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Ref	NR/SP/SIG/I0067
Issue	2
Date	August 2003

Requirement Specification for a VDU Based System (formerly RT/E/S/I0067)

This temporary front sheet facilitates change to the new Network Rail Standards referencing nomenclature.

The Ref above will be formally allocated to this standard when it is next changed in the meantime the contents, date and issue number of this Network Rail Standard are UNCHANGED and with immediate effect it should be referred to as “(new ref) formerly (old ref)”.

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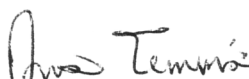


Network Rail Company Specification

VDU BASED SIGNALLING CONTROL SYSTEM

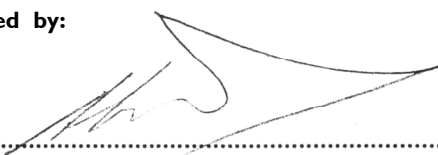
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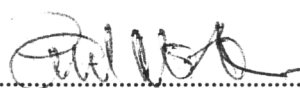
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Issue record

Issue	Date	Comments
1	May 1997	Initial Issue
2	August 2003	Updated to regularise various temporary non compliances, introduction of a symbol set and SPAD alarm functionality

Implementation

The requirements specified in this document shall be enforced from 1 August 2003.

Compliance

The requirements specified in this document shall be met by the Supplier of the VDU based Signalling Control System for all systems introduced into service from 1 October 2003, or currently under development, unless express written permission is obtained for any deviation from the Director Engineering. Retrospective action is not required in respect of existing signalling control systems. This specification does not apply to Network Management Centres (NMC) or IECC, for which separate requirements documentation is being developed/is available.

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I PURPOSE

I.1 Preface

The purpose of this Requirement Specification is to define the essential and desirable requirements for a VDU based Signalling Control System (VSCS) for signalling applications. Its scope is limited to requirements for the system hardware and software, and does not include requirements for the Signaller's environment (e.g. desk, chair, etc)

I.2 Background

Currently on Network Rail there are two main types of signalling control interface with the Signaller: the Signalling (Mimic) Panel and the VDU based Signaller's Display Sub-system (SDS) or newer Display Sub-system (DIS), associated with the Integrated Electronic Control Centre (IECC). The Signalling Panel is a relatively inflexible system which could be readily replaced using modern technology. Therefore a VDU based Signaller's interface is required as a cost effective alternative to the Signalling Panel. This document interprets the top level requirements for a Signaller's control and display system as specified in the appropriate Railway Group Standards, to form a detailed requirement specification for any VDU based signalling control system.

2 SCOPE

2.1 Overview of Requirement

The prime requirements are:

- a) the VSCS shall provide a safe and reliable means of controlling and monitoring signalling equipment and movement of trains via a separate interlocking system;
- b) The VSCS should support immediate and intuitive control;
- c) one VSCS shall incorporate one or more signalling workstations (where one signalling workstation shall provide an interface equivalent to that capable of operation by one Signaller);
- d) VSCSs shall be capable of being linked together to enable the addition of more signalling workstations and expansion of the controlled area;
- e) the VSCS shall be VDU based with a Signaller's interface conforming to [GK/RT0025](#).^[0]
- f) each VSCS shall run with common system functional software and separate geographic data to configure the system for the particular area to be controlled;

- g) the VSCS shall have the capability to control and monitor one or more signalling interlockings including Solid State Interlocking (SSI), CBI or equivalent sized relay interlocking types;
- h) the VSCS shall have the ability to interface with other signalling systems, including fringe and adjacent signal boxes, train describers, automatic route setting systems, junction route setting systems, information systems etc.

2.2 Other Specifications

2.2.1

Attention is drawn to the following specifications which may effect the design of a VSCS developed to meet the requirements of this specification:

- a) Signalling Control and Display Systems, [GK/RT0025](#) ^[0].
- b) Safety Related Colours for Signalling Application, [GK/RT0005](#) ^[0].

3 REFERENCE DOCUMENTATION

GK/RT0025	Railway Group Standard, Signalling Control and Display Systems, , issue 1.
GK/RT0005	Railway Group Standard, Safety Related Colours for Signalling Application, , issue 1, March 1996.
BR800	British Railways Board Specification for Train Describers, , October 1985.
RT/E/PS/00012	Specification for the Preparation and Implementation of Train Descriptor System Parameter Tables, , Issue 1, August 2001.
RT/E/PS/00009	Specification for Message Handling and Data Transmission Requirements between Processor Based Systems, , Issue 1, August 2001
RT/E/S/17503	Specification for Integrated Electronic Control Centre Internal Subsystems Communications Requirements, Issue 1, June 1999.
EN 50128	European Standard, Railway Applications – Communications, signalling and processing systems-Software for Railway Control and Protection Systems,:2001.
ENV 50129:	European Standard, Railway Applications - Safety Related Electronic Systems for signalling, 1998.
British Railways Board Specification No 967	Railway Signalling Apparatus: Environmental Conditions, January 1973.
BS EN 29241	Ergonomics Requirements for Office work with Visual Display Terminals,
Yellow Book	Railtrack Engineering Safety Management issue 3, 3.

EN50121-4:	Emission and Immunity of the Signalling and Telecommunications Apparatus, 2000
RT/E/S/17504	IECC Operating Specification for Railway Signalling Control and Indication Purposes, , Issue 2, December 2001
RT/E/S/11221	Signalling Works Testing, issue 2, June 2002.
BS EN 50160	Voltage Characteristics of Electricity Supplied by Public Distribution Systems, , 1995.
RT/E/S/10131	Requirement Specification for “Signals On” Controls for SSI Schemes, , Issue 1, April 1999
RT/E/S/11130	Requirements for the Provision of SPAD Alarms at Signalling Control Centres, , Issue 1, Dec 2002
BR1921A	Interfacing a Panel Multiplex System with A Solid State Interlocking System, March 1988.

4 ABBREVIATIONS

ARS	Automatic Route Setting system (IECC type)
CENELEC	European Committee for Electrotechnical Standardisation
CIF	Common Interface File
CSR	Cab Secure Radio
DIS	IECC Display Sub-system
E&P	Electrification & Plant
EE&CS	Electrical Engineering & Control Systems
ERTB	Electronic Train Register Book
HABD	Hot Axle Box Detector
HSE	Health & Safety Executive
IECC	Integrated Electronic Control Centre
ISO	International Standards Organisation
JRS	Junction Route Setting (simple first come, first served)
LED	Light Emitting Diode
MTBF	Mean Time Between Failure

MTTR	Mean Time To Repair
PES	Programmable Electronic System
RAM	Reliability, Availability, Maintainability
RRI	Route Relay Interlocking (any Network Rail type)
SCADA	Supervisory Control And Data Acquisition
SDS	Signaller's Display Sub-system
SGRC	Signal Group Replacement Control
SIL	Safety Integrity Level
SPAD	Signal Passed at Danger
SPT	Signal Post Telephone
SSI	Solid State Interlocking
TDM	Time Division Multiplex transmission
TRUST	Train Running System using TOPS
TSDB	Train Services Database
VSCS	VDU based Signalling Control System
VDU	Visual Display Unit
WILD	Wheel Impact Load Detector

5 DEFINITIONS

Inhibit	A facility, indicated on the Signaller's workstation, that prevents the Signaller from operating an item of signalling infrastructure.
Hit area	The area of, and surrounding a visual target which will allow the entering of commands to the VSCS using the pointing device.
Long route	A route combining one or more other routes.
Maintainer	A trained and competent person responsible for the repair and maintenance of signalling equipment.
One shot	Allows the Signaller to operate a function only once, usually in conjunction with a inhibit.
Reminder	A screen indication applied to remind the Signaller not to operate an item of signalling infrastructure.
Signaller	A trained and competent person responsible for operating the signalling system to ensure train movements occur safely and to planned routes.
Soft Key	A visual target on a display screen representing a specific control function or function key.
"S" Message	Message classification used in BR800 protocol to allow transfer of signalling data between train describers.

6 MANDATORY FUNCTIONAL REQUIREMENTS

This section provides a statement of the essential VSCS features, functionality and levels of performance. Functional Safety Requirements are identified by an **(S)** at the end of the requirement statement.

6.1 Displays & Indications

6.1.1 Each VSCS workstation shall:

- be equipped with a number of VDUs not normally exceeding five in number.
- be able to display in overview the workstation's complete control area.
- be able to display detailed views of defined sections of the layout.

- d) be able to display general information about the railway or the VSCS.
- e) be able to display all colours defined for signalling applications in GK/RT0005 [0].

Additional equipment (possibly VDU based) may be supplied separately for other systems such as telecommunications and level crossing control.

6.1.2

A continuously updated clock (displaying hours, minutes and seconds) shall be provided on the display. The clock shall be synchronised with other critical clocks in the signalling centre and tied to a recognised national time standard, e.g. the Rugby clock. Any fault in the VSCS system which prevents screen update shall freeze this display. (S)

6.1.3

A symbol set is included in Appendix A, which is based on the existing Network Rail practice of a black background.

6.1.4

Alternative background colours are also considered to be acceptable. Where other background colours are proposed, alternative colour schemes will be required. These alternative colour schemes will require Ergonomic consideration and acceptance by Network Rail Headquarters.

6.1.5

An overview display shall:

- c) show in schematic form the actual track layout.
- d) show all main running signals including displayed aspect.
- e) differentiate between different categories of signal (controlled, automatic, banner etc.).
- f) indicate which controlled routes are set.
- g) indicate the lie of points.
- h) indicate which track circuits (or groups of track circuits if combined into a track section for ease of presentation) are occupied.
- i) indicate the train description of each train.
- j) indicate the locations of all level crossings.

- k) indicate the location of fixed structures such as stations, tunnels, bridges, viaducts etc, where required by the infrastructure controller.
- l) indicate the boundary with and the name of, any adjacent signalling control centre.
- m) indicate points out of correspondence or loss of detection.
- n) indicate separate route exit symbols where provided.
- o) provide other indications as required by the screen layout.
- p) provide 'hit areas' for the displayed indications as required.

6.1.6

A detail display shall show all the information required by the overview with the addition of:

- a) location and aspect of all position light shunt signals.
- b) locations of HABD, WILD and Hot Wheel Detectors.
- c) separate 'hit areas' for main, warning and shunt routes.
- d) track circuits which are part of a combined group on an overview display shall be individually shown.
- e) the end of a signal overlaps, reduced overlaps or phantom overlaps.
- f) other indications as required by the screen layout.
- g) 'hit areas' for the displayed indications as required.

6.1.7

The detail display shall also provide on request:

- a) signal identities (numbers).
- b) point identity (numbers) and normal lie indicator (icon).
- c) ground frame identities (numbers).
- d) track section identities (number or letter code).
- e) indication of interlocking and ARS (where provided) boundaries.

6.1.8

The general information display shall consist of:

- a) train describer maps of adjacent workstations or signal boxes, as required.
- b) an echo display of any keyboard input.
- c) alarms about railway operation.
- d) alarms about the operation of the VSCS.
- e) alarms about other equipment.

6.1.9

Lines of railway forming the schematic track layout shall:

- a) be shown horizontally but limited diagonal and, if essential, vertical sections may be used where necessary.
- b) normally show unoccupied train detection sections in grey.
- c) show the first track character in the route flashing white/grey when the entrance signal to the route is selected but the route is not committed.
- d) show track with a committed route set in white.
- e) show a train detection sections indicating occupied in red.
- f) show lines controlled by absolute block as a grey outline with black central strip with Line Clear, Train on Line and Normal roundels.
- g) show non-train detection sections or an adjacent signal box by grey outline with black central strip.

6.1.10

Main running signal indications shall:

- a) consist of an appropriately orientated post, normally grey, with at least one roundel at the top of the post.
- b) show the signal post as white when a route is set from the signal.
- c) show the colour aspect of the signal. Signals controlled by other signal boxes or where limited information is available to the control system shall show limited colours or grey.
- d) be able to flash the signal roundel, eg, red to indicate approach locking timer operation or yellow for a flashing yellow aspect.

- e) have supplementary static symbols available to differentiate between different classes of signal (automatic, repeater etc.). Some of these may be restricted to detailed displays.
- f) provide 'light out' indications for controlled signals.
- g) be provided with additional symbols and 'hit areas' as required (e.g. automatic working, emergency replacement).

6.1.11

Shunt signals shall:

- a) consist of an appropriately orientated post normally grey with either a red or white quadrant.
- b) show the signal post as white when a route is set from the signal.
- c) be able to flash the quadrant if required.

6.1.12

Point indications shall:

- a) on detail displays, when individual points are controlled, display an N (Normal) or R (Reverse) next to the points. The letter shall flash until the points correspond with the demand.
- b) have a symbol available to show the Normal position of the points. This shall be switched with the point identity.

6.1.13

Train descriptions shall:

- a) be shown bounded by at least two characters of the occupied track section.
- b) move from berth to berth and shall function generally in accordance with BR 800 [0] supplemented by RT/E/PS/00012 [0] .
- c) be able to show 5 characters.
- d) normally overwrite a section of track layout.
- e) normally be of a pink colour.
- f) be blue/cyan when under the control of an automatic routing system.
- g) other colours will be used for trains subject to special operating conditions (e.g. whether or not the train is running to contingency plan or special timing pattern etc.).

6.1.14

Auxiliary indications shall be provided as follows:

- a) to suit the specific application being controlled. Examples include:
 - ground frames, indicating no release, release given and release accepted;
 - slot controls, indicating when release given and release received;
 - train ready to start indicators;
 - notice boards;
 - limit of shunt indicators;
 - direction arrows for reversible and bi-directional lines.
- f) indications for axle counter restoration sequences. These may require all other controls to be inhibited whilst in use or the cessation of the restoration control if another control is used.
- g) indications of relevant boundaries, such as interlockings or ARS areas. Boundaries shall be hidden under normal operation.
- h) interlocking boundaries shall be retained in the system and displayed automatically when the interlocking fails.
- i) similar boundaries to d) for remote control systems controlling a RRI.

6.1.15

Reminder/inhibit indication requirements shall be as follows:

- a) symbols or backgrounds shall be able to be applied to elements of the diagram to act as reminders.
- b) there shall be two types of device:
 - inhibits which, in the case of an SSI controlled area are passed to the interlocking, prevent that function being operated by any control method. These shall be displayed by an appropriate coloured background to the relevant symbol which will normally exclude track. A “one shot” override facility shall be provided. (S)
 - reminder indications only. These are attached only to track elements and consist of changed background colour. (S)

6.1.16

Isolated track sections monitored by axle counters, within track circuit areas shall be identified by (X) within the track section description.

6.1.17

Isolated track sections monitored by track circuits, within axle counter areas shall be identified by (T) within the track section description.

6.1.18

Track sections monitored by axle counters shall have a 'Restoration Indication'. The restoration indication shall be agreed and accepted by Network Rail.

6.2 Controls

6.2.1

Controls shall be implemented via a keyboard and pointing device. The pointing device shall be a trackerball with pushbuttons or an optical mouse (but not both). Pushbuttons associated with the pointing device shall be able to fulfil the following functions:

- a) set / cancel commands,
- q) normal / reverse / centre option commands for point key functions.

A separate pushbutton for each function is not essential. The action of a pushbutton may be dependent on the function selected. The function shall be activated by placing the pointing device on the 'hit area' of the screen item.

6.2.2

The types of controls which shall be provided cover:

- a) signalling commands and alarms;
- b) train describer commands and alarms;
- c) system alarms.

6.2.3

A display cursor shall be controlled via the pointing device.

6.2.4

The cursor shall be able to be moved from VDU to VDU by moving it towards the relevant edge of the screen and continuing movement in that direction until the cursor jumps to the next VDU. This function shall provide a smooth and easy transition from one VDU to the next.

6.2.5

The cursor control functions shall:

- a) set a route by using the cursor and operating appropriate controls using the entrance-exit selection method, i.e. placing the cursor on the entrance signal symbol and operating the 'set' command, followed by placing the cursor on the exit signal or button symbol and operating the 'set' command;
- b) set alternative routes as above with additional intermediate symbols if appropriate;
- c) cancel a route by placing the cursor on the entrance signal symbol and operating the 'cancel' command;
- d) control points by placing the cursor on the relevant point end and operating the appropriate point control command;

6.2.6

The following facilities shall be set and cancelled by positioning the cursor on the appropriate symbol and operating controls as appropriate:

- a) automatic working facility for a controlled signal;
- b) emergency replacement facility for automatic signals;
- c) Signal Group Replacement, see RT/E/S/10131 ^[0]
- d) emergency alarms; (where controlled via VSCS)
- e) SPAD Alarm Inhibition; (where provided)
- f) application, override and removal of reminders and inhibits
- g) slot controls; (where controlled via VSCS)
- h) request information on normal lie of points;
- i) point heater commands; (where controlled via VSCS)
- j) tokenless block normal/accept and offer/train arrived facilities;

- k) miscellaneous facilities where indications are provided;
- l) ground frame release; (where controlled via VSCS)
- m) absolute block controls; (where controlled via VSCS)
- n) view selection, i.e. detail or overview displays and on which VDU;

6.2.7

Alarms that shall be able to be acknowledged via the pointing device or keyboard shall include:

- a) emergency alarm from adjacent signal box; (where controlled via VSCS)
- b) automatic level crossing alarms; (where controlled via VSCS)
- c) SPAD Alarm;
- d) general alarms;
- e) remote control system failure alarms.

6.2.8

The loss of one method of entering commands shall not affect the Signaller's ability to control the signalling.

6.2.9

Commands shall be able to be entered with a minimum of keyboard strokes. Commands shall be unambiguous and use labels that are easy to interpret by the Signaller and correspond to the control being requested.

6.2.10

All signalling commands shall be allowed via the keyboard and include:

- a) route setting;
- b) route cancellation;
- c) individual point control;
- d) automatic working of a controlled signal;
- e) emergency replacement facility for automatic signals;
- f) SGRC;
- g) emergency alarm sending, cancelling, acknowledgement of receipt and cancellation (where controlled via VSCS);

- h) SPAD Alarm Inhibition (where provided);
- i) slot controls (where controlled via VSCS);
- j) request for information on normal lie of points;
- k) point heater control (where controlled via VSCS);
- l) ground frame release (where controlled via VSCS);
- m) patrolman's lockout switch (where controlled via VSCS);
- n) absolute block controls (where controlled via VSCS);
- o) tokenless block normal/accept facility (where controlled via VSCS);
- p) tokenless block offer and train arrived facility (where controlled via VSCS);
- q) display of signal, point and track circuit identities on the detail displays;
- r) application override and removal of reminder symbols;
- s) view selection, i.e. detail or overview displays and on which VDU;
- t) acknowledgement of signalling display alarms (where controlled via VSCS);
- u) control of miscellaneous facilities where indications are provided;
- v) query route, where an automatic route setting system is provided.

6.2.11

The minimum set of train describer commands which shall be allowed via the keyboard include:

- a) interpose train description;
- b) cancel train description;
- c) recall by train description or berth.

6.2.12

Controls shall be available to the user on the VDU to adjust brightness and contrast and to perform degaussing (degaussing on CRT monitors only).

6.2.13

The workstation boundaries and VSCS control boundaries shall be data configurable such that for all applications they shall be coincident with interlocking boundaries and not overlap each other. (S)

6.2.14

Where axle counters are provided, a Signaller's control should be provided for axle counter restoration. The form of the control shall be proposed by the Supplier and agreed with Network Rail Headquarters via an Axle Counter Application Safety Case.

6.2.15

The VSCS shall minimise the number of occasions when it passes a Signaller's request to the interlocking for a route to be set which is clearly unavailable according to data supplied by the interlocking to the VSCS. (S)

6.2.16

The setting of combined routes ('long routes') shall be data configurable (where provided).

6.3 Alarms

6.3.1

All alarms requiring an acknowledgement shall be capable of being acknowledged separately via the keyboard.

6.3.2

There shall be a clearly differentiated set of audible alarms with a maximum of five levels available for allocation. More strident sounding alarms shall be used as the alarm criticality level increases.

6.3.3

Alarm text messages shall indicate the level of criticality of the alarm.

6.3.4

The level of alarm (e.g. a level from 1 to 5) allocated to any event shall be data configurable dependent on the specific application.

6.3.5

It shall be possible to generate alarms on the VSCS in response to both events occurring within the VSCS e.g. system alarms, train not described alarms and also external alarms, e.g. other equipment alarms.

6.3.6

For all alarms the output from the VSCS shall ensure that the Signaller can rapidly and accurately identify the alarm type and the location of the incident. (S)

6.3.7

Alarms that do not require Signaller action shall be directed to the maintainer. It shall be possible to configure the system such that these alarms alert the Signaller of the need to inform the maintainer that attention is required.

6.3.8

Standard Signaller's alarms shall be data configurable and include:

- a) emergency alarm from adjacent signal box (where controlled via VSCS);
- b) automatic level crossing alarms (where controlled via VSCS);
- c) general alarms, such as tunnel flooded, hot axle box detector, etc. (where controlled via VSCS);
- d) SPAD Alarm, see RT/E/S/11130; ^[14.18]
- e) TPWS failure alarms;
- f) remote control system failure alarms;
- g) interlocking critical alarms;
- h) train not described;
- i) signalling power supply failure alarms;
- j) VSCS system alarms;
- k) alarms if point detection is unexpectedly broken, i.e. when the points have not been called to move by either points key action or setting of a route;
- l) alarms if a signal returns to danger unexpectedly, i.e. not caused by train movement or Signaller's action.

6.3.9

The VSCS should provide a facility to monitor and log the sequence of track circuit occupancy and clearance and provide an alarm if the sequencing fails. The exact sequence algorithm shall be data configurable and geographically configurable. Two alarm types shall be possible: track circuit unexpectedly occupied or track circuit unexpectedly clear.

6.4 Performance

6.4.1

The VSCS shall be capable of receiving at least 128 indication changes per second per signalling workstation, under normal operating conditions. **(S)**

6.4.2

The VSCS displays shall be updated within 100 ms of receiving indication data from the interlocking under normal operating conditions. (S)

6.4.3

Under avalanche loading conditions the data shall be processed in the order received and the displays shall be capable of showing the updated display within 5 seconds. Under avalanche loading conditions (e.g. SSI initialisation) up to 1600 changes could be received within one second (S)

6.4.4

The VSCS shall react to signalling alarms within one second of receipt or generation, and within two seconds for all other alarms and messages. (S)

6.4.5

The VSCS shall be capable of receiving at least 5 train description steps per second per signalling workstation simultaneously with the maximum number of indication changes.

6.4.6

Train description steps shall be displayed within 1 second of the trigger for the step occurring.

6.4.7

The VSCS shall be seen (via the user VDUs) to react to a Signaller's control within 200 ms of receiving the command (in the event of waiting for a response from a connected system the VSCS shall still acknowledge the Signaller's command).

6.4.8

The VSCS shall remove any indication to the Signaller that a route is being called if no affirmative response has been received from the interlocking within 5 seconds.

6.4.9

The VSCS shall interpret and start sending a Signaller's control to the interlocking within 200 ms of receiving the command.

6.4.10

The VSCS shall interpret and start sending a Signaller's control to systems other than the interlocking (e.g. to an automatic route setting system) within 200 ms of receiving the command.

6.4.11

The VSCS shall be capable of sending at least four commands per second per signalling workstation (assuming a single workstation is controlling the equivalent of four SSIs).

6.4.12

The VSCS shall not output more than 1 command per 100 ms to any individual interlocking. (S)

6.5 Degraded Operation

6.5.1

It shall always be possible to display a complete overview of a Signaller's controlled area in the event of any single VDU failure, e.g. by reconfiguring the displays that remain functional.

6.6 Event Logging

6.6.1

All changes of state of the VSCS for at least the previous 48 hours (changes of indications, input of commands, alarms etc.) shall be recorded, in the order in which they are received, as an event log on non-volatile media and time stamped to an accuracy of one second, synchronised from a suitable radio synchronised clock. The format of the event log shall be agreed with Network Rail.