

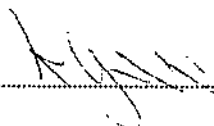
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Date	February 2006

Business Process Document

400 V 3 phase a.c. shore supply equipment for use in non-electrified areas

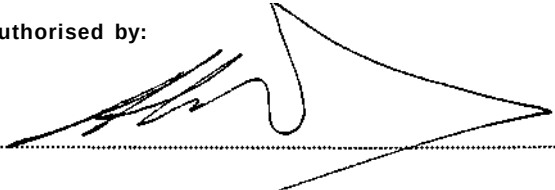
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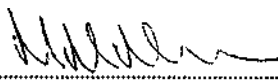
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Published & Issued by: Network Rail 40 Melton Street, London NW1 2EE



Ref:	NR/PS/ELP/00022
Issue:	2
Date:	February 2006

Issue record

Issue	Date	Comments
2	February 2006	Re-issued as a SAF3 Business Process Document

Implementation

4 February 2006

Compliance

This Network Rail product specification is mandatory and must be complied with by Network Rail and its contractors from 4 February 2006

When this product specification is implemented, it is permissible for all projects, which have formally completed GRIP Level 4 to continue to comply with the Issue of any relevant Network Rail standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the head of electrification and plant has stipulated otherwise in the accompanying briefing note.

Where the head of electrification and plant has specified that all projects will comply with the requirements, specific authority not to comply can be sought in the usual manner using the appropriate non-compliance authority processes described in Network Rail standard, [NR/SP/STP/045](#) *Managing the process for non-compliance authority* (formerly RT/LS/P/045).

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I Purpose

This product specification states the requirements for the design, manufacture, testing, installation and commissioning of 400 V, 3 phase, 3 wire, 50 Hz shore supply equipment for use in non electrified areas in depots etc, to provide power supplies for train auxiliaries when the train is stabled and the on-board auxiliary power supplies are not in service.

The document is to be read in conjunction with details of a specific location, including the number of shore supplies required and the power supply arrangements.

2 Scope

This product specification applies to all new 400 V, 3 phase, 3 wire 50 Hz shore supply systems for use in non electrified areas to provide power for train auxiliaries.

The shore supply equipment consists of the following main elements:

- a) an indoor shore supply switchboard in an adjacent substation;
- b) an outdoor lineside control panel to house local controls, indications and test facilities for each shore supply;
- c) an outdoor service outlet box for terminating a trailing cable for each shore supply;
- d) an outdoor stowage box for storage of each trailing cable and plug;
- e) current transformer(s) mounted on the distribution transformer star point to earth connection and associated connections to the shore supply switchboard;
- f) a comprehensive electrical protection and insulation condition monitoring system;
- g) mounting plinths or bases for lineside control panels, stowage boxes and service outlet boxes.
- h) the power connections from the supply transformer(s) to the switchboard;
- i) the power connections from the switchboard to each of the service outlet boxes;
- j) the trailing power cables and plugs from the service outlet box(es) to the train(s);
- k) the control connections from the switchboard to the lineside control panel(s);
- l) the interlock circuit connections from the lineside control panel(s) to the service outlet box(es);
- m) the trailing interlock circuit connection(s) from the service outlet box(es) to the train(s);
- n) all circuit connections for the electrical protection and monitoring system;
- o) new cable route(s) including ducting and trenching;
- p) the connection of the switchboard to the substation earth bar;
- q) the bonding of a designated running rail(s) to provide an earth return path;
- r) the connection(s) between the running rail(s) and the substation earth bar;
- s) the bonding of the lineside control panel(s), service outlet box(es) and stowage box(es) to the running rail(s).

The following item are excluded:

- i. the substation earth bar and connections to an earth electrode at the substation.

Note: The distribution transformer and resistor or reactance connected between the distribution transformer secondary star point and earth, and the associated connections to the substation earth bar are normally provided by others. When the transformer and resistor or reactance are to be provided, they shall comply with the requirements of this specification.

3 Reference documentation

RT/CE/S/044	Network Rail Company Specification – Undertrack Crossings
RT/E/S/21031	Network Rail Company Specification for the finishing of outdoor and indoor steel housings and enclosures for electrical equipment
RT/E/S/21107	Network Rail Company Specification for bolted running rail connections for traction bonding on A.C. and D.C. Electrified Lines
RT/E/S/40027	Network Rail Company Specification – Core maintenance specification for train pre-heating shore supplies
EN ISO 9001	Model for quality assurance in design, development, production, installation and servicing
EN 60044	Instrument transformers
EN 60051	} Direct acting indicating analogue electrical measuring instruments and their accessories
BS 89	
EN 60269-1	} Low-voltage fuses
BS 88	
EN 60439	Specification for low-voltage switchgear and controlgear assemblies. Specification for type-tested and partially type-tested assemblies
EN 60521	} Class 0.5, 1 and 2 alternating-current watt-hour meters
BS 5685	
EN 60529	Specification for degrees of protection provided by enclosures (IP code)
EN 60947	Specification for low voltage switchgear and controlgear
EN 61036	Alternating current static watt-hour meters for active energy (classes 1 and 2)
EN 61558	Safety of power transformers, power supply units and similar
BS 5378	Safety signs and colours
BS 5467	Specification for 600/1000 V and 1900/3300 V armoured electric cables having thermosetting insulation
BS 6231	Specification for PVC-insulated cables for switchgear and controlgear wiring
BS 7430	Code of practice for earthing
BS 7671	Requirements for electrical installations: IEE Wiring Regulations

4 Definitions

For the purpose of this specification the following definitions shall apply:

British Standard	A standard published by the British Standards Institution. Its alphanumeric identity is prefixed by BS.
Equipment	Equipment including all component parts and accessories.
European Standard	A standard published by the European Committee for Standardisation or by the European Committee for Electrotechnical Standardisation. Its alphanumeric identity is prefixed by EN.
International Standard	A standard published by the International Electrotechnical Commission. Its alphanumeric identity is prefixed by IEC.
Lineside control panel	A control station at the lineside for controlling a shore supply to a train.
Service outlet box	A connection box at the lineside for connecting the trailing cable to the power supply and control cable(s).
Trailing cable	Flexible power and interlocking circuit cable(s) from the service outlet box to the train.

5 Description of the shore supply power distribution system

5.1 General

The overall shore supply installation normally forms part of a power distribution system at a train depot, stabling siding or passenger station platform. A complete shore supply installation comprises of:

- an incoming high voltage supply;
- distribution transformer(s) to provide a low voltage supply;
- a shore supply distribution switchboard fed from the distribution transformer(s);
- lineside service outlet box(es) fed from the distribution switchboard, and which in turn feed trailing cables fitted with plugs which provide power to the train(s);
- a power distribution system on the train fed from the shore supply or an alternator on the train;

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- f) operating controls for each shore supply located in a lineside control panel and duplicated on the distribution switchboard.

5.2 The high voltage supply

The power supply system, which provides power to the shore supply equipment at each location, may differ in detail.

The incoming power supply to the depot is three phase, 50 Hz, usually 11 kV, and is derived from a Regional Electricity Company (REC) supply point.

Within the depot there is normally a high voltage cable distribution network, usually an open ring main, with one or more distribution substations. At a distribution substation near the location of the shore supply equipment the supply is, typically, teed off through separate fused switch(es) to one or two distribution transformers, which are used exclusively for the shore supply equipment.

In some cases, REC supplies are taken direct to the shore supply substation instead of by way of the depot high voltage network.

5.3 Low voltage supplies to shore supply equipment

The 400 V, 3 phase supplies from the distribution transformers normally feed directly to a shore supply switchboard.

The shore supply switchboard is usually located within a substation near the tracks where trains are stabled. Remote control of the shore supplies is carried out from the lineside control panel(s) or the switchboard. The shore supply switchboard supplies several service outlet boxes located adjacent their respective tracks and from which flexible trailing cables fitted with plugs can be connected to sockets on the train(s).

5.4 Power supplies on trains

The 400 V, three phase, 3 wire supplies for train auxiliaries are drawn from bus lines running the length of the train. The electrical loading usually comprises of heaters, air conditioning, rectifiers and lighting. The vehicles forming the train are jumpered together by means of flexible cables, plugs and sockets incorporating auxiliary pilot circuits.

When the train is in normal service, the power source is an on-board alternator.

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5.5 Earthing arrangements

The low voltage shore supply operates as an IT system as defined in [BS 7671](#). The earthing arrangements are intended to limit the earth fault current that can flow and the potential that could appear on exposed conductive parts, including the train underframe.

The star point of each supply transformer is normally earthed at the shore supply substation through resistors of 2400 Ω or reactors to limit the maximum earth fault current that can flow to 100 mA.

One or both rails are bonded throughout the length of each track concerned and connected back to the substation earth bar to provide a low impedance earth path for fault current.

5.6 Interlock systems on the trains and shore supply equipment

There is an interlock system on the train to prevent paralleling of the shore supply and the on-board supply, should the engine be supplying the heaters etc. Another interlock is provided in the shore supply socket using a shorting connection between two wires to stop the engines if an attempt is made to power the train with a shore supply plug inserted. These interlocks do not require any facilities on the shore based installation.

To ensure that connections at all plugs and sockets are adequately made an interlock circuit is incorporated within the trailing cables and plugs, train sockets and the train busline. The shore supply can be switched on only when all connections have been completed and interrupts the power should any attempt be made to unplug the power circuits whilst alive.

5.7 Cabling routes

Armoured cables run from the switchboard to the lineside equipment and are usually buried direct. The trailing cables from the service outlet box(es) to the trains(s) are exposed. When not in use the plug is placed in the stowage box.

6 General clauses

6.1 Safety, legislation and regulations etc.

At all times the equipment shall be safe. Measures shall be taken to ensure the safety of persons concerned in its installation, operation, maintenance, repair and its eventual disposal. All apparatus and connections for the safe and satisfactory operation, control and protection of the equipment concerned, shall be provided whether or not specifically mentioned.

The equipment shall be adequately provided with interlocking and locking facilities, earthed, insulated, screened, shielded, enclosed etc. Safe and appropriate access shall be provided for operation and maintenance purposes.

The equipment shall comply with the requirements of all relevant statutory acts, rules, regulations or orders and amendments thereto, including:

- a) Health and Safety at Work Act 1974;
- b) Electricity at Work Regulations 1989;
- c) Construction (Design and Management) Regulations 1994;
- d) Railways (Safety Case) Regulations 1994;
- e) Railways and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994;
- f) European Union directive EMC/89/336/EEC;
- g) Noise at Work Regulations 1989;
- h) Electromagnetic Compatibility (EMC) regulations, within [EN 50121](#) - series;
- i) Control of Substances Hazardous to Health Regulations 1999.

For substances falling within these regulations the supplier shall provide a risk assessment covering the life of the equipment and its eventual disposal. Materials containing asbestos, chlorinated fluorocarbons (CFCs) or polychlorinated biphenyls, (PCBs) shall not be used.

Cognisance shall be taken of relevant sources of guidance, for example:

- i. The HM Railways Inspectorate Railway Safety Principles and Guidance;
- ii. The Health and Safety Executive guidance notes and other publications.

This information is not necessarily exhaustive and does not modify the legal obligations of the supplier.

The supplier shall provide recommendations for training in safe operation and maintenance of the equipment.

6.2 Design, manufacture and workmanship

The equipment shall be designed, manufactured and installed in accordance with best practice, taking cognisance of the system in which it will operate. All material shall be of the quality and of the type most suitable for working under the conditions specified for the full service life of the equipment.

The supplier shall provide a safety case for equipment with novel or innovative features not previously used within the railway environment. The safety case shall quantify any additional risks and indicate how these risks are controlled.

6.3 Spare parts and consumables

The supplier shall make recommendations to Network Rail for holdings of spare parts and consumables based on estimated replacement rates and delivery periods to ensure that the equipment complies with this specification throughout its specified service life. Where possible, the supplier shall indicate the extent of commonality with equipment previously supplied to Network Rail.

6.4 Instruction manual

The supplier shall produce a comprehensive and specific instruction manual covering all aspects of installation, operation and maintenance and eventual disposal, and shall supply the number of copies stated. The manual shall provide guidance to enable all work to be carried out safely and efficiently. The manual shall contain only relevant information and shall include:

- a) a description of the construction, installation, functioning and rating of the equipment;
- b) operating instructions for normal and abnormal conditions, including safety and isolation procedure;
- c) routine maintenance, including any special precautions, fault finding and major overhaul procedures and periodicity, and shall comply with the requirements of [RT/E/S/40027](#);
- d) full details of recommended adjustments and settings for the equipment and its protective devices;
- e) instructions for eventual disposal including safety and handling precautions and recommendations;
- f) drawings, illustrations and data enabling all component parts to be readily identified and to allow procurement for replacement purposes;
- g) the drawings listed in clause entitled 'Drawings';
- h) a list of locations and associated serial numbers.

The manual shall be of loose leaf design size, including all necessary drawings. Drawings can alternatively be presented in electronic format.

Three copies of the final version of the manual shall be submitted to Network Rail prior to delivery of the equipment.

Before Network Rail takes over full responsibility for the equipment, for example, at the expiry of the maintenance period, any necessary modifications shall be made and sufficient copies provided to Network Rail for incorporating into the full quantity of manuals supplied.