

Category 2 Standard

S2502
(Formerly E7204)

Design of Safety Signalling



**Please read the Written Notices
attached to this standard**

Issue No.: A4

Issue date: February 2012
Review date: February 2017

MAYOR OF LONDON



Contents

1	Purpose	3
2	Scope	3
3	Requirements	3
3.1	Safety considerations	3
3.2	Quality assurance	3
3.3	Principal functional requirements	4
3.5	Performance requirements	24
3.6	Availability, reliability and maintainability	25
3.7	Design considerations	25
3.8	Installation and commissioning	26
3.9	Personnel requirements	26
3.10	Maintenance	26
3.11	Verification	26
4	Responsibilities	26
5	Supporting information	27
5	References	27
6.1	Documentary references	27
6.2	Abbreviations	28
6.3	Definitions	29
6.4	Technical content manager	31
6.5	Document history	32
7	Attachments	33
7.1	Attachment 1: Typical design process	33
7.2	Attachment 2: Diversity, circuit example	34
7.3	Attachment 3: Wrong road protection	35
7.4	Attachment 4: Sighting distance calculations	36
7.5	Attachment 5: Sighting distance calculations	37
7.6	Attachment 6: Use of the 1955 Signal Overlap Formula	38
7.7	Attachment 7: Table of controls	39
8	Current Written Notices attached to this standard	40

1 Purpose

- 1.1 This standard sets out the present level of LU functional and performance requirements for the safe and reliable system design of conventional, fixed block, wayside signalling.

2 Scope

- 2.1 The objective of this standard is to communicate issues that need to be considered when producing designs for safety signalling systems, and to assist those required to audit the work.
- 2.2 This standard does not cover specific application design or configuration issues, which shall be described in project particular specifications or other associated project documents.
- 2.3 This standard replaces E7204 A3.

3 Requirements

3.1 Safety considerations

3.1.1 System safety

- 3.1.1.1 The signalling system shall be designed to ensure that an unsafe or a potentially unsafe condition shall occur no more frequently than the target stated in the detailed specification. This target (for mean time between wrong side failure, MTBWSF) shall be developed from a number of site or line specific attributes including the following:
- a) each interlocking site shall not produce an unsafe or potentially unsafe condition more than once every 10^9 hours;
 - b) each station area, where there are no points and crossing work, shall not produce an unsafe or potentially unsafe condition more than once every 10^{10} hours.
- 3.1.1.2 It is the designer's responsibility to meet the level of the LU design and quality standards required to produce a safe and efficient signalling system, to ensure the safety of both LU's passengers and employees.

3.1.2 Safety assurance

- 3.1.2.1 The signalling system shall be developed and assured in compliance with BS EN 50126, BS EN 50128 and BS EN 50129.

3.1.3 Health and safety

- 3.1.3.1 Designers shall consider all aspects associated with relevant legislation including that noted in this document.

3.2 Quality assurance

- 3.2.1 The application of this standard shall invoke the contractual requirements of the London Underground Contract QUENSH Conditions (standard 1-552) and as a minimum shall require a Quality Plan to be prepared. Designers of safety signalling systems shall operate a management system that meets the requirements of BS EN ISO 9001.

3.2.2 All facets of the system design, construction, installation and commissioning shall be subject to the designer's quality plan(s).

3.2.3 Project monitoring of design change control shall cover:

- a) the preparation of the specification;
- b) prototype design and build;
- c) prototype evaluation.

3.3 Principal functional requirements

3.3.1 Design process

3.3.1.1 General

3.3.1.1.1 The design of the safety signalling system shall follow a recognised process. A process of checking and approval shall be established between LU and the designer, and shall be agreed by the Professional Head of Signalling. The LU standard design approach incorporates a typical hierarchy as detailed in Attachment 1.

3.3.1.1.2 The design process shall include documented design reviews at a level, depth and frequency appropriate to the task, but as a minimum, within 60 days of the start of the design and every 6 months or prior to a design issue, whichever is more frequent. The design review shall include persons with a system understanding of the project requirements and expertise from all the prime facets of the implementation of that design.

3.3.1.2 Design authority

3.3.1.2.1 A design authority shall be agreed with the Professional Head of Signalling.

3.3.1.2.2 The design authority shall be independent of the design team.

3.3.1.2.3 The design authority shall be responsible for the approval of all designs.

3.3.1.3 Change control

3.3.1.3.1 The designer shall submit the procedures to be used to control design changes, for agreement by LU.

3.3.1.3.2 The designer shall implement procedures for the formal control of the issue and configuration of all hardware and software. Duplicate versions of all software issued shall be held for at least one year after the software has been superseded in all such systems used by LU.

3.3.2 System engineering

3.3.2.1 All commonly envisaged component or system failure modes, such as broken wires, damaged or dirty contacts, failure of a watch-dog function, loss of correspondence, failure of any device to respond, loss of power, or any similar failure, shall not result in an unsafe condition in any combination.

3.3.2.2 Any single independent component failure shall result in a safe condition. Component failures which are not independent, that is, those failures that occur as a result of another failure, shall be considered in combination with the original failure and all other failures resulting from the same original failure. This shall not cause an unsafe condition.

3.3.2.3 When an earth free system is used, each circuit which affects the safety of train operation shall be kept free of any earth or combination of earths which would permit a

flow of current equal to or in excess of 30% of the release value of any relay, electromagnetic device, or process input. However, circuits connected to the running rails shall be earthed in the interests of safety, and designed accordingly.

- 3.3.2.4 Earth free systems must have continuous monitoring for detecting earth faults and these must be alarmed to the technician.
- 3.3.2.5 Vital circuit design shall ensure a safe status for any combination of open circuit, short circuits, partial opens, partial shorts, oscillations or any other known failure modes of specific components.
- 3.3.2.6 Filters used in vital circuits shall prevent undesired signals (outside the design pass band limits) from passing through the filter at any level that may cause unsafe conditions, even in the event of component failure within the filter.
- 3.3.2.7 PCB's and plug-in apparatus shall be mechanically or electrically keyed or both to prevent improper insertion or operation.
- 3.3.2.8 The system design shall incorporate features to facilitate the acceptance testing, commissioning and subsequent maintenance testing of the system. This shall include provision of labelled test points at locations which allow observation of equipment operation whilst taking measurements. The test points shall not be more than three metres apart, except if the test is expected to be performed by one person, then the maximum distance apart shall be one metre. Return test points shall be provided on racks and equipment cabinets and labelled.
- 3.3.2.9 The designer shall consider the maintainability of the system in its design.
- 3.3.2.10 Alarms, mechanical recording, and monitoring shall be transmitted to a location which is manned for a minimum of seven hours per day. Provision to test and acknowledge alarms shall be provided.

3.3.3 Diversity

- 3.3.3.1 The signalling system shall make use of diverse means of ensuring safe operation of sub-systems in critical areas where analysis has shown a high potential of risk or other known areas of concern such as the primary train detection system and the Authority to Proceed instruction.
- 3.3.3.2 Diversity can be achieved by the use of two, or more, physically different sub-systems which either perform the same system function or are arranged so that one sub-system performs a check on the correct operation of another sub-system.
- 3.3.3.4 An example of where LU uses diversity in its existing system is shown in Attachment 2.
- 3.3.3.5 An example of another method of diversity is that of monitoring the correct sequence of circuit operations. In these cases it is imperative that right side failures or operations within the sequencing checking do not have a significant effect on the system operation.
- 3.3.3.6 The application of diverse or redundant techniques shall include management systems to identify failures within those systems such that they can be repaired prior to a system failure or as necessitated by the system safety analysis.

3.3.4 Segregation

- 3.3.4.1 A positive identifiable and physical demarcation shall be provided between vital equipment and control and communications systems in order to preserve the vital principles of design and safety provided by the vital equipment and circuits.

3.3.5 Train separation

- 3.3.5.1 The principal requirement of the safety signalling design is to ensure a safe distance between trains and to prevent conflicting movement.
- 3.3.5.2 The minimum safe distance between trains is that which allows a train to brake and come to rest before the position of another train or obstruction ahead. For fixed block signalling systems, this safe distance is called the overlap. For overlap calculations, see 3.4.3 to 3.4.6 inclusive.

3.3.6 Train detection

- 3.3.6.1 The designer shall ensure that the safety signalling system provides continuous train detection and that the train detection system complies with E7055, Train Detection systems.
- 3.3.6.2 Insulated rail joints, if used, shall be kept to a minimum, and in junction areas kept out of the main route where possible.

3.3.7 Locking functions

- 3.3.7.1 The designer shall ensure that locking functions comply with those described in S1195 Signalling Functional Requirements and E7054, Signalling Interlocking Systems.
- 3.3.7.2 The minimum tracklocking distances, measured from the point tips, are as follows:
- a) facing passenger moves: 20m;
 - b) facing shunt moves: 10m;
 - c) trailing moves: 3m.
- 3.3.7.3 If the total operating time of the equipment associated with the tracklocking distances (such as, the point mechanism, the train detection equipment and the signalling system processing equipment) exceeds two seconds then the minimum tracklocking distances stated in 3.3.7.2 shall be agreed by the Professional Head of Signalling prior to their use.
- 3.3.7.4 If the minimum tracklocking distances cannot be achieved then an approaching train must be proved stationary before the points are moved.

3.3.8 Proving

3.3.8.1 Trainstop proving

- 3.3.8.1.1 The design shall include circuits to prove that the trainstop arm has returned to the "ON" (raised) position after every occasion that it has been lowered. The proving shall be such as to minimise the effect on signal operations in the event of a trainstop failure, e.g. double block working.
- 3.3.8.1.2 The design shall include circuits to indicate to the train operator that the trainstop arm has lowered not to the "OFF" position when the signal has cleared and to indicate to the train operator that it has not lowered at sufficient distance to stop at the raised trainstop.

3.3.8.2 *Function proving*

- 3.3.8.2.1 When interlocking devices such as timing devices or train presence detectors are used in the safety signalling system, they shall be proved to have returned to their normal or rest position before they are next used.

3.3.9 **Setting of timing devices**

- 3.3.9.1 When timing devices are being set, the operating tolerance shall always be ADDED to the required delay to ensure that the safety level of design speed cannot be exceeded. e.g. where a device has an operating tolerance of + ½ second, the device shall be set for 5 seconds for a required delay of 4½ seconds.

3.3.10 **Signal types**

- 3.3.10.1 The classes and types of signal used on LU's lines are detailed in E7005, Wayside Signalling.
- 3.3.10.2 Passenger routes shall be controlled and terminated by colour light signals with appropriate overlaps.
- 3.3.10.3 Non-passenger (shunt) moves shall normally be controlled by shunt signals. However, if the route runs onto the main line and is protected by an appropriate speed overlap with passenger locking and route holding standards then a colour light signal may be used.
- 3.3.10.4 Rail gap indicators shall be provided in accordance with E7005.

3.3.11 **Sighting of signals**

Note: Refer to E7203, Sighting of lineside signals, signs and indicators for requirements.

- 3.3.11.1 Continuous sighting of signals is not required.
- 3.3.11.2 When the positions of signals have been determined, the designer shall ensure that the train operator can have sight of the signal or a repeating signal from the signal's sighting point.

3.3.12 **Round the bend signals**

- 3.3.12.1 In tube areas additional signals shall be provided over and above those required for normal sighting and headway considerations. These were introduced to reduce the risk of a possible collision, where the view forward is restricted by the curvature of the track, following the application of the 'trip and proceed' rule. These signals shall be installed to the requirements specified in 3.3.12.2 and 3.3.12.3. These additional signals shall be known as 'round the bend' signals and shall be uniquely numbered so that they can be readily identified from other signals.
- 3.3.12.2 Around curves of less than 300 m radius, the signals shall be provided spaced at approximately 150 m intervals.
- 3.3.12.3 Around curves that are 300 m radius, (or more shallow than 300 m radius) and where the sighting distance of the train tail lamps is less than the safe braking distance for 33 km/h, signals shall be spaced at about 180 m intervals.

3.3.12.4 A headway signal may serve a dual purpose of achieving the headway requirements and satisfying the requirements for 'round the bend' signals.

3.3.12.5 The signal in the rear of a 'round the bend' signal shall be prevented from clearing until the 'round the bend' signal itself displays a proceed aspect.

3.3.13 Read through of signals

3.3.13.1 At locations where the train operator of a train being held at a controlled signal can observe a clear signal less than 250 m in advance of the train, the operating hazards shall be considered and the signal position reviewed and approach controls shall be considered to reduce the possibility of the train operator assuming that the immediate route has cleared.

3.3.13.2 The designer shall ensure that a signal on one road cannot be misread by or confuse a train operator of a train on another road.

3.3.14 Starting signal control

3.3.14.1 The signalling system shall ensure that starting signals at "all trains to stop" stations cannot display a clear to proceed aspect until the approaching train has been proved to be braking towards the station, or has been stationary in the platform.

3.3.15 Signal, point and track numbering

3.3.15.1 All signalling equipment, including but not confined to signals, points and track circuits shall be numbered in a logical way for identification purposes. Each signal on LU shall be uniquely identified.

3.3.15.2 When the alterations to the signalling are within an existing signalling system, the numbering shall conform to LU's existing numbering method for the site(s).

3.3.15.3 When an entire line is being resignalled the controlled signals at each controlled site shall be prefixed with a three letter abbreviation of the site location, e.g. "WER" for West Ruislip, followed by a one or two digit number, except for permissive and special signals which shall have additional numbers to identify them. At each controlled site location one road shall have low odd numbers increasing in direction of travel and the other road shall have high even numbers decreasing in direction of travel. The site location abbreviations shall be agreed with the Professional Head of Signalling.

3.3.15.4 When an entire line is being resignalled the automatic signals shall be prefixed with the letter 'A' and have a three digit number, except for special signals such as 'round the bend' signals. On the entire line the automatic signal numbers shall have odd numbers increasing in direction of travel on one road and even numbers decreasing in direction of travel on the other road. Allowances in the numbering shall be made at each site for an additional signal to be provided at a later date.

3.3.15.5 When an entire line is being resignalled the points at each site location shall have one or two digit numbers in the centre of the range between the low and high numbers used for the controlled signals at that site location.

3.3.15.6 When an entire line is being resignalled the track circuits shall be uniquely numbered.

3.3.15.7 The numbering used in the systems described in 3.3.15.3, 3.3.15.4, 3.3.15.5 and 3.3.15.6 shall be agreed with the Professional Head of Signalling.

3.3.16 Wrong road protection

3.3.16.1 At sites where the service may reverse, the design shall include functions to prevent the train operator from taking the wrong route.

- 3.3.16.2 Shunt signals shall be provided for Draw Ahead moves.
- 3.3.16.3 A wrong road fixed red light shall be installed at the entry end of the platform of the station in rear of the reversing station, in situations where it is likely that detraining may take place when the reversal facility is in use.
- 3.3.16.4 In tube sections a wrong road trainstop and fixed red light shall be provided at the entry end of the platform at reversing stations. In open sections only the fixed red light shall be provided.
- 3.3.16.5 The wrong road trainstop shall be lowered (released) for normal direction train movements but is not required to be proved to have returned to the "ON" position after the passage of a train, unless it terminates a signalled move.
- 3.3.16.6 A reflective "Limit of Shunt" sign shall be provided at the position where a reversing train, travelling in the normal direction of travel, has to stop prior to reversing. For moves in the wrong direction a FRL and trainstop shall be provided instead of the limit of shunt sign.
- 3.3.16.7 At tube section stations, other than those referred to in 3.3.16.3, a reflective "Stop" sign shall be provided, to assist in preventing wrong road moves, at the entry end of the platform.
- 3.3.16.8 Two layouts are shown in Attachment 3, these are only examples of reversing sites, and there will be reversing sites with many different layouts. However, the principles, and the degree of protection shall be equivalent to these.

3.3.17 Terminal station and siding protection

- 3.3.17.1 The speed of a train approaching a terminal station or siding shall be controlled when nearing the stopping point. The required speed shall be dependent on the overrun or length of arrester available. Reference should be made to S1195, S1197 and E7005.
- 3.3.17.2 The designer shall consider the need to include traction control in order to prevent trains attempting to leave a siding against the exit signal and fouling other lines or causing infrastructure damage. Reference should be made to S1195 and S1197.

3.3.18 Staff protection keyswitches

- 3.3.18.1 Staff protection keyswitches shall be provided to protect staff when they have to enter areas of limited clearance during Traffic Hours. For design principles refer to E7005.

3.3.19 Push outs, long trains and short trains

- 3.3.19.1 The designer shall take into consideration the running of long works trains and the need to push-out a failed train by another train, thereby effectively doubling the length of the train. This facility shall be provided for all running signals and shunt routes into depot roads or roads with a length suitable for two trains.
- 3.3.19.2 Diverse route holding protection is to be designed for the maximum length of service train and not for push outs.
- 3.3.19.3 The design shall ensure correct operation of the signalling system for short trains with a minimum distance between the front and rear wheels of 9m.
- 3.3.19.4 The design shall ensure that after the passage of a works train in the wrong direction, the signalling shall return to its normal state to allow train movements in the right direction of travel.



3.3.20 Point detection

- 3.3.20.1 The system shall ensure that all points (turnouts) are detected and proved locked in either the NORMAL or REVERSE position and in correspondence with the lever or equivalent.
- 3.3.20.2 Detection circuits shall be 'double cut.'
- 3.3.20.3 For running lines each end of a crossover shall be detected separately and both functions shall be used in the relevant circuits.
- 3.3.20.4 Where facing points, with facing point lock, are to be taken out of commission for more than one week, then the points switch shall be proved closed in the appropriate signal controls, in addition to having daily visual inspections performed and to being clipped, scotched, padlocked and plated.
- 3.3.20.5 Where trailing points are out of commission for more than three months, then the point switch shall be clipped, scotched, padlocked and plated.
- 3.3.20.6 The two switches of wide to gauge points shall be interlocked against each other.

3.3.21 Remote securing of points

- 3.3.21.1 Remote securing of points is a function which allows trains to pass through junctions during certain failure conditions, with a subsidiary indication, without the need to manually secure the points with scotch and clip.
- 3.3.21.2 Where remote securing is provided, the points appropriate to normal signal clearance must be proved in the interlocking level, but only those point ends which the train runs over up to the next signal (excluding non-powered trailing points) need to be set, locked and detected in the correct position before displaying the "Remote Secure" indication.
- 3.3.21.3 A facility shall be provided at the SCC to enable the signal operator to introduce and cancel remote securing at individual sites.
- 3.3.21.4 On initiation of remote securing, local circuitry shall lock the route.
- 3.3.21.5 On initiation of remote securing, an internally illuminated sign displaying "Route Secured", installed at the last junction signal in rear of the points which can be secured by the facility, shall be lit. Cancelling of remote securing shall extinguish the sign.
- 3.3.21.6 On initiation of remote securing, all unwanted routes shall be prevented from being set by the automatic route setting system.
- 3.3.21.7 A facility shall be provided to enable remote securing to be initiated locally.
- 3.3.21.8 Remote securing can be cancelled at any time, however, if the "Route Secured" sign has been displayed to the train operator then the route locking shall be maintained.
- 3.3.21.9 The provision of additional securing signs are to be considered at each site considered critical by the Operator, to enable remote securing to be applied for trains which have overrun the last signal before the junction.
- 3.3.21.10 A simpler alternative approach to remote securing which provides more operational flexibility at a lower cost is being developed by LU. This consists basically of point controls and indications in the SCC together with procedural operating arrangements.

3.3.22 Point heaters

- 3.3.22.1 The moving parts of surface and sub-surface ends of points shall be fitted with purpose designed point heating equipment in areas as required by the operating departments. Point heater equipment shall not compromise track circuit operation under any failure mode.
- 3.3.22.2 LU uses electric point heaters exclusively - pad, strip and cartridge types. The designer may suggest other types of point heaters for consideration by the Professional Head of Signalling.
- 3.3.22.3 The heaters shall be controlled by a temperature sensor installed local to the points being heated. A facility shall be provided to manually override the temperature sensor. In addition, a point heater status indicator (e.g. on, off, failed) shall be provided in the SER and in the SCC.
- 3.3.22.4 It is acceptable to install the point heating transformers, supply cubicles and control cubicles at the trackside.

3.3.23 Trap points

- 3.3.23.1 The design shall ensure that trap points are restored to resume their trapping function after the passage of a train.

3.3.24 Circuit requirements

- 3.3.24.1 Circuits shall be protected by individual MCB's or fuses sized to protect the wire, equipment, terminating device and personnel in accordance with BS 7671 and the Electricity At Work Regulations.
- 3.3.24.2 The circuits shall be designed such that fuses or MCB's fail with a discrimination toward the fuse or MCB most local to the point of failure, thus giving minimum circuit disruption.
- 3.3.24.3 The circuits shall be designed such that MCB's or fuses do not fail under normal operating transient conditions.
- 3.3.24.4 Circuits leaving or entering the SER shall do so via links or isolators. These links or isolators shall be of a type capable of being secured in the isolated condition. Where there is significant risk that the circuits may come into contact with 600V traction rails (e.g. track circuits rail connections) then the links or isolators shall be replaced by or fuses or suitable protective devices. Links, isolators, fuses or MCB's used at the entry point of SER's on new installations shall provide touch protection against electric shock. They shall also incorporate touch protected connection points on both sides of the isolation to permit a remote switch to be wired across the isolator for simulation purposes during testing, and for the application of test instruments during fault finding. These connection points shall permit the rapid disconnection of the simulation facilities without disturbance to the permanent wiring. The exact form of connection shall be agreed with the Professional Head of Signalling.
- 3.3.24.5 A maximum of two wires shall be connected to any one terminal except on diagrams where terminals are provided for multiple connections.
- 3.3.24.6 A minimum of 10% spare terminals shall be provided on each terminal block on the rack. Terminals used to terminate spare multicore wires shall not be considered as spare terminals.
- 3.3.24.7 There shall be only one feed per circuit.
- 3.3.24.8 Interconnecting wiring between the various racks and cabinets within the SER shall be installed in a suitable cable racking system.

- 3.3.24.9 Where plug connections are used, the wiring shall be arranged such that no voltage is present on exposed pins when disconnected. The plug connectors used shall be mechanically keyed to prevent improper insertion and identify equipment of compatible types.

Note: This does not preclude the use of rack mounted plug couplers for maintenance, if these conditions are met.

- 3.3.24.10 Wiring shall comply with the requirements of BS 7671, where applicable.

3.3.25 Earthing

- 3.3.25.1 The designer shall ensure that the earthing of the signalling system complies with 1-106, Earthing and bonding of LU electrical networks.

3.3.26 Power supplies

- 3.3.26.1 The designer shall provide a diverse power supply dedicated to the signalling system. Within SER's, equipment such as mains transformers shall be duplicated.
- 3.3.26.2 The supply frequency for new installations shall normally be 50Hz. However, the designer may suggest alternative frequencies on technical or commercial grounds, or both, for consideration by the Professional Head of Signalling.
- 3.3.26.3 Facilities shall be provided for the rapid and convenient isolation of all electrical supplies entering an SER or originating within it (such as UPS).
- 3.3.26.4 The design of the power supplies shall comply with the Electricity at Work Regulations and BS 7671, IEE Wiring Regulations.

3.3.27 Equipment location

- 3.3.27.1 Equipment shall preferably be housed in the SER. The amount of equipment to be mounted either on or about the track shall be kept to a minimum (especially in tunnels). Active circuit components are required in some forms of equipment and these shall be located within an SER, whenever possible.
- 3.3.27.2 The top of relays, PCB's or equipment panels shall be no more than 2 m above floor level and the bottom row of equipment not less than 0.4 m above floor level. However, it shall be possible to mount equipment below this height if future expansion so demands.
- 3.3.27.3 Terminals, connector panels and any power distribution panels shall be mounted such that they are a segregated section of the rack.
- 3.3.27.4 Equipment and components shall be accessible for testing or replacement without the removal of other equipment.
- 3.3.27.5 Two or more points of adjustment which are required during the same operation shall be located in such a way that they can be operated and observed by one person.
- 3.3.27.6 Equipment shall be positioned in a logical manner on racks whenever practical.

3.3.28 Cable routes

- 3.3.28.1 The designer shall produce continuous cable route designs for the installation of cables between the equipment rooms and the wayside equipment. Post mounting is the preferred method.
- 3.3.28.2 The design shall ensure the route is the most practical for each individual site.

- 3.3.28.3 The route shall have the capacity to hold all the required cables, together with a 20% spare capacity to cover future needs.
- 3.3.28.4 Vital signalling cables shall be kept separate from power cables and, where possible, from control systems and communications cables, e.g. by running in separate shelves of a cable run.
- 3.3.28.5 It is LU's practice in open sections to place the air main, if required, on the top shelf or hanger of the run, LV and communication cables in the lowest shelf and signalling cables in the middle shelves. Where there is no separate HT cable route, the HT cables shall be placed on the back of the signal cable route.
- 3.3.28.6 Cable routes shall comply with Standards S1197, E7005 and SCS-ST-0021.

3.3.29 Positioning of equipment in signalling rooms

3.3.29.1 The following criteria shall apply:

- a) no equipment shall be positioned under air conditioning units and no wiring shall be run above air conditioning units;
- b) the vital system shall be located in separate parts of the SER from the control and communication systems;
- c) aisles between rows of racks and cabinets shall normally have a clear width of at least 760mm, and unless agreed by the Professional Head of Signalling shall allow doors to swing completely open and back to allow free access by staff;
- d) if draw-out equipment is used, adequate spacing shall be allowed to remove and maintain the equipment in the draw out position;
- e) the position of racks and cabinets shall not present a danger to staff working in the room;
- f) if local site computers are to be located within the SERs, adequate space shall be provided to ensure that staff can work at or about them without hindrance;
- g) equipment must be mounted, positioned and protected in such a way that it is not possible for staff to inadvertently affect its operation whilst they are working in the room.

3.3.30 Signal room diagrams

- 3.3.30.1 Each signal equipment room shall be provided with an illuminated signalling diagram or VDU with diagram facilities for maintenance purposes.
- 3.3.30.2 The diagram shall be a copy, in geographical track layout terms, of the portion of the SCC diagrams that represents that site.
- 3.3.30.3 When installed, and viewed from the front, the diagrams layout shall be in the same geographical orientation as the actual site layout. This is in order to prevent confusion to staff in the SER.

3.3.31 Trackside equipment

- 3.3.31.1 Items of trackside equipment used in LU's wayside signalling systems are described in standard E7005.