

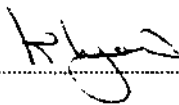
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| Ref   | <b>NR/SP/ELP/21019</b> |
| Issue | 2                      |
| Date  | December 2005          |

# Business Process Document

## Specification for transformer and rectifier equipments for d.c. traction substations

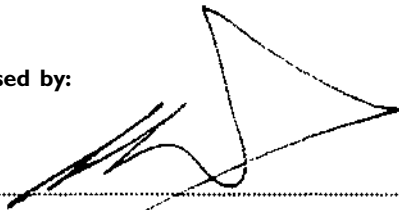
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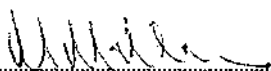
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Published & Issued by: Network Rail 40 Melton Street, London NW1 2EE



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| Date:  | December 2005          |

## Issue record

| Issue | Date          | Comments                                      |
|-------|---------------|-----------------------------------------------|
| 2     | December 2005 | Re-issued as a SAF3 Business Process Document |

## Implementation

3 December 2005

## Compliance

This Network Rail specification is mandatory and must be complied with by Network Rail and its contractors from 3 December 2005.

When this 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 fixed plant has stipulated otherwise in the accompanying briefing note.

Where the head of electrification and fixed 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 specification states the requirements for the design, manufacture and testing of transformer/rectifier equipments for use in d.c. traction substations for the conversion of the high voltage, three phase a.c. supply to d.c. having a nominal voltage in the range 650 to 750 V.

The document is to be read in conjunction with the relevant procurement specification.

## 2 Scope

This specification applies to all new transformer/rectifier equipments installed on the D.C. Electrified Lines.

## 3 Reference documentation

|                                                       |                                                                                                                                   |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">NR/SP/ELP/21028</a>                       | Network Rail specification for ancillary wiring of electrical distribution equipment                                              |
| <a href="#">NR/SP/ELP/21033</a>                       | Network Rail specification for the welding of transformer tanks and conservators during manufacture                               |
| <a href="#">BS 171</a><br><a href="#">EN 60076</a>    | Power transformers                                                                                                                |
| <a href="#">EN 60726</a>                              | Dry-type power transformers                                                                                                       |
| IEC 616                                               | Terminal and tapping markings for power transformers                                                                              |
| <a href="#">EN 60146</a>                              | Semiconductor converters general requirements and line commutated converters                                                      |
| EN 60296                                              | Fluids for electrotechnical applications. Unused mineral insulating oil for transformers and switchgear                           |
| <a href="#">EN 60529</a>                              | Specification for degrees of protection provided by enclosures (IP code)                                                          |
| <a href="#">EN 60044-1</a>                            | Instrument Transformers. Current transformers                                                                                     |
| <a href="#">EN 60269-1</a><br><a href="#">BS 88-2</a> | Low-voltage fuses                                                                                                                 |
| <a href="#">EN 60439</a>                              | Specification for Low-voltage switchgear and controlgear assemblies                                                               |
| <a href="#">BS 2562</a>                               | Specification for cable boxes for transformers and reactors                                                                       |
| <a href="#">BS 5499-6</a>                             | Graphical symbols and signs. Safety signs, including fire safety signs.<br>Specification for geometric shapes, colours and layout |
| <a href="#">EN 60947</a>                              | Specification for low voltage switchgear and controlgear                                                                          |

|                          |                                                                                     |
|--------------------------|-------------------------------------------------------------------------------------|
| <a href="#">BS 7215</a>  | Specification for separable insulated cable connector system above 1 kV up to 36 kV |
| EN 60270                 | High-voltage test techniques                                                        |
| <a href="#">EN 60255</a> | Electrical relays                                                                   |
| <a href="#">EN 60742</a> | Isolating transformers and safety isolating transformers                            |

## 4 Definitions

|                                  |                                                                                                                                                                                    |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>British Standard</b>          | A standard published by the British Standards Institution. Its alphanumeric identity is prefixed by BS.                                                                            |
| <b>Equipment</b>                 | Equipment including all component parts and accessories.                                                                                                                           |
| <b>European Standard</b>         | A standard published by the European Committee for Standardisation or by the European Committee for Electrotechnical Standardisation. Its alphanumeric identity is prefixed by EN. |
| <b>International Standard</b>    | A standard published by the International Electrotechnical Commission. Its alphanumeric identity is prefixed by IEC.                                                               |
| <b>Network Rail Standard</b>     | A collective term for a Network Rail documents published by a directorate of Network Rail PLC. Its alphanumeric identity is prefixed by NR/, followed by a unique reference.       |
| <b>Procurement Specification</b> | The contract specific Network Rail documentation, such as, Invitation to Tender or Technical Work Scope.                                                                           |
| <b>SCADA</b>                     | Supervisory control and data acquisition.                                                                                                                                          |

## 5 General clauses

### 5.1 Design, manufacture and workmanship

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.

## 5.2 Spare parts and consumables

The supplier shall make recommendations to the purchaser 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. The supplier shall indicate the extent of commonality with equipment previously supplied.

## 5.3 Drawings

Drawings of the equipment covering each of the following aspects shall be submitted to the purchaser for scrutiny:

- a) General arrangement (internal and external)
- b) Static and dynamic loadings and foundation and fixing requirements
- c) Schematic/circuit diagrams
- d) Diagram and rating plates
- e) Details of cable entries and terminations
- f) Detailed wiring diagram or schedules.

All drawings shall be of good, legible quality. Four copies of each drawing or as varied by the procurement specification shall be provided.

Where it is essential for clear understanding of the circuits, block or circuit diagrams shall include details of components which are existing or are not being provided by the supplier. Wiring diagrams shall include any unused wires, contacts, plugs, sockets, terminals and the like.

As an alternative to separate circuit and wiring diagrams, combined diagrams may be provided. In this case the position of each wire termination shall be indicated either on the drawing or by means of a schedule of terminations.

A short description of each revision shall be provided under consecutive revision letters or numbers together with the date.

Wherever feasible, some means shall be used to identify the location of the most recent revision, for instance by circling the locations.

All drawings shall be brought up to date as necessary, to provide a permanent as-fitted record and shall be supplied in the software format specified in the procurement specification.

## 5.4 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 in the procurement specification. 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, including safety and isolation procedure.
- c) Procedures with periodicities for routine maintenance including any special precautions, fault finding and major overhaul procedures and periodicity.
- d) Full details of recommended adjustments and settings for the equipment and its protective devices where appropriate.
- 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) List of locations and associated serial numbers.
- i) List of all consumable items with Part Numbers or references.

The manual shall be of loose leaf design with at least four retaining rings and with oil resistant hard covers. It shall be of A4 size and include drawings reduced to A3 or A4 size. Drawings reduced in size shall remain clearly legible. The purchaser may accept drawings larger than A3 subject to suitable, clearly labelled protective drawing storage folders being provided for inclusion in the manual.

The manual shall be split into two parts, first part being the generic description and second part being equipment/site specific.

Three copies of the draft manual shall be submitted to the purchaser not later than the end of the third quarter of the period between the contract date and scheduled delivery date and in sufficient time to enable any modifications to be incorporated and the full quantity of final copies to be available prior to delivery of the equipment.

Before the purchaser 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 the purchaser for incorporating into the full quantity of manuals supplied.

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In addition two electronic copies of the manual shall be supplied to the purchaser.

## 5.5 Delivery

The equipment shall be suitably prepared to withstand, without damage or deterioration, the method of transport to site, cramage, storage and positioning stated in the procurement specification. The equipment shall be protected, as necessary, against the weather. The destination for delivery shall be as stated in the procurement specification.

Any factor which may affect the onward delivery to a final site (e.g. dimensions and weight limits) shall be subject to agreement between the supplier and the purchaser.

## 5.6 Specific equipment standards

The equipment shall be designed, manufactured, tested at works in accordance with [BS 171](#), [EN 60076](#), EN 60726 and all other relevant standards.

# 6 Performance requirements

## 6.1 General

The equipment shall be fit for its intended purpose.

The equipment shall be complete with all items, including parts, consumables and first fillings of lubricants, insulating oil/liquid, desiccants etc., necessary for service operation.

## 6.2 Environmental conditions

The equipment shall be suitable for its rated characteristics when installed at locations adjacent to railway tracks.

The service conditions are as [EN 60146-1-1](#) clause 2.2 and [EN 60146-1-3](#) clause 3.2 for normal service conditions, as modified for the following special service conditions:

- a) For indoor equipment, the temperature of ambient air is not below -5 °C and not above +40 °C and not exceeding +35 °C average over any 24 hour period and +25 °C average over any one year.
- b) For outdoor equipment, the temperature of ambient air is not below -25 °C and not above +40 °C and not exceeding +30 °C average over any 24 hour period and +20 °C average over any one year.
- c) The pollution degree is Number 3 to [EN 60947-1](#). The ambient air is polluted by the presence of airborne iron dust from train brakes.
- d) The equipment is subject to strong magnetic fields emanating from adjacent electrical equipment and to vibration caused by passing trains.

- e) Hand-held portable radio transmitter/receiver apparatus will be used near the equipment.
- f) Additional conditions as stated in the procurement specification.

### **6.3 Noise emission**

Noise emission from indoor and outdoor equipment shall be the minimum practicable and shall be less 55 dBA measured at any point 2 m in a horizontal direction from the envelope of any item. In addition, the level in any of the octave bands of centre frequency 250 Hz, 500 Hz, 1 kHz, 4 kHz and 8 kHz shall be less than 53 dB. All levels shall apply to the equipment when operating over its full working range. Ambient noise level shall be assumed to be 10 dB below these values.

The installation building or housing shall be considered to have reverberant surfaces.

### **6.4 Maintainability**

The equipment shall be designed for minimum maintenance and should not require a shutdown for routine preventive maintenance for more than a single period of five hours duration in a two year period or as specified in the procurement specification.

### **6.5 Reliability and availability**

For critical items of the equipment offered the supplier shall state the mean time to failure, the mean time to repair and the mean time to preventative maintenance to maintain full operational performance. For equipment with novel features or where insufficient historical data is available the supplier shall state the methods used to determine reliability performance.

### **6.6 Service life**

The equipment including components, but excluding consumable items, shall be capable of complying with this specification, including performing its intended purpose, for at least thirty years or as specified in the procurement specification, without deterioration in reliability and without preventive maintenance requirements in excess of those stated in clause entitled 'Maintainability'.

### **6.7 Rectifier operation and rating**

Each transformer/rectifier equipment shall be arranged for 12 pulse operation.

The rating of the rectifier shall be in accordance with the procurement specification including:

- a) The rating class and in the case of class G, the duty cycle.
- b) The rated power in kW.