

Category 1 Standard

S1194 Signalling Control - Functional Requirements

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1 Purpose

- 1.1 The purpose of this Standard is to define the functional requirements for Signalling Control Systems which are used in the operations of the London Underground railway.

2 Scope

- 2.1 This Standard defines the functionality of the Signal Control Systems and addresses the following:
- a) Office of Rail Regulation (ORR) Railway Safety Principles and Guidance (RSPG); Part 1, and Part 2 Section D, Guidance on Signalling;
 - b) Safety;
 - c) Dependability;
 - d) Operability under normal, abnormal, degraded, and emergency conditions;
 - e) Human and Technical Interfaces;
- 2.2 The Standard applies to the following systems which are used on the London Underground railway:
- a) Mainline Signal Control Systems (remote and local) and Depot Signal Control Systems;
 - b) Automatic Vehicle Identification (AVI);
 - c) Control and Information Equipment (including programme machines and dot matrix display systems);
 - d) Interfaces to Management and Customer Information Systems.
- 2.3 This Standard focuses on requirements of the Control System functionality. The totality of requirements contained within the complete suite of Signalling and Signalling Control Standards, see 5.1.2, shall be complied with for these systems.
- 2.4 The issue of this standard replaces 1-194A2.

3 Functional requirements

3.1 Main Line Signalling Control

3.1.1 Operational Requirements

3.1.1.1 Levels of control

- 3.1.1.1.1 The system shall provide a minimum of two levels of control:

- a) Line-based control;
- b) Control of individual interlockings.



3.1.1.1.2 Each interlocking site shall be capable of operating under control from the Service Control Centre (SCC), to provide line-based control, or by local operation.

3.1.1.1.3 For Line-based control, provision shall be made to enable the operator to issue high level commands such as timetable editing, which modify train trips and cause the control system to generate actions which operate on individual local signalling subsystems which are under its control.

Note: Line-based controls encourage the operator to view the service as a wide area system comprising linked train trips.

3.1.1.1.4 In line-based control operation, control of the train movements shall be scheduled automatically in accordance with the timetable or previously entered Operator commands.

3.1.1.1.5 The system shall provide the facility to control interlockings on an individual function level as detailed within the System Requirements Specification.

3.1.1.2 Operator Interface

3.1.1.2.1 An analysis of human factors shall be carried out as part of the development of the operator interfaces. Where the analysis identifies that a two stage select and execute mechanism is required for a command, this shall be provided. The mechanism shall provide an operator with the option to abort the command between the select and execute steps.

Note: Operator interfaces typically include:

- a) Line Control Centre operator and maintainer interfaces;
- b) depot shunter interfaces;
- c) siding and rear cab clear plungers and displays; and
- d) remote terminals.

3.1.1.2.2 Only control options permitted by the relevant authority level of the Operator shall be presented.

3.1.1.2.3 Where warning devices (e.g. low air pressure detector) and systems are incorporated to alert the LU operations or maintenance staff, or both, to an event with potential safety implications, the alarms generated from such devices or systems shall be dealt with as required in section 3.1.2.1 of this standard.

3.1.1.2.4 Operational diagrams and controls shall be provided to facilitate the emergency working of signalled routes (normal routes or degraded routes using Route Secure) on a localised basis to ensure continued operation under a major systems failure, taking into account all credible failure modes. The aim shall be to provide graceful degradation. The precise nature, functionality and location shall be agreed with LU.

Note: Requirements for a Maintenance Panel are covered in Standard S1195, Signalling - Functional Requirements

3.1.1.2.5 The Signalling Control System shall form part of a service control facility that provides an integrated user interface to enable other systems to be controlled and monitored.



Note: Typically the systems to be integrated could consist of CCTV, radio, and train systems. The level of integration will be determined by factors including practicality, reliability and operability.

3.1.1.2.6 Safety related functions shall include the Stop Trains (Code Amber and Code Red) commands.

3.1.1.2.7 An on-line help facility shall be included as one of the facilities of the Signalling Control System. It shall include on line help for any automatic train control system which is under the supervision of the Signalling Control System. The scope of this facility shall be determined through the human factors input to the system design.

3.1.1.2.8 An engineer's workstation shall be provided with the means to control and receive indications on the status and configuration of the Control System and its communications network.

3.1.1.3 Display Requirements

3.1.1.3.1 The control system shall be designed to display all the information which has been identified in the User Requirements Documentation as necessary to enable each LU Operator to carry out their role in the supervision of the train service.

Note: For details of requirements associated with User Requirements Documentation and System Requirements Specification see section 3.2.1 of Standard S1196, Signalling and Signalling Control - Concept and Requirements.

- a) Train location;
- b) Train direction;
- c) Train identity;
- d) Crew identity;
- e) Train destination;
- f) Train status (mode of operation);
- g) Train loading;
- h) Signal status;
- j) Signal identification;
- k) Tripcock test status;
- m) Movement authority;
- n) Route status;
- o) Point status;
- p) Point identification;
- q) Point heater status;
- r) Platform edge door status;
- s) Control system status;



- t) Junction mode status;
- u) Floodgate status;
- v) Low negative shoe status;
- w) Station skip;
- x) Signalling equipment failure status;
- y) Temporary speed restrictions.

3.1.1.3.2 The system shall be capable of displaying information on a large scale diagram displaying an overview of the area under the control of the system. Any requirement to provide a large scale diagram shall be identified by the operator in the User Requirements Specification.

3.1.1.3.3 Information shall be presented so as to minimise the probability of its misinterpretation by a user and shall meet the requirements of Standard 1-218, Universal Human Computer Interaction.

3.1.1.3.4 An LU Operator shall have the choice of the level of detail to be displayed on visual display track diagrams and shall be able to change the level of detail at any time.

3.1.1.3.5 When changing between different views of related data, the first view shall continue to be displayed and shall not be obscured until the system is ready to refresh the screen with the replacement data.

Note: This is in order to minimise the period when no data is shown.

3.1.1.3.6 Information which is known to be erroneous or out of date, shall be clearly and unambiguously indicated as such when displayed.

3.1.1.3.7 The system shall have the facility for selected LU operators to request current, historic and train prediction information from the System for display. The Control System shall include interfaces to customer and management information systems.

3.1.1.3.8 The Control System shall include interfaces to customer and management information systems.

Note: An example of a management information system for staff is the 'Trackernet system'.

3.1.1.3.9 The Control System shall only offer valid selections, and the current actual selections.

3.1.1.4 Remote Point Securing

3.1.1.4.1 Where the Remote Securing of Points is to be available within the safety signalling system, a facility shall be provided at the SCC to enable an LU Operator to introduce and remove remote securing at individual sites, or on a route by route basis.

Note: An individual site refers to a bounded area of control such as an interlocking area or a station area.

3.1.1.4.2 On initiation of remote securing, all automatic route setting shall be inhibited at that site.



3.1.1.5 Train Movement Requirements

3.1.1.5.1 It shall be possible to identify uniquely every train controlled by the Signalling Control System.

3.1.1.5.2 The Signalling Control System shall contain functionality to support movement of abnormal length trains.

Note: This should accommodate the running of short trains, the running of long works trains and the need to pull-out or push-out a failed train using another train, thereby effectively doubling the length of the train. This facility should be provided for all routes on the mainline and into depot roads or roads with a length suitable for two trains.

3.1.1.5.3 The design shall ensure that after the passage of a works train in the wrong direction, the signalling control shall return to its normal state to allow train movements in the signalled direction of travel.

3.1.1.5.4 Facilities to enhance the operational performance such as automatic service regulation shall be considered for inclusion in the User Requirements Documentation. The implementation for such facilities shall be agreed with LU.

Note: The facilities could include:

- a) regulation to optimise energy consumption (and peaks in power demand such as block starting of trains after a service disruption);
- b) regulation to minimise journey time;
- c) regulation to optimise headway.

3.1.1.6 Train Prediction Function

3.1.1.6.1 The system shall generate train prediction information for LU defined Control Points on the railway. The prediction time and re-calculation frequency shall be specified in the User Requirements Documentation for the system.

Note: Train prediction information should typically include:

- a) Train identity;
- b) Train destination;
- c) Current location;
- d) Lateness (deviation from timetable);
- e) Predicted time to arrive at Control Point.

3.1.1.7 Simulator

3.1.1.7.1 A simulator shall be provided at the location specified in the User Requirements Documentation for training SCC staff and maintenance staff, testing of programs, data and systems, and for checking timetables. It shall be capable of simulating single or multiple sites in real time, as specified in the Systems Requirements Specification.

3.1.1.7.2 The simulator shall provide a simulation of:



- a) Train movements;
- b) The signalling system, and;
- c) The signalling control system interface to SCC staff.

3.1.1.7.3 The signalling system simulator shall simulate a full train service and provide interfaces for the trainer and trainee.

3.1.1.7.4 The Simulator shall provide an accurate representation of the area of the Railway being simulated which is sufficient to enable SCC staff to be trained to deal with normal operations and conditions which are abnormal, degraded, and emergency (see definitions in section 6.3).

3.1.1.7.5 It shall be possible to start the simulation with the date and time set to any required value to allow flexibility of use and to allow the checking of timetables prior to their use on the signalling control system.

3.1.1.7.6 It shall be possible to run the simulator in real time and at a specified higher speed of at least twice real time. It shall also be possible to suspend the simulation and resume operation after a time interval, and to change from one mode to another without starting a new simulation. When running the simulator in real time, realistic response times shall be included.

3.1.2 System Requirements

3.1.2.1 General

3.1.2.1.1 The functional requirements for a signalling control system shall be detailed in a System Requirements Specification as defined in Standard S1196, Signalling and Signalling Control - Concept and Requirements.

3.1.2.1.2 Alarms shall be managed in accordance with Standard 1-218, Universal Human Computer Interface.

Note: An example of an alarm which may be included is that of a train which has not moved for a defined period of time.

3.1.2.1.3 Where there are control centres with more than one control position for the areas under control, then it shall be possible to dynamically allocate specific areas of the railway to specific positions as agreed between LU and the Supplier.

3.1.2.2 Automatic Routing and The Timetable

3.1.2.2.1 In Automatic Mode routes shall be set within the signalling system using commands generated by, and received from, the Control System.

3.1.2.2.2 A railway timetable shall be used as the primary source of information for the automatic control of trains.

3.1.2.2.3 In the absence of an available timetable, the system shall route trains from any destination information that is provided by the Signalling System or the Control System.

3.1.2.2.4 The Control System shall normally set routes in accordance with the timetable entry for the train being considered, as modified by automatic routing requirements and manual intervention as agreed with LU.