

## **ANCILLARY LIGHT CURRENT EQUIPMENT**

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### **TABLE OF CONTENTS**

PURPOSE AND SCOPE .....	1
<b>PART 1 – PROCEDURAL .....</b>	<b>2</b>
1 GENERAL REQUIREMENTS .....	2
2 PERFORMANCE REQUIREMENTS.....	12
3 TEST REQUIREMENTS .....	14
4 TECHNICAL DATA .....	14
5 FORMS AND RECORDS.....	14
<b>PART 2 - DEFINITIONS AND DOCUMENT HISTORY .....</b>	<b>14</b>
6 DEFINITIONS .....	14
7 AMENDMENTS RECORD .....	14
<b>PART 3 - GUIDANCE NOTES AND APPENDICES .....</b>	<b>15</b>
8 REFERENCES .....	15

### **PURPOSE AND SCOPE**

This document describes the technical requirements for User's equipment directly connected to the England and Wales Transmission system and located within NGET's busbar protection zone operating at nominal voltages of 400 kV, 275 kV, 132 kV and 66 kV unless otherwise agreed with the user as defined in the Bilateral agreement. The principles of this document applies to equipment connected at other voltages".

This specification describes the overall functional and performance requirements for all ancillary light current equipment for use in substations, including equipment used in conjunction with protection, control, monitoring and metering systems and ancillary equipment associated with primary plant. It covers the requirements for:

- Light current equipment, auxiliary switches and indicators
- Cubicles, boxes and kiosks
- Marshalling
- Earthing of light current equipment
- Marking and labelling
- Components and accessories
- Interposing relays
- Testing facilities

Additional requirements may also apply depending on the light current system application and reference should be made to the appropriate Technical Specifications (RES).

## PART 1 – PROCEDURAL

### 1 GENERAL REQUIREMENTS

Ancillary light current equipment in substations shall conform to the relevant International or British Standards for its application, be fit for purpose. The constructional requirements and tests for controlgear assemblies shall comply with BS EN 60439-1.

Electrical installations shall comply with the appropriate requirements of BS 7671.

*Informative:*

*The use of auxiliary energising voltages above 110 V (ac) shall be avoided, the preferred voltage for such ac circuits is 110 V, the use of centre tap earthed 110 V is preferred. Supplies for test purposes above 110 V (ac) shall be labelled as such. Heating and lighting circuits in cubicles and kiosks shall comply with the requirements of BS 7671. Electrical hazard labels shall be fitted to all plug and sockets connected to systems with nominal voltages above 125 V (ac) or (dc). The labels shall be in accordance with BS 5499-5.*

**In the event that NGET are required to operate and/or maintain Users equipment, the following requirements will apply.**

All equipment shall be marked to identify the Manufacturer and the Manufacturer's reference.

Equipment that consists of elements that can be withdrawn shall have marking on all the fixed and removable portions, to assist in the correct replacement of equipment.

Covers shall be easily removed and replaced without risk of damage to, or inadvertent operation of, equipment. They shall be constructed and fastened so that they cannot be replaced incorrectly, or damaged or distorted by their fastenings.

Where plug in links are employed the installation shall be such that it is impossible to insert the link incorrectly. For example, it may be necessary to use different horizontal and vertical link spacing to avoid a possible cross connection.

All materials shall be non-ignitable or resistant to flame propagation (tested in accordance with BS EN 60695-2-13 or BS EN 60695-9-1).

All materials shall be dimensionally stable i.e. they shall be distortion-free to the extent necessary for the correct functioning of the equipment in service.

Protective finishes shall be of such a standard that they shall not require renewal during the life of the equipment in the specified ambient conditions.

All contacts and mechanisms shall be protected from dust.

Equipment shall be designed such that all maintenance operations may be carried out safely, in an unencumbered manner and in compliance with the statutory requirements quoted in TS 1(RES)

Equipment that has to be removed from a panel or cubicle for maintenance purposes shall be readily removable without disturbing other equipment or wiring.

## 1.1 Power Supply Isolation

Where fuses, links and their holders are used for power supply isolation they shall comply with the requirements of BS EN 60269 - 1.

Where Miniature Circuit-Breakers (MCBs) are used for power supply isolation purposes they shall meet the requirements of IEC 60947-2 and shall either be removable or facilities shall be provided such that they can be locked in the open position. MCBs shall have an auxiliary contact such that their operation may be alarmed.

The rating of the fuse or MCB shall be clearly identified.

## 1.2 Switchgear Auxiliary Switches

Auxiliary switches in HV switchgear shall comply with the requirements of BS EN 60694. Indicators

Indicators of plant state must be clearly visible from all points of operation.

## 1.3 Indoor Equipment Cubicles

Cubicles shall normally be manufactured, equipped, wired and tested in the manufacturers or contractors works before delivery to site. All equipment, terminals and wiring shall be readily accessible. All trunking provided within the cubicle(s) shall be capable of accommodating all cables and wiring for the complete site installation. On the completed installation all cable identification, ferruling and labelling shall be clearly visible and legible to personnel requiring access to the cubicle for maintenance or testing/commissioning purposes.

Cabling from external plant and equipment shall be terminated on one side of the terminal blocks within the cubicle only. Inter cubicle or bus wiring shall also be located on separate terminal rails within the cubicle.

Where a cubicle is to house differing systems within the same panel the following conditions apply:

- a) Equipment within the cubicle must be segregated and clearly labelled on both the front and rear of the cubicle.
- b) All equipment within a system must be grouped together. For the avoidance of doubt, system in this context includes fuses, links and MCBs.
- c) Different systems shall where practicable use separate terminal rails.
- d) All terminal blocks shall be clearly labelled.
- e) All tripping racks shall be mounted as separate systems and shall not be incorporated into other protection systems, excepting a trip relay that is part of a function based system. The tripping racks shall include all necessary trip relays, trip circuit supervision relays, fuses, links and MCBs.

Cubicles shall comply with the dimensions stated in IEC 60297 Part 2. The cubicle shall be rigid, free standing and capable of being fixed down. All equipment cubicles shall have 19" rack mounting arrangements.

Cubicles shall be provided with internal illumination such that all internal labelling, ferruling and wiring can be readily read/identified. Cubicle lighting shall be supplied from a 230 V (ac) single-phase supply that incorporates earth leakage protection.

On cubicles where equipment is mounted on a swing door, stops to limit the travel of the equipment frame shall be provided. When closed, the equipment door shall be secured against vibration.

The cubicle by its construction shall minimise the spread of fire from any cubicle to its neighbour.

Cubicles shall meet rating IP 44 as a minimum requirement as specified in BS EN 60529. Where individual equipment such as relays have an IP rating less than that specified in the appropriate NGET Technical requirements, consideration shall be given to increasing the cubicle IP rating to meet the NGET Technical requirements. Facilities shall be provided to maintain the air temperature and humidity within the ranges specified in TS 1 (RES) – Environmental Service Conditions.-All cubicles shall be provided with locking facilities.

*Informative: IP44 is required due to the higher reliability requirements of the Transmission System.*

Equipment on panel fronts shall be flush mounted.

All equipment requiring access for test or adjustment and or equipment that has a readable display shall not be mounted either less than 1 m or greater than 1.7 m above permanent access ways.

#### **1.4 Outdoor Kiosks**

Outdoor kiosks shall be of rigid construction and suitable, without any maintenance, for the life of the associated plant. Kiosks shall meet Environmental Class 4 conditions, (see TS 1(RES)), without any condensation forming and shall meet IP 54 as specified in BS EN 60529.

All equipment, terminals and wiring shall be readily accessible. Doors shall be weatherproof.

An unrestricted view of the instruments without opening the doors shall be provided. Instruments which are required to be read accurately shall not be more than 1.7 m above access ways, and where vibration is to be expected the instruments shall be on resilient mountings.

The cable entry (eg gland plates) shall be at least 450 mm above ground level and shall be vermin proof and shall project above the inside of the kiosk base to prevent water entering the cable.

Kiosks shall be provided with locking facilities.

#### **1.5 Termination Boxes**

Termination boxes shall be of rigid construction and suitable, without any maintenance, for the life of the associated plant. Termination boxes shall not collect condensation.

All terminations and connections shall be readily accessible.

Cable entries (e.g. glands) shall project above the inside of the termination box base to prevent water entering the cable.

For outdoor termination boxes, cable entries shall always be from below.

When vibration is expected, termination boxes shall be fitted on anti-vibration mountings.

Termination boxes for ambient site conditions covered by TS 1(RES) – Environmental Service Conditions may be provided with sliding covers. Other types of covers shall be secured with captive fasteners.

Termination boxes for use outdoors shall be compliant with the ambient requirements of TS1(RES) - Environmental Service Conditions and shall be mounted so as to prevent pockets or spaces that could collect water. Termination boxes shall meet the requirements of BS EN 60529 with classification IP 54. Indoor termination boxes shall be to IP 44 as specified in BS EN 60529.

Padlocks and locking facilities are required on mechanism and terminal boxes of HV plant for locking-off purposes.

## 1.6 **Marshalling**

Marshalling cubicles or racks in relay or equipment rooms shall be arranged with external cables entering the cubicle at the bottom and inter-panel connections entering from the top. External cables shall be glanded above the floor of the cubicle or rack and cores shall be terminated on terminal blocks in number order. All cores shall be terminated on the same side of the terminal block and the side used shall be consistent with the rest of the site/installation. Inter-panel connections shall be terminated on terminal blocks in number order and on the same side of the terminal blocks in each panel, where practicable. All cores on both external cables and inter-panel connections shall be terminated. A jumper field, which shall be installed in the factory whenever possible, shall be used to interconnect the external cables and the inter-panel connections.

Systems employing fibre optics shall be installed such that the fibre optic cable and its terminations are not subjected to bend radii in excess of those stipulated in the cable manufacturer's recommendations. This requirement applies equally to installations where the equipment is mounted on movable panels (e.g. swing-frame racks). The cable and terminations shall not be put under tension or be bent beyond the manufacturer's guidelines throughout the complete range of motion of the cubicle panel/door.

## 1.7 **Earthing**

Cubicles, racks, kiosks, and termination boxes shall be connected to the station earth system by a 25 mm wide by 3 mm thick copper bar or aluminium equivalent. Where a copper earth bar is employed, the stud connection to the earth bar shall be phosphor bronze or high tensile brass. Where an aluminium earth bar is employed, the stud shall be galvanised steel.

All equipment within a cubicle and the cubicle metalwork shall be electrically bonded to earth. A single earth connection shall be provided between the cubicle and the substation earth mat. This connection shall meet the requirements of TS 3.1.2(RES). As a minimum a cubicle shall be fitted with an earth terminal or stud as specified below, for kiosks and termination boxes. The disconnection of any one piece of equipment from earth shall not disconnect any other equipment.

Kiosks and termination boxes shall be provided with a 10 mm diameter, low resistivity earth terminal or stud. This termination shall be in an accessible position, clear of obstruction and unambiguously labelled.

Electrical continuity shall be maintained between cubicles and associated termination boxes. If electrical continuity is not inherently provided between the cubicles and associated termination box then a copper earth wire shall interconnect the equipments. The cross-sectional area of the wire shall be not less than 2.5 mm<sup>2</sup> if protection against mechanical damage is provided, and 4 mm<sup>2</sup> if mechanical protection is not provided. Doors, covers, subracks etc shall be similarly interconnected to ensure electrical continuity to earth.

Where earth connections are made to metal work, paint shall be removed to ensure a good electrical contact, and the connection protected against corrosion.

All current transformer (CT) secondary circuits shall be connected to earth at one point of the circuit only. This connection shall be via a secure sliding link and shall be labelled as an earth link. The link shall be of a captive type and mounted such that the moving element shall, if inadvertently left loose, fall under gravity to the earthed position. All circuit earth connections and links shall be readily accessible in the relay cubicle or associated terminal box. A notice warning of dangerous voltage shall be provided adjacent to the CT secondary circuit link.

The secondary circuits of interposing transformers shall not normally be earthed.

## **1.8 Marking and Labelling of Equipment**

Labels shall be provided for the clear and unambiguous identification of all equipment requiring operation and maintenance. Equipment with the same system function (e.g. First Main Protection) shall be clearly identified and separate from other equipment in the same panel but providing another protection function (e.g. System Back-up Protection). Such equipment shall be clearly and unambiguously labelled front and back. For the avoidance of doubt equipment in this context includes links, MCBS and, where possible, terminal rails.

Additional warning labels shall be supplied where specified.

All labels and inscriptions shall be resistant to wear or deterioration in the ambient conditions prevailing and shall be suitable for the life of the equipment.

Adhesives for instruction labels and identification labels within enclosures shall be tested in accordance with BS EN 28510-2.

All terminals of equipment shall be marked. It shall be possible, through the use of wire-end marking ("ferruling"), to identify individual wire-end terminations along with their function. All wire-end marking shall be in accordance with the requirements of Energy Network Association Technical Specification 50-19 – Standard Numbering for Small Wiring. All numerals shall be in strong contrast to the colour of the insulation. The identification shall be given in arabic numerals. In order to avoid confusion, unattached numerals 6 and 9 shall be underlined.

For telecommunications equipment marking may be omitted where the design and arrangement of the equipment is such that marking is unnecessary (e.g. colour coding and wire schedules etc).

Where an installation is either the refurbishment/ replacement of or an extension to equipment on an existing site the wire-end termination identification methodology used at that site shall be maintained on the new installation. Within a panel or an item of equipment a supplier shall use its proprietary wire-end identification. At the point of interface with existing equipment, where differing wire-end identification methods have been used, both methods shall be employed so that the change is clear and unambiguous.

Marking and labelling of equipment shall provide a logical and convenient means by which the lifetime management of the equipment can take place.

Where identification labels are affixed to doors or covers, a similar label shall be provided and sited so that it is visible when the door or cover is opened or removed.

Labels shall be consistently sited and not obscured by any other equipment. There must be no ambiguity as to the equipment to which the labelled parts refer.

Circuit labels shall be provided on the front of cubicles and on the back for rear access cubicles.

Each rail/group of terminals shall be identified with an appropriate rail/group reference. Terminals within each rail/group shall be individually and sequentially numbered. The labels shall be mounted such that they are not disassociated from the mouldings when access to terminals is required.

## 1.9 Terminal Blocks

For the avoidance of doubt the requirements contained in this section apply to all substation equipment including, but not limited to, circuit breakers, disconnectors, current and voltage transformers.

Terminal blocks shall be adequately rated for their duty and conform to the appropriate requirements of BS EN 60947-7-1.

All terminal blocks shall be demonstrated to provide reliable and secure connection and shall be suitable for the life of the primary equipment without maintenance.

The design of terminal blocks shall be such that the integrity of the connection may be confirmed by visual inspection.

Terminal blocks of the insulation displacement type are acceptable only for telecommunications applications.

*Informative: Insulation displacement type terminal blocks are not acceptable for internal wiring (e.g. control, protection and SCADA) associated with Primary equipment such as HV Circuit Breakers, Power Transformers etc.*

Terminal blocks using push-on connections are acceptable where the connection is secured, e.g. by means of a spring clip.

Where terminals of the screw or stud types are used, the correct torque shall be applied in accordance with the manufacturer's instructions. The torque setting shall be confirmed during commissioning.

Terminal blocks shall be suitable for accommodating the required number of terminations in accordance with the terminal block manufacturer's instructions.

Terminal blocks and their installation shall allow unencumbered access to all terminations. For the avoidance of doubt termination arrangements that provide more than two cable entries on the same vertical plane (double stacked terminal blocks) are not acceptable.

Terminal blocks provided for alarm connections to substation control system equipment shall incorporate isolating facilities.

Terminal blocks in outdoor kiosks or equipment cubicles shall have separate terminals for incoming and outgoing connections, not more than two terminations being permitted on any one terminal excluding any purpose made interconnectors.

Wire-ends shall be marked as specified in Section 1.9.

All terminal blocks shall by virtue of their design prevent accidental short-circuiting between adjacent terminals.

Terminal covers shall be provided where terminal blocks are used at nominal voltages above 125 V (ac) or (dc), or where high transient over-voltages may occur, eg current transformer circuits. They shall be to IP20 as specified in BS EN 60529. They shall preferably clip onto

the mouldings, with warning labels as necessary where hazardous voltages could be present.

No live metal shall be exposed at the back of terminal blocks.

For screw type terminal blocks associated with CT wiring and VT and dc circuit wiring that serves circuit protection systems the design shall be such that loosening off of the primary captive arrangement e.g. the terminal screw shall not lead to a change in the current carrying capability. Alternatively, the terminal block manufacturer shall demonstrate that by virtue of the design of the terminal block, loosening off of the primary captive arrangement through vibration or other environmental factors cannot occur.

Current Transformer terminal blocks housed at the marshalling point closest to the Current Transformer shall facilitate the application of temporary shorting links that are secured using a nut and washer locking arrangement. Facilities for isolating the short circuited CT shall also be provided at this point. The design shall be such that the integrity of the short and open circuits may be readily confirmed by visual inspection. The terminal block shall be located at an easily accessible position.

On high impedance busbar protection schemes only - termination blocks that facilitate the in service shorting and disconnection of circuit current transformers (i.e. isolation and earthing links) shall be provided at the point of connection to the common bus-wiring.

Test sockets, where provided, preferably shall be suitable for test plugs of 4 mm diameter, but a smaller size may be acceptable where the terminal block dimensions make 4 mm impractical.

Where a protection system incorporates a selection facility for the direct or qualified tripping of the remote end of a circuit from the local busbar protection system(s) this shall be provided by clearly and unambiguously labelled bolted or hard wired links mounted in the back of the appropriate relay cubicle panel.

All connections shall be made in accordance with the terminal manufacturer's instructions. Connections shall be made only by appropriately trained and supervised staff. The correct tools shall be used and where applicable these shall be calibrated (e.g. torque screwdrivers). Each connection shall be inspected, including checking of torque settings where applicable, and the inspection recorded.

## **1.10 Terminations**

The application and conditions of use for conductor terminations shall be in accordance with the terminal manufacturers requirements. The design of conductor termination or the means by which a conductor is terminated shall be appropriate to the application, taking into account the lifetime management of the equipment. The type of termination shall be compatible with the terminal with which it is to be used as specified by the terminal manufacturer.

The termination shall be made such that there is no undue tension in the wire or force exerted on the terminal after connection.

Where insulation displacement type terminations are used conductors shall have sufficient excess length to permit a minimum of four re-connections during the life of the equipment.

### **1.10.1 Crimps**

Crimps shall meet the requirements of BS EN 60352-2.

Barrel sizes shall suit the sizes and forms of conductor supplied. Barrels that take a range of conductor sizes are acceptable.



An extended sleeve over the crimp barrel shall be used to provide additional conductor insulation support on flexible stranded conductor below 0.5 mm<sup>2</sup> and on single strand conductor of 1 mm<sup>2</sup> and below.

Each crimped termination shall be fitted with one conductor only.

Where crimps are used for CT secondary terminations, the manufacturer shall demonstrate that the connection cannot become loose through vibration or other environmental factors.

Crimping shall be carried out in accordance with the crimp manufacturer's instructions.

#### 1.10.2 Heavy Duty Plug and Socket connectors

Plug and socket connectors shall be equipped with a coding facility to avoid incorrect connections being made. The design of connector used shall ensure correct alignment of the pins on connection.

Each plug and socket shall be identified. Where the connector contains current transformer circuits the plug body shall be coloured yellow unless specific design features are provided to prevent inadvertent open circuiting of the current transformer circuit, in the event of the connector being split. The socket body shall carry a warning label "CAUTION CURRENT TRANSFORMER CIRCUITS".

The degree of protection provided on plug and socket connectors for use in protection and control cubicles sited in relays rooms shall be to IP 50 as specified in BS EN 60529. Outdoor types shall be a minimum of IP 54 and shall be suitable for the environment in which they are applied over the life of the associated primary equipment.

Cable strain relief shall be provided at the cable gland, such that the integrity of the plug/socket housing IP rating is not affected.

Male and female electrical contacts for use in protection and control systems shall not be of the stamped metal design.

#### 1.11 Small Wiring

The colouring of small wiring shall comply with Table 1 except where as specified below.

Function	Colour
Protective conductors	Green-and-yellow
Functional earthing conductors	Cream
a.c. power circuit (motor/fan drives, power socket outlets, lighting, etc)	
single-phase	Brown (L), Blue (N)
three-phase	Brown (L1), Black (L2), Grey (L3), Blue (N)
a.c. control circuits and other applications (including VT/CT secondaries)	White*
d.c. control circuit	White

\*CT secondaries ferruled in red coloured ferrules at termination blocks; VT secondaries ferruled in yellow coloured ferrules at termination blocks

**Table 1 - Small Wiring Colours**

Where a minor addition or modification to an existing wiring scheme is undertaken, the existing wiring convention should be adopted. For the purposes of the above, minor shall be considered as being an addition or deletion of single protection or control functions. Full protection or control replacements shall require the adoption of Table 1.

Factory produced equipment wiring panels, i.e. those associated with and included within a Type Registration submission, are not affected by the requirements of this clause. Examples of the above are:

- a) A current transformer (CT) secondary winding loom from the CT winding to the equipment terminals connection point.
- b) Wiring from a HV disconnect motor winding and/or its auxiliary contact assemblies to the equipment terminals connect point.

Current transformer small wiring shall have a cross sectional area of not less than 2.5 mm<sup>2</sup> unless specifically agreed with National Grid. For other applications the general wire size shall be 1 mm<sup>2</sup>, smaller wire sizes may be acceptable with the agreement of National Grid. Wiring sizes shall always be designed for electrical requirements such as volt drop, current etc and take into account mechanical integrity. The conductor shall meet the requirements of IEC 60228.

PVC insulated small wiring shall be in accordance with BS 6231, BS 6004 (or IEC 60227 parts 1 to 4) and BS 7211 as appropriate to the particular application being considered. The contract shall specify the general ambient conditions for small wiring and where, if appropriate, low smoke zero halogen insulation is required.

## **1.12 Interposing Relays**

### **1.12.1 General**

The environmental and performance test requirements for interposing relays are as specified in TS 3.24.15(RES)

When a plug-in relay is utilised it shall have a device to retain the relay or element in place. It shall not be possible to insert a plug-in relay into its base incorrectly.

The relay shall have an enclosure specification to IP 50 as specified in BS EN 60529 and have transparent covers.

It shall not be possible to replace a cover incorrectly.

The contact performance for relays used for local control purposes shall be in accordance with the requirements stated in IEC 61810-1 where relevant. However a lower rating may be used where it can be shown that the contacts are suitable for the particular application.

The relay will be required to operate either from a 48 V or 110 V nominal dc supply as specified in TS 2.12(RES)

### **1.12.2 In/Out Switching Relays for Protection and Auto-Reclose Equipments**

The relay shall be of the latched type with independent operate and reset coils. The operate coil shall perform the 'Out' function. A contact in series with each coil shall break the coil current during, or at the end of the mechanical travel.

A self resetting indicator on the relay that displays the words 'IN' and/or 'OUT' when applicable and masks the inapplicable word shall be provided.

A hand resetting mechanism shall not be fitted.

The relay shall be sized according to the application. Consideration shall be given to the provision of a sufficient number of spare contacts to allow for future requirements.

#### 1.12.3 Control Interposing Relays

The contacts of interposing relays for control purposes shall be suitable for controlling inductive circuits associated with the operating gear of the equipment to be controlled.

48 V (dc) control interposing relays shall be double pole switched.

110 V control interposing relays shall be Class 2 in Table 2 or shall be double-pole switched.

#### 1.12.4 Forced Tripping Relays

Relays that provide a forced tripping function on 110 V (dc) systems shall be Class 1 or Class 2 as specified in Table 2. Class 2 may be required where extensive dc wiring is associated with the relay and operation due to capacitive discharge is more likely.

Forced tripping relays for use on 48 V (dc) systems, shall be double pole switched.

### 1.13 Testing Facilities

Facilities shall be provided to enable all routine maintenance testing to be carried out from the front of the equipment.

Test Blocks must be provided on the Protection Equipment panels to enable access into the CT, VT and DC circuits of the protection relays for commissioning and periodic testing of the relay equipment without disturbing any wiring connections associated with the protection scheme. Test Plugs for use with the Test Blocks, must have all circuits brought out to twenty eight 4mm sockets on the front of the plug, with no shorting devices between the sockets or plugs, allowing full access to the CT, VT and Protection relay circuits for injection or measurement purposes. The Test Plugs must be compatible with Test Blocks (MMLG 01 or equivalent) used on pre NICAP Protection panels.

The Test Blocks must be 19" rack compatible, and shall comply with the following IEC specifications:-

#### 1.13.1 High Voltage Withstand

##### Insulation

- BS EN 60255-5:2001. – 5kVrms for 1 minute between all case terminals connected together and case earth terminal
- 5kV rms for 1 minute between any contact pair and either adjacent alternate contact pair provided the intermediate contact pair is not used.
- 2kV rms for 1 minute between any contact pair and either adjacent contact pair.

#### 1.13.2 Current Withstand

- All contact circuits rated at 20A continuously or 400A for 1s, ac or dc

*Informative: The above is historical and caters for older type Circuit Breaker trip coils which may still be in service on the transmission system. NGET will advise the User if this is a requirement on a site-by-site basis.*

### 1.13.3 Atmospheric Environment

#### Temperature

- BS EN 60255-1: 2010 – Storage and transit -25°C to +70°C.
- Operating -25°C to +70°C.
- BS EN 60068-2-1:2007. – Cold.
- BS EN 60068-2-2:2007. – Dry Heat.

### 1.13.4 Humidity

- BS EN60068-2-78:2002. – 56 days at 93% RH and +40°C.

### 1.13.5 Enclosure Protection.

- BS EN 60529:1992. – IP50 (dust protected).

### 1.13.6 Mechanical environment

- BS EN 60255-21-1: 1996. – Response Class 2

Where Test Blocks are fitted they should be mounted in such a way that when the Test Plug is inserted it will not foul any other equipment when the relay panel door that they are mounted on, is not in the normal closed position.

For the avoidance of doubt this includes a requirement to provide a 'Simulated Trip Test' facility for each circuit bay tripping system. The simulated trip test system shall provide a means of testing the tripping system up to but not including the bay circuit breaker. A 'dummy circuit breaker' shall be provided in the form of a portable plug in test box that simulates the operation of the bay circuit breaker. As a guide the 'Simulated Trip Test' facility shall provide an equivalent interface and have the same functionality as the Areva Simulated Trio Test Socket and Dummy Circuit Breaker Test Box.

## 2 PERFORMANCE REQUIREMENTS

### 2.1 Enclosures and Equipment

Enclosures, equipment and ancillary components etc, shall be designed to operate under the appropriate general ambient conditions specified in TS 1 (RES) - Environmental Service Conditions.

### 2.2 Terminal Blocks

Terminal blocks for use on CT circuits shall have a rated insulation voltage of 1 kV and be tested with a test voltage selected from BS EN 60947-7-1 Table V (3500 V rms). The terminal block shall also meet the requirements of the impulse voltage test in IEC 60255-5 with a test voltage of 5 kV.

Terminal blocks for use in 110 V and 48 V(dc) systems shall have a rated insulation voltage up to 300 V and be tested with a test voltage selected from BS EN 60947-7-1 Table V.

Terminal blocks for use with pilot cables shall be rated to withstand the potential rise induced during switching of the associated primary circuits.

### 2.3 Plug and Socket Type Connectors

The rated insulation and impulse voltage shall be in accordance with the requirements for terminal blocks.

## 2.4 In/Out Switching Relays for Protection and Auto-Reclose Equipments

For operation at 48 V (dc) the following requirements apply:

- a) The burden of the coil shall not exceed 15 W at 48 V (dc)
- b) For general application the relay shall function correctly with 200  $\Omega$  in series with each coil and with a battery voltage of 46 V. For applications associated with a coordinated control system, where the control is via a local bay computer the relay shall function correctly with 15  $\Omega$  in series with each coil.

*Informative: The above value of 200  $\Omega$  historical and the requirement would still apply to 'Users equipment' located within the Busbar zone. NGET will advise the User if this is a requirement on a site-by-site basis.*

- c) The relay shall function correctly when 56 V (dc) is applied and maintained at the appropriate terminals.
- d) Minimum operating and resetting current shall be 25 mA.
- e) Operation or resetting should not occur when 110 V (dc) 50 Hz is applied to the external case terminals of the respective relay coil circuit for 5 seconds).

For operation at 110 V (dc) the following requirements apply:

- f) The relay shall function correctly with 30  $\Omega$  (or 15  $\Omega$  where the supply originates at the relay panel) in series with each coil and a battery voltage of 100 V.
- g) The relay shall have a rated voltage of 125 V (dc).

## 2.5 Control Interposing Relays

Relays associated with the direct operation of switchgear shall have Class 1 or Class 2 performance as specified in Table 2.

Class	1		2
	D.C. System Nominal Voltage (V)	110	48
Relay rated voltage (V)	125	48	125
Normal Working Voltage (V)	125	54	125
Operative Voltage Range (V)	87.5 to 137.5	37.5 to 60	87.5 to 137.5
Energising current at or below which the relay shall not operate (mA)	25	10	50
Capacitance discharge test *	N/A	N/A	10 $\mu$ F at 150 V
Thermal withstand voltage at 40 °C ambient (V)	137.5	60	137.5

**Table 2 - Control Interposing Relays**

\* For details of the capacitive discharge test refer to Section 3.1.

The requirements for capacitor discharge immunity shall not apply to auxiliary energising circuits of a relay.

### 2.5.1 48 V(dc) Control Interposing Relays

The relay shall function correctly with 200  $\Omega$  in series with each coil and with a battery voltage of 46 V.

*Informative: The resistor value of 200  $\Omega$  is historical and relates back to equipment installed on the transmission system at the time of calculation. NGET will advise the User if this is a requirement on a site-by-site basis.*

#### 2.5.2 110 V (dc) Control Interposing Relays

Interposing relays energised at 110 V (dc) shall operate within their declared specification with 100  $\Omega$  in series with the operate coil.

### 3 TEST REQUIREMENTS

Equipment offered to meet this specification shall have passed the test requirements laid down in applicable International or British Standards.

#### 3.1 Control interposing relays

##### 3.1.1 Capacitance discharge test

The trip relay shall be tested to ensure that it does not operate when a charged capacitor is discharged across the dc energising circuit(s). The value of the capacitor and charging voltage is as specified in Table 2.

### 4 TECHNICAL DATA

The equipment supplier shall provide technical data to support the general, performance and test requirements where required by National Grid to demonstrate compliance with this specification.

### 5 FORMS AND RECORDS

Not applicable.

## PART 2 - DEFINITIONS AND DOCUMENT HISTORY

### 6 DEFINITIONS

The definitions given in TS 1(RES) and TS 2.2(RES) apply to this document.

### 7 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	October 2014	New document		

## PART 3 - GUIDANCE NOTES AND APPENDICES

### 8 REFERENCES

This Specification makes reference to, or should be read in conjunction with, the following documents.

#### International and British Documents

- BS EN 28510-2 Adhesives - Peel Test for a Flexible Bonded to Rigid Test Specimen Assembly. 180 Peel
- BS EN 60269-1 Low Voltage Fuses Part 1: General Requirements
- BS EN 60352-2 Solder-less connections. Solderless crimped connections. General requirements, test methods and practical guidance
- BS EN 60439-1 Specification for Low-Voltage Switchgear and Controlgear Assemblies - Type Tested and Partially Type Tested Assemblies
- BS EN 60529 Degrees of Protection Provided by Enclosures (IP code)
- BS EN 60694 Common Specifications for High-Voltage Switchgear and Controlgear Standards
- BS EN 60695-2-13 Fire Hazard Testing . Test methods. Glowing/hot-wire based test methods. Glow wire ignitability test method for materials
- BS EN 60695-9-1 Fire hazard testing. Surface spread of flame. General guidance
- BS EN 60947-2 Specification for low-voltage switchgear and controlgear. Circuit-breakers
- BS EN 60947-7-1 Specification for low-voltage switchgear and controlgear. Ancillary equipment. Terminal Blocks for Copper Conductors
- IEC 60227 (1-4) Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
- IEC 60228 Conductors of insulated cables
- IEC 60255-5 Electrical Relays – Part 5: Insulation coordination for measuring relays and protection equipment – Requirements and tests
- IEC 60297-2 Dimensions of Mechanical Structures of the 482.6 mm (19 in) Series. Part 2: Cabinets and pitches of rack structures
- BS 5499 Part 5 Graphical symbols and signs. Safety signs, including fire safety signs. Signs with specific safety meanings
- BS 6004 Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V for electric power, lighting and internal wiring
- BS 6231 Specification for PVC-Insulated Cables for Switchgear and Controlgear Wiring
- BS 7211 Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and

internal wiring, and having low emission of smoke and corrosive gases when affected by fire

BS 7671 Requirements for Electrical Installations

ENA – TS 50-19 Standard Numbering for Small Wiring

#### **National Grid Documents**

TS 1(RES) Ratings and General Requirements for Plant, equipment and Apparatus for the National Grid System and Connection Points to it

TS 2.2(RES) Switchgear

TS 3.1.2(RES) Earthing

TS 2.12(RES) Substation Auxiliary Supplies

TS 3.24.15(RES) Environmental and Test Requirements for Electronic Equipment

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