

Electricity Specification 397

Issue 5 September 2024

Electrical Installations within Distribution Substations



Amendment Summary

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Issue 3 July 2007	<p>Wording added to Scope to clarify that this specification applies to all substations housing UU equipment but not necessarily owned by UU.</p> <p>Prepared by: G. Bryson Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director</p>
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Issue 5 September 2024	<p>Following sections revised: -</p> <p>Section 1 Inspection & Testing added. Section 2.1 Free issue 100A cut out. Section 2.2 Surge Protection Device. Section 2.3 LED Luminaires. Location of pull cord. Section 2.4 Type A RCD Protection Section 2.5 Tubular Heaters. Section 2.6 Auxiliary supplies. Section 2.8 Earthing. Section 2.10 Test Certificates. Section 2.11 Redundant Equipment</p> <p>Prepared by: Kelvin Smith Approved by: Policy Approval Panel and signed on its behalf by Mr Paul Turner, PAP Chairperson</p>

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1 Scope

This specification covers the requirements for the electrical installation works within indoor 6.6kV or 11kV Distribution Substations (non-kiosk type) housing equipment owned and operated by Electricity North West Limited, hereinafter referred to as Electricity North West. This specification supersedes and replaces ES397 – Issue 4.

A typical substation wiring installation shall comprise:

- Low Voltage Main Supply
- Mains and Distribution Equipment
- General Lighting Installation
- General Power Installation
- Electric Heating Installation
- Auxiliary Supplies for Battery Charger Unit (where required)
- Facility for Supply to Dehumidification Unit (where required)
- Earthing of the Installation
- Labelling of the Installation
- Inspection & Testing

Distribution Substations which house 6.6kV and 11kV Single Busbar Indoor Switchgear and associated 110V battery charges and ancillary equipment, which are more typically found in Primary substations, are not covered by this specification and reference should be made to ES366 – Heating, Lighting & Small Power Installations in G&P Substations.

2 Technical and Performance Requirements

2.1 Low Voltage Main Supply

2.1.1 General

In each substation, the method to provide the low voltage supply shall be selected from the Options below and agreed between the Engineer and the contractor, who shall consider all Health & Safety implications and relevant Electricity North West policies.

2.1.2 Option 1 (preferred option)

The preferred option for arranging the low voltage supply for the substation electrical installation shall be to take the supply from the low voltage fuseboard within the substation.

Commonly, many low voltage fuseboards within distribution substations have provision for an auxiliary supply to be taken from a High Rupturing Capacity (HRC) fuse of 32A rating mounted on the front of the low voltage board framework. The supply to the new consumer unit shall be connected to this fuse via 6mm² copper, either insulated and sheathed PVC singles, contained in high impact conduit / trunking, or SWA cable.

If no auxiliary fused supply exists, then if practical, a 32amp rated HRC fuse carrier shall be installed to provide this supply.

1 N^o 100A standard cut-out with a RED solid link fitted shall be installed. This cut-out will be free issued by Electricity North West

Where an existing installation is being replaced and the cables connecting to the HRC fuse are deemed by the engineer to be in a suitable condition, connection can be made via a conduit box to extend the cables to the new cut-out. In this instance a 3 core 6mm² Steel Wire Armoured (SWA) cable must be used between the conduit and the cut-out. Minimum size of existing cable from HRC which remains is 4mm².

If the previously described supply arrangement does not exist then other options as detailed below shall be considered for the provision of the low voltage supply.

2.1.3 Option 2

This option shall be used, wherever practicable, when the preferred option is not available.

The low voltage supply shall be taken from a phase core of a suitable low voltage cable fed from the substation's low voltage board. The method of connection shall be by an Electricity North West approved live piercing type connector. The neutral / earth conductor shall be either connected to the corresponding neutral on the main cable or to the LV board's neutral bar if 3 core waveform type cables are in use.

The sub mains cabling shall terminate in a standard 100A cut-out complete with a 60A HRC fuse.

The supply to the cut-out shall be connected via 16mm² copper insulated and sheathed PVC singles, contained in high impact conduit or trunking.

This method of installation shall be undertaken by competent staff that are trained to work on the Electricity North West low voltage network.

2.1.4 Option 3

This option shall be used when options 1 and 2 above are not practical.

The low voltage supply for the substation electrical installation shall be taken from a separate low voltage incoming single phase service cable. The incoming service cable shall be connected to an underground Low Voltage mains cable within the substation grounds and shall supply a standard 100A cut-out complete with a 60A HRC fuse. The distribution cabling to the new consumer unit shall be connected to this cut-out via 16mm² copper insulated and sheathed PVC single cables or 3 core 16mm² steel wire armoured cable if more suitable.

This method of installation shall be undertaken by competent staff that are trained to work on the Electricity North West low voltage network.

2.2 Mains and Distribution Equipment

The contractor shall supply and install the following equipment:

1 N° 100A rated single phase totally enclosed metalclad consumer unit complete with a Surge Protective Device (SPD) (a preference for an SPD with integral fuse to avoid the need for a dedicated MCB and use of an additional way within the consumer unit). Consumer unit outgoing circuits shall be configured into outgoing ways as indicated below:

Way 1: Radial Circuit Socket Outlet - 16A MCB, labelled "General Power".

Way 2: Radial Circuit Socket Outlet - 16A MCB, labelled "Test Equipment Power".

Way 3: Radial Circuit Lighting - 6A MCB, labelled "Lighting".

And in special circumstances, if requested by Electricity North West in writing any or all of the following: -

Way 4: Radial Circuit Electric Heating - 16A MCB, labelled "Heating".

Way 5: Radial Circuit Dehumidifier - 16A MCB, labelled "Dehumidifier".

Way 6: Radial Circuit Battery Charger - 16A MCB, labelled "Battery Charger".

Way 7: Radial Circuit Smart Street Supply – 16A Type B MCB, Labelled "Smart Street Supply"

All consumer units shall have a minimum of 1 spare way. Any ways that are not utilised will have blank inserts fitted and labelled up as a spare way.

All MCBs installed shall be to BS EN 60947-2 with a minimum fault rating of 10kA.

All conduits shall be high impact PVC. On completion of the wiring all conduits shall have at least 35% spare capacity

All accessories shall be metalclad and sourced from a quality manufacturer.

The cut-out shall be mounted on a standard meter board fixed via plastic spacers to the substation wall. The meter board shall be fixed at least 1m from the nearest part of the low voltage board. The consumer unit top edge shall be positioned 1200mm Above the Finished Floor Level (AFFL).

2.3 General Lighting Installation

The contractor shall supply and install the general lighting installation as detailed below:

The general lighting installation shall comprise linear LED luminaires to IP65. (See guidelines below). Circuit wiring to the luminaires shall be carried out using a minimum size of 1.5 mm² PVC copper single cables + a minimum size of 1.5 mm² PVC circuit protective conductor. The circuit wiring shall be contained within 20mm high impact PVC conduit.

All light fittings shall be connected via a plug in ceiling rose to facilitate safe replacement of the light fitting without disconnection of the main circuit wiring.

The number of luminaires installed shall depend upon the substation dimensions and arrangement of apparatus within the substation. The service luminance level shall be a minimum of 130 lux on and in front of all Low Voltage and High Voltage apparatus.

To reduce the risks of working at height, the luminaires are to be wall mounted.

To achieve this level of luminance the following guidelines apply:

Substation Dimensions	Lightening Requirements
4m x 3m	2 N ^o -1.8m twin LED luminaires to IP65
7m x 4m	4 N ^o -1.8m twin LED luminaires to IP65

The luminaires shall be spaced to provide an even level of illumination and shall be positioned, where possible, to provide maximum illumination on High Voltage and Low Voltage switchgear. The position of luminaires shall be such that they provide for safe working conditions for staff carrying out HV and LV operational work.

The contractor shall supply and install a one-way switch immediately adjacent the entrance door, the switch shall be surface mounted at 1200mm to top AFFL. The exact position of the switch shall be considered before installation. Switches shall be mounted to be within easy reach of a person, immediately on entry to the substation via a single door or via the first leaf of a double door, without endangering the person through coming into contact with any exposed live LV apparatus such as LV boards, etc. Where it is not possible to install a switch in a safe location close to the door, due to existing equipment, a ceiling mounted pull cord with integrated neon can be used. This shall be installed so that it is both visible and accessible on opening the door.

All switches shall be metalclad 6 / 10 A rated and incorporate a permanently illuminated neon locator to indicate the switch location for staff entering the substation during darkness. These switches shall be based on a grid switch system.

Two-way or intermediate switching shall be installed where the substation has two or more entrances. Each switch shall incorporate a neon locator.

The contractor shall avoid the installation of luminaires or wiring containment directly above open type Low Voltage boards due to the increased risk to Health & Safety.

2.4 General Power Installation

The contractor shall supply and install the general power installation as detailed below.

The general power installation shall comprise of 2 No two gang 13A switched socket outlets.

The socket outlets shall be standard metalclad type and shall comply with BS 1363 (Rev 2023) The socket outlets shall be wall mounted adjacent to each other at a height of 450mm to lower edge AFFL.

Wiring to the socket outlets shall be in a minimum size of 2.5mm² PVC copper singles cables + a minimum size of 1.5mm² PVC circuit protective conductor. The socket outlets shall be connected as two single radial circuits from the consumer unit.

Each socket outlet shall be designated for use as follows:

Socket Outlet No1 (Way 1 of the consumer unit) shall be 13A rated with integral 30mA type A RCD protection and used for general power tools etc.

Socket Outlet No2 (Way 2 of the consumer unit) shall be a standard 13A switched socket outlet, labelled 'TEST EQUIPMENT ONLY'

2.5 Electric Heating Installation

The contractor shall supply and install an electric heating installation in the following Distribution Substations:

Those that contain High Voltage apparatus specifically designed for indoor use (this rule applies only where it is considered that the Distribution Transformer within the substation is unlikely to provide sufficient heat to maintain an adequate temperature). This situation will probably be experienced where transformers are very lightly loaded during winter.

Those that contain High Voltage apparatus specifically designed for indoor use where no Distribution Transformer is present. In this case the transformer will probably be installed in an adjacent room and will offer no heat gain to the room housing the High Voltage apparatus.

The purpose of the heating installation is to maintain a temperature of 10°C within the substation so that apparatus such as oil dashpots/switch mechanisms and battery charger units etc. remain in serviceable and satisfactory working order.

The heating installation shall comprise of a 2kW wall mounted panel heater or equivalent sized Industrial finned type tubular heater. The finned type tubular heaters shall be fitted with a cage to prevent direct contact with the fins.

The heater shall be installed on the wall at the rear of the high voltage switchgear, where possible, and shall be controlled by an external thermostat located away from the heater with a typical range of 0°C to 35°C. The thermostat should be set to 10°C and be mounted at 1800mm AFFL.

In substations larger than 7m x 4m the contractor shall install 2 No heaters to provide the required protection.

Wiring to each panel heater shall be carried out in radial circuits using a minimum size of 2.5mm² PVC copper singles cables + a minimum size of 1.5mm² PVC circuit protective conductor. Each panel heater shall be controlled via a 13A switched metalclad fused connection unit, with flex outlet and neon indicator, fixed at 450mm AFFL adjacent the panel heater.

The final connection to the panel heater shall be in 3-core 1.5mm² heat resistant flexible cable securely clipped to the substation wall if required.

2.6 Auxiliary Supplies to Battery Charger Unit (where required) or other auxiliary supply

These supplies are required in substations that contain a battery for the purpose of high voltage protection tripping supplies or other auxiliary supply such as a SMART street supply. Electricity North West will confirm in writing, at the design approval stage, or at a point where the design is formally issued for construction, if this is required. If no such written confirmation is issued there will not be a requirement for this circuit.

The contractor shall supply and install a radial circuit wired in a minimum size of 2.5mm² PVC copper singles cables + a minimum size of 1.5mm² PVC circuit protective conductor contained within 20mm high impact PVC conduit.

The contractor shall supply and install a 13A unswitched metalclad fused connection unit, with flex outlet and neon indicator, adjacent to the battery charge unit or other auxiliary equipment and make final connection in suitably rated 3 core heat resistant flexible cable.

All auxiliary supplies should supply only one piece of equipment.

2.7 Facility for Dehumidification Unit Supply

The contractor shall supply and install a 20A MCB within the Consumer Unit for the provision of a circuit to a dehumidification unit (if required). Electricity North West will confirm in writing, at the design approval stage, or at a point where the design is formally issued for construction, if this is required. If no such written confirmation is issued there will not be a requirement for this circuit.

2.8 Earthing of the Installation

The whole of the electrical installation shall be earthed to comply with the current edition of the IEE Regulations for Electrical Installations-BS7671.

The contractor shall supply and install 16mm² PVC copper single cable as a main earthing conductor from the substation low voltage earth bar to the new cut-out for the substation electrical installation. The consumer unit shall be connected to the earth system using 16mm² PVC copper single cable. Where connection to a dedicated earth bar is not available or unsafe to make, connection to the internal earth tape is acceptable.

Where the LV supply is not derived from the local substation the earth shall be connected to the substation earth to ensure no touch potential hazards can arise within the substation. Consideration should be given to transfer potential to third party installation in this case.

2.9 Labelling of the Installation

The whole of the electrical installation shall be labelled to comply with the IEE Regulations for Electrical Installations-BS7671, and in accordance with [sections 2.2 and 2.4](#) of this specification.

In general, labels shall be fixed to the following items:

Item	Text
Main Earth Connection to Substation LV Bar	Electrical Earth-Do Not Remove
Distribution Consumer Unit (all circuits labelled)	As section 2.2
Test Van Socket Outlet	Test Equipment Only

All labels shall be clearly printed and unambiguous.

2.10 Inspection & Testing of the Installation

During and at the completion of the works, the entire electrical installation shall be inspected, tested and commissioned in accordance with BS7671, and the results recorded on the Electrical Installation Works Certificate, an example of which can be found in BS7671-Section 7 - Inspection & Testing. One copy of the certificates shall be stored on site in the LV cabinet and one copy of the certificates shall be returned to the civil maintenance department .

2.11 Redundant equipment

Where an existing substation's electrical installation is being refurbished. All redundant equipment shall be removed from site, where it is safe to do so without endangering the operator. It may be necessary to leave existing metal conduit in-situ due to its location, for example metal conduit running above live exposed LV boards. In instances like this, the existing conduit should have new galvanised band straps installed to ensure it remains safely attached to the wall. Sections located away from the hazard shall be removed from site.

3 Documents Referenced

DOCUMENTS REFERENCED	
BS EN 60898	Specification for Circuit Breakers for Overcurrent Protection for Household and Similar Installations.
BS 1363	13A Plugs, Socket Outlets and Adaptors
BS 7671	2001 Requirements for Electrical Installations.

4 Keywords

Distribution; Battery; LV Board; Inspection; Lighting; Substation; Wiring