating MAs, speed information, etc.

Train drivers are a key element in the safe operation of the **System**, and therefore the likelihood of human error, the development of procedures, ergonomic issues and competency requirements are addressed by the requirements.

4.7.6 Other Equipment

The requirements also make provision for the **System** to accept inputs from ancillary systems such as hot axle box detectors, dragging equipment detectors, etc. These are not regarded as part of the **System** itself, however.

In addition, the communication links between the various parts of the fixed infrastructure and trains are not necessarily part of the **System**. In many cases these will be open systems and transparent to the data, where the integrity of the **System** is independent of the communication links.