

Business Process Document

Guidance for signalling power supplies

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1 Purpose

This document supports NR/SP/ELP/27243: Specification for Signalling Power Supplies. This document provides guidance on the requirements of its counterpart standard.

Signalling power supply installations are required to comply with the requirements of the Electricity at Work Regulations 1989 (EAWR). GI/RT7017 mandates 'as far as reasonably practicable' the application of BS7671 to signalling power distribution installations as a means of achieving compliance with the EAWR Regulations. However, the requirements of other Standards such as Railway Group, Network Rail Company, British, European and International for equipment installed in the Railway environment must also be considered, and where appropriate, applied.

2 Scope

This guidance applies to new works and modifications to signalling power supply distribution installations as defined by Railway Group Standards. The associated specification NR/SP/ELP/27243 - *Specification for signalling power supplies* should be read in conjunction with this document.

The extent to which NR/SP/ELP/27243 should be applied to signalling power distribution systems is dependent on whether it is a new or existing installation. There is currently no requirement to bring existing installations into compliance with the requirements in Railway Group Standards. However, installations commissioned or modified when the Electricity at Work Regulations (EAWR) came into force should already be compliant with the requirements of EAWR.

Design, commissioning, test and inspection of new installations must be carried out in accordance with BS7671. Guidance on the process of design is provided within NR/GN/ELP/00015 - *Signalling power supply design*.

It is permissible for Projects that have formally completed GRIP level 4 before 4 September 2006 to continue to comply with relevant Network Rail standards that were current when GRIP level 4 was achieved. However it is recommended that all planned work is reviewed against NR/SP/ELP/27243 to identify any requirements that can be practicably implemented.

If the requirements of NR/SP/ELP/27243 cannot be achieved, a formal derogation to the standard is required which describes the means by which compliance with the EAWR Regulations are being achieved. The derogation must have the support of the Territory E&P Engineer.

3 Reference Documentation

BS 7671	Requirements for Electrical Installations (incorporating amendments 1 and 2, 2004)
BS EN 50122-1	Railway applications. Fixed installations. Protective provisions relating to electrical safety and earthing
GI/RT7017	Signalling and Safety Related Telecommunications Power Supplies and Circuits
GI/GN7607	Guidance for Low Voltage Electrical Installations
G5/4-1	Engineering Recommendation G5/4-1 Planning Levels for Harmonic Voltage Distortion and the Connection of Non-Linear Equipment to Transmission Systems and Distribution Networks in the United Kingdom
ETR 122	An application guide to G5/4
NR/GN/ELP/27244	Guidance for Signalling Power Supplies
NR/GN/ELP/00015	Guidance Note for Signalling Power Supply Design
Commentary on IEE Wiring Regulations	16 th Edition BS7671 – IEE, Stevenage ISBN 085296 237 1

4 Abbreviations and Definitions

Competent Engineer	An engineer within Network Rail's Engineering Division who possesses the appropriate competencies to assess, design, construct or maintain low voltage power distribution installations as defined in BS7671.
DNO	Distribution Network Operator
EAWR	Electricity at Work Regulations 1989
ESQC	Electricity Supply Quality and Continuity Regulations 2002
FLC	Full Load Current - the highest demand experienced during the normal operation of the load. This is NOT the sum of the power rating of all downstream equipment.
FSP	Functional Supply Point, i.e. boundary between power supply and signalling functional circuits.
IET	Institute of Engineering and Technology
MP&I	Major Projects and Investment
OFGEM	Office of Gas and Electricity Markets
PSP	Principle Supply Point

TPE	Territory Plant Engineer
TSE	Territory Signalling Engineer

5 Application of BS7671 (IEE Wiring Regulations)

Designers should have a thorough understanding of BS7671. The IET publishes a commentary on the regulations which aides understanding on a range of issues including earthed equipotential bonding and Class 2 insulation.

Although the majority of requirements defined in BS7671 can be applied many regulations are either inappropriate or require modification. A list of regulations that fully apply, partly apply with clarification or do not apply are defined within NR/SP/ELP/27243.

6 Core requirements for signalling power distribution systems

6.1 Fundamental design requirements

The performance of the distribution system is driven by the operational, work force safety, and reliability requirements. The equipment power supply requirements determine the size and extent of the distribution system.

The **reliability** and availability requirements for signalling equipment must be defined. The designer must identify how the operational and personnel safety requirements are being met. The installation must be designed to meet the aforementioned requirements as well as the equipment power needs.

The designer needs to consider the impact of DNO supply outages on the resilience of signalling power distribution system. The number of, and duration, of outages should ideally be obtained from credible sources such as power supply monitoring equipment across the network e.g. data loggers on UPS or the failure data in Frame.

For example in 2001/2 data taken from data loggers on UPS equipment in the South West and Scotland showed that on average, there were 4.4 outages per year in Scotland compared with 7 outages per year in the Western. Hence the distribution design for the Western may need to be more resilient to loss of supply for a route that is as critical as one in Scotland.

Where it is not possible to obtain information from in-service records, supply outage probabilities can be estimated from the Ofgem's annual Quality of Supply Reports which are available free of charge from Ofgem's website.

The signalling loads for an installation need to be obtained in order to determine the optimum equipment size(s) and rating(s). Where appropriate, load diversity should be taken into account, and the full load current determined.

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The FSP voltage tolerance takes account of the Electricity Supply Quality and Continuity Regulations (ESQC) 2002 which permits a tolerance of +10/-6% on the DNO voltage "save in exceptional circumstances". The ESQC regulations allow a frequency tolerance of +/-1% again "save in exceptional circumstances".

The FSP Frequency tolerance takes account of the Electricity Supply Quality and Continuity Regulations (ESQC) 2002 which permits a tolerance of +/-1% on the DNO frequency "save in exceptional circumstances". European Standards now allow a greater frequency variation (+4 –6 %) however these have not yet been adopted in the UK.

Use of power conversion equipment i.e. inverters in UPS equipment can introduce undesirable harmonic currents and voltages onto a power distribution system. Engineering recommendation G5/4-1 defines acceptable levels for connection of loads to the UK distribution network. Guidance on how to apply of G5/4-1 can be found in ETR 122. The DNO is permitted to disconnect loads that introduce unacceptable harmonics onto their network. Clearly, disconnection of a DNO infeed to signalling power supply distribution system would lead to unacceptable scenarios.

The DNO is obliged under ESQC 2002 to provide on request, any relevant safety and technical information about the supply from their distribution systems to Network Rail's distribution system, providing the requester can 'show a reasonable cause for requiring the information'. Data that can be requested from the DNO is listed in regulations 27 and 28 of ESQC 2002 and includes voltage and frequency declarations as well as earth loop impedance and upstream protective device ratings.

Verification of a design is a fundamental part of any project assurance process, and is an ongoing, cyclical process.

It is important that the designer confirms that the signalling power distribution system will not be affected by the permissible (statutory) variance in supply quality. This can be achieved by evaluating the steady state and dynamic characteristics of the signalling power distribution system. The designer should also consider the effect of any temporary short-term transients i.e. short duration voltage spikes on correct operation of equipment.

All Signalling power distribution designs must be verified against the requirements of NR/SP/ELP/27243. Designs produced using electrical design software or other automated design tools must be verified using hand calculations.

A signalling power installation is expected to have a service life of at least 35 years. Based on operational experience, the minimum anticipated load growth is between 10 to 15% of the full load current required at the PSP hence the allowance for 20%.