



## Electricity Specification 330

Issue 3

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# 110V Battery and Charging Equipment

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### Approved for issue by the Technical Policy Panel

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Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
0  01/11/88	Issue 1  First Issue  Prepared by: A N Other
1  17/01/90	Issue 1  Amended  Prepared by: BB
0  25/06/08	Issue 2  Prepared by: G Bryson  Approved by the Technical Policy Panel and signed on its behalf by:
0  26/11/14	Issue 3  Major rewrite to allow modular construction of battery, charger and distribution board. Includes options for battery saver technology to be supplied for sites that have a black start requirement. Modified to include powerlock connectors for generators, and suitable connectors for use of an external traveller battery pack. Overall the specification has been opened up to allow different options and technologies to be tendered by manufacturers.  Prepared by: R Cawson, D Rothwell, B Cosgrove, S Rushton  Approved by the Technical Policy Panel and signed on its behalf by:

## 110V BATTERY AND CHARGING EQUIPMENT

### 1. INTRODUCTION

This Electricity Specification sets out the requirements for 110V batteries and charging equipment for use on the electricity distribution system owned by Electricity North West Limited, hereinafter referred to as Electricity North West.

### 2. SCOPE

This specification covers 110V installations and batteries together with the associated charging and distribution equipment and all necessary interconnections. Detailed specifications are given for one standard type of equipment, to cover both heavy duty (HD) and medium duty (MD) loading demands for Primary, BSP & GSP sites including black starting requirements.

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HD loading is usually associated with BSP & GSP substations or Primary sites having 33kV and 11/6.6 kV circuit breakers or sites having 11/6.6kV circuit breakers only with solenoid closing.

MD loading is usually associated with substations having 11/6.6kV circuit breakers but having no 33kV circuit breakers.

Tenderers shall complete the clause conformance sheets in Appendix B.

### 3 DEFINITIONS

- Approval:** Sanction by the Electricity North West Protection Systems Manager that specified criteria have been satisfied.
- Contract:** The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
- Contractor:** The person or person's firm or company, including personal representatives, successors and permitted assigns, whose tender has been accepted by Electricity North West.
- Specification:** The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
- Sub-Contractor:** Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Protection Systems Manager, and the legal representatives, successors and assigns of such person.
- Supplier:** Any person or person's firm or company who supplies goods to Electricity North West or to its contractor.
- Tender:** An offer in writing to execute work or supply goods at a fixed price.
- Tenderer:** The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a tender.

## **4. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING**

### **4.1 Product not to be changed**

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Protection Systems Manager, and receipt of a written agreement to the proposed change from the Electricity North West Protection Systems Manager.

### **4.2 Electricity North West Technical Approval**

4.2.1 The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Protection Systems Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

4.2.2 Alternatively, the Tenderer may submit technical reports and other data that he considers will demonstrate, to the satisfaction of the Electricity North West Protection Systems Manager, compliance with this specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Protection Systems Manager but will not be unreasonably withheld.

4.2.3 Approval shall be 'factory specific' and is not transferable to another factory without the written approval of the Electricity North West Protection Systems Manager.

4.2.4 The supplier and product shall comply with all the relevant requirements of Electricity North West documents EPD311 and CP311.

4.2.5 Existing approved equipment is listed in appendix C. Proposed new equipment will be considered for approval in accordance with this specification.

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### **4.3 Quality Assurance**

4.3.1 The Tenderer shall confirm whether or not approval is held in accordance with a Quality Assurance Scheme accredited under ISO 9000. If not, he shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

4.3.2 The right is reserved for the Electricity North West Protection Systems Manager to require, from time to time, the repeat of such tests as he may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

4.3.3 The Tenderer shall submit, with his Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Protection Systems Manager, fitness for installation and service.

4.3.4 The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Protection Systems Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Protection Systems Manager will confirm the requirement for samples at the time of Tendering.

4.3.5 The right is reserved for the Electricity North West Protection Systems Manager to make, from time to time, such inspections of the Tenderer's facilities as he may deem to be reasonably necessary to ensure compliance with this Specification and any Contract of which it forms a part.

- 4.3.6 The Tenderer shall submit, with his Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001: 1996 – Environmental Management Systems.

#### **4.4 Formulation**

The Tenderer shall submit, with his Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that he requires it to remain confidential and the Electricity North West Protection Systems Manager will, if requested, confirm his agreement to this prior to receipt of the information.

#### **4.5 Identification Markings**

- 4.5.1 The Tenderer shall submit, with his Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Protection Systems Manager, and shall in all cases include the Electricity North West Approved Description and Commodity Code Number.

- 4.5.2 The Tenderer shall submit, with his Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Protection Systems Manager.

#### **4.6 Minimum Life Expectancy**

The minimum life expectancy of all products covered by this specification is 8 years for batteries and 25 years for all other equipment. Consideration will be given to those products that can demonstrate a longer life expectancy.

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#### **4.7 Product Conformity**

Preference will be given to those suppliers who can provide suitable Product Conformity Certification to a recognised or specified standard, or an equivalent certification.

### **5. REQUIREMENTS FOR TYPE AND ROUTINE TESTING.**

The Electricity North West Protection Systems Manager shall set out the requirement of the following tests to be carried out by the supplier at the suppliers' cost.

#### **5.1 Requirement for Type Tests at the Suppliers' Premises**

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Protection Systems Manager.

These may or may not be destructive tests.

## 5.2 Requirement for Routine Tests at the Suppliers' Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Protection Systems Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined.

## 6. TECHNICAL PARTICULARS

### 6.1 Battery Type

6.1.1 The battery shall be of a type approved by the Electricity North West Protection Systems Manager.

6.1.2 Battery units shall comply with the requirements of Directive 2006/66/EC of the European Parliament and of the Council, on batteries and accumulators.

6.1.3 Batteries shall not be approved that exceed a weight of 25kg to enable safe lifting and handling.

6.1.4 Only valve regulated maintenance free cells shall be considered.

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### 6.2 Battery Capacity (at 20°C)

6.2.1 Assuming an initial fully charged state, the battery must be capable of supplying full substation DC functionality after a loss of AC supply. There will be two different time periods under consideration for the loss of AC supply, the first being 10 hours for normal substations and the second being 72 hours for black start substations. Full functionality shall include the ability to maintain any required constant loading for this period and the ability to re-energise the substation with protection fully functional. The voltage of the full string at this time shall be no lower than 97.2V. The constant loadings to be considered are

(a) MD 5.7A

(b) HD 10A

### 6.3 Accessories and Labelling

6.3.1 Each complete battery shall be supplied with all inter-unit connections.

6.3.2 All terminals and interconnections shall be shrouded and shrouding should allow for it to remain intact except for sections which need to be removed to give necessary access to terminals for maintenance and/or testing.

6.3.3 The batteries shall be labelled to indicate cell number. The labelling shall be sufficient in size to be clearly visible. Labels shall be fixed when the battery is initially assembly, with numbering "1" commencing at the positive end of the battery string.

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### 6.4 Battery Accommodation

6.4.1 The batteries shall be installed in a cabinet or approved open racking system. The cabinet shall be louvered to allow for natural cooling. Both options shall be included in the tender.

- 6.4.2 The battery cabinet shall be sufficiently sized to house the batteries designated by the Electricity North West Protection Systems Manager while still providing adequate space for cell testing.
- 6.4.3 Battery cabinets shall be of a material and design that it provides sufficient protection and support to the batteries and it is possible to attach an additional cabinet to the side to increase site capacity. This shall include provision to allow all battery cabling to be routed internally between any additional cabinets.

## 6.5 Charging and Distribution Equipment Enclosure

- 6.5.1 The charging equipment shall be accommodated in a separate cabinet which may be wall mounted or bolted on the battery accommodation cabinet or on the DC distribution cabinet.
- 6.5.2 The distribution board shall be accommodated in a separate cabinet which may be wall mounted or bolted on the battery accommodation cabinet or charging equipment cabinet. Distribution cabinets shall be designed so that additional distribution boards can be added if required.
- 6.5.3 The distribution board and charging equipment cabinets shall be of a material and design that they provide sufficient protection, support, access, working space and ventilation for the equipment within. Additionally they shall meet all other requirements for expansion or connection to other cabinets in this specification.
- 6.5.4 Cables shall be either top or bottom entry and a multicore cable gland plate shall be fitted at a height of between 250mm and 350mm from the base. The gland plates shall be removable and undrilled.
- 6.5.5 Routine inspection and maintenance access shall be available on charger, battery & distribution cabinets via a hinged front door.
- 6.5.6 Each cubicle shall have an earth bar of 3 x 25mm hard drawn high conductivity copper with M12 drilled connection points. Provisions shall be provided to allow inter cabinet and main substation earthing connections to these bars. The multicore cable gland plate shall be connected to this earth bar by means of 16mm<sup>2</sup> copper conductor.
- 6.5.7 Hinged doors shall be fitted to the battery charger and distribution cubicles preferably with lift-off hinges. The doors shall be fitted with a hasp and staple to accommodate Electricity North West' standard padlocks of 7mm diameter hasp with 25mm clearance.
- 6.5.8 The enclosure shall have an IP rating of IP21.

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## 6.6 Temperature and Humidity Range

- 6.6.1 The charger shall be capable of operating within an ambient temperature range of -10°C to +35°C. There shall be no assisted cooling.
- 6.6.2 The charger shall be capable of operating within a humidity range of 5 to 95% relative humidity (RH) non-condensing.

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## 6.7 Charger Input Power Supply

- 6.7.1 The mains input shall be fused in the live pole. The charger shall be able to operate with an input power supply of 216 – 253V AC 50+/- 1 Hz.

6.7.2 Provision shall be provided to allow connection of a suitable generator to power the charger in the event of a loss of mains, via Powerlock connectors as specified in ES613 & CP 613.

6.7.3 Alternative options for maintaining charging of the batteries under loss of mains will be considered. These may include renewable energy solutions such as solar arrays, wind turbines or other alternatives.

## 6.8 Charger Output Voltage

6.8.1 The charger output voltage shall have a negative temperature co-efficient of approximately 3mV per cell per °C (-0.16V/°C for 54 cell battery).

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6.8.2 Output voltage regulation of  $\pm 0.5\%$  shall be provided over a range of mains input variation of  $\pm 10\%$  voltage and  $\pm 2\%$  frequency, for 0-100% of output load variation.

6.8.3 A range of adjustment for output voltage shall be provided, this to be at least 110V to 130V. The unit shall be factory set at 122.6V.

6.8.4 Maximum output ripple voltage shall not exceed 110mV peak to peak.

6.8.5 Only a single mode float charge mode is required.

## 6.9 Charger Output Current

6.9.1 The DC output current shall be able to support minimum specified standing loads as per section 6.2.1 but limited to a level agreed with the Electricity North West Protection Systems Manager.

6.9.2 After the specified discharge period as covered in section 6.2.1 the charger shall be capable of recovering the cells to nominal float voltage within 24 hours

6.9.3 The AC component of the charger output current shall not exceed, at full load output a level agreed with the Electricity North West Protection Systems Manager.

6.9.4 The output shall be protected against overload or short circuit. Upon the removal of a short circuit or overload, the charger shall automatically assume its normal constant voltage output.

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6.9.5 The charger shall not cause interference with radio and telephone equipment and the audible noise shall not exceed 65 dBA in operation, measured at 1m from the charger.

## 6.10 Charging Equipment

6.10.1 The charger shall be operated by a withdrawable modular control unit which can easily be replaced if the charger faults.

6.10.2 Chargers shall be suitable for substation environments. The chargers should not be susceptible to damage due to rise in the substation earth potential rise due to power system earth faults.

## 6.11 Charging Equipment - Small Wiring

6.11.1 Small wiring shall be PVC type B to BS 6231. All insulated wire shall be a minimum of 16/0.2mm (0.5mm<sup>2</sup>). The stripping tool, crimping tool and crimps shall be a compatible system and this system shall be quality assured. Both ends of all wires or control cables shall be provided with a marker bearing a permanent inscription corresponding to the diagram of connections.



6.11.2 Each charger shall be provided with a circuit diagram and parts list.

## 6.12 Alarms

6.12.1 Battery alarms shall be provided by fitting an approved unit that must indicate battery earth faults (with separate positive and negative indication), battery high and low volts alarms, battery high impedance and charger fail.

6.12.2 The unit shall be connected to monitor the DC distribution board.

6.12.3 The low voltage alarm shall be set at 116V (2.15V/cell). The high voltage alarm shall be set at 130V (2.4V/cell).

6.12.4 For each of the DC battery alarms specified in 6.12.1 a separate alarm relay with two voltage free contacts shall be provided. The contacts of the relays shall be rated for 48/110V DC supplies.

The high impedance, low and high voltage relays shall be normally energised and capable of being time delayed for up to 130 seconds. All other alarms shall be initiated immediately.

6.12.5 An under voltage relay shall be provided connected to the main incoming AC supply. This relay shall provide a normally closed contact to give a "Main Charger Supply Fail Alarm."

## 6.13 DC Distribution Board

6.13.1 Fuses of a type approved by the Electricity North West Protection Systems Manager shall be provided for all circuits. The fuse for each circuit shall be clearly labelled.

Fuse ratings are given in the example drawing in Appendix A which is Electricity North West drawing no 900200-118.

Any fuse carriers, bases and links shall be coloured in accordance with the following code:

<u>Function</u>	<u>Colour</u>
2A fuse	Black
6A fuse	Black
16A fuse	Sea Green (No. 217 is BS 381C)
Fuses above 16A	Black
Withdrawable links	White
Bolted links	Tinned Copper

6.13.2 The DC output of the charging circuit shall be connected to the load side of the battery fuses.

6.13.3 The wiring, on the battery side of all fuses shall be as short as practicable and routed to minimise the possibility of battery faults. There shall be no wiring in the vicinity of the connections on the battery side of the main battery fuses. All wiring connections must be shrouded.

- 6.13.4 The charger ammeter shall be connected on the charger side of the charger fuse. The connection to the battery shall be as short as practicable and routed to avoid the battery negative pole connections.
- 6.13.5 All fuses shall be contained within the cubicle and covered when doors are closed.
- 6.13.6 A point of connection shall be provided on the DC distribution board to enable the attachment of an external "Traveller" battery pack. The connection shall be made via insulated "push in" terminals and sockets approved by the Electricity North West Protection Systems Manager. The connections shall be of such a design that it shall not be possible to cross polarity upon connection.
- 6.13.7 Provision shall be made to allow interconnection between additional distribution boards if required.

## 6.14 Battery Saver

- 6.14.1 In the event of an extended loss of mains to a substation (for example a Black Start Event) the battery system shall be capable of maximising the battery usage by disconnecting the load (or part thereof) as described in ER G91.
- 6.14.2 In automatic mode the system shall automatically disconnect the load (or part thereof) after a fixed time delay. On return of mains the system should reconnect the load after a fixed time delay.
- 6.14.3 All time delays shall be adjustable by Electricity North West. The time range shall be 15 minutes to 24 hours.
- 6.14.4 The system shall also be capable of control locally and remotely via telecontrol. All local operations should be padlockable. The system shall always be capable of being overridden by telecontrol. All telecontrol interposing relays should be 48V rated with a 500Ω operate coil. All remote indications shall be volt free contacts rated for switching 48V.
- 6.14.5 If a permanent power supply is required for the control and monitoring system, it may be supplied from either the 110V or 48V batteries within Electricity North West substations. If this is required the Tenderer must state the power usage of the system.
- 6.14.6 Maintenance and testing shall be possible on the system without disconnecting the load, via a fully rated manual override switch.
- 6.14.7 Remote indications and controls are required in order to allow our control room to monitor the system. Indications and controls shall include

(a) Indications/Alarms:

- System normal
- Automatic Disconnect Imminent
- Load Connected
- Load Disconnected
- Auto / Non Auto
- Telecontrol Override Set

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(b) Controls

- Disconnect Load
- Connect Load

(c) Local alarms shall reset after a time delay, settable between 4-24 hours.

6.14.8 The battery saver system shall be fully rated for connecting and disconnecting the required battery load.

## 6.15 Instruments

6.15.1 All instruments shall be flush mounted. Ammeters shall be at  $\pm 3\%$  accuracy to BS 89. Instrumentation must provide both the charger and load current readings.

6.15.2 A suitable 1% voltage instrumentation scaled 0-150V must be provided.

## 6.16 Drawings and Documentation

6.16.1 The following drawings and instructions shall be provided with the tender & delivered with each unit:

- (a) General arrangement drawing – fully dimensioned including civil interface information, weights, fixing details and equipment / internal layout
- (b) Circuit Diagram
- (c) Wiring Diagram
- (d) Operation and installation instructions. These shall be of sufficient standard to allow Electricity North West to install and commission the system without assistance from the supplier
- (e) Battery Sizing Calculation

6.16.2 Drawings shall be provided to Electricity North West Protection Systems Manager in Autocad 2010 format and PDF. Multi sheet booklets shall not be used.

For any bespoke units preliminary versions shall be provided with the tender. Final versions shall be provided 6 weeks following receipt of an order.

## 7. CRITICAL SITES

There may be some sites which require a higher capacity DC supply. The general requirements will be similar to the standard sites but typically the capacity will be higher to give greater than 72hr standby capability with higher discharge rates.

The actual capacity requirement will be specified for each site.

Factors that shall be taken into account in determining capacity are:

- (a) The standing load on the battery, generally comprising protection equipment and switchgear control circuits
- (b) The standby period required and the duty expected at the end of that period
- (c) The number of open / close operations required
- (d) Emergency lighting

For these sites the following options may be offered:

- (e) Duplicate battery chargers
- (f) Double string of batteries
- (g) Online monitoring of battery condition

## 8. DOCUMENTS REFERENCED

Health and Safety at Work Act 1974

The Control of Substances Hazardous to Health Regulations 2002

Health and Safety Manual Handling Operation Regulations 1992

EN ISO 14001 – Environmental Management Systems

ISO 9000 – Quality Systems

Directive 2006/66/EC of the European Parliament and of the Council

BS 89 - Direct acting indicating analogue electrical measuring instruments and their accessories

BS 6231 - Specification for PVC-insulated cables for switchgear and control gear wiring

BS 6290 - Lead-acid stationary cells and batteries

ER G91 – Substation Black Start Resilience

EPD311- Approval of Equipment

CP311- Equipment Approval Process

## 9. KEYWORDS

Battery; Substation.



## APPENDIX B

### CONFORMANCE DECLARATION

#### SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following Conformance Declaration Codes.

Conformance Declaration Codes:

- N/A = Section is not applicable/appropriate to the product/service.
- C1 = The product/service conforms fully with the requirements of this section.
- C2 = The product/service conforms partially with the requirements of this section.
- C3 = The product/service does not conform to the requirements of this section.
- C4 = The product/service does not currently conform to the requirements of this section, but the manufacturer proposes to modify and test the product in order to conform.

**Manufacturer:**

**Product/Service description:**

**Product/Service reference:**

**Assessor details**

Name:

Company:

Signature:

Date:

**SECTION-BY-SECTION CONFORMANCE**

<b>Section</b>	<b>Section Topic</b>	<b>Conformance Declaration Code</b>	<b>Remarks * (must be completed if code is not C1)</b>
4.1	Product not to be changed		
4.2	Electricity North West Technical Approval		
4.3	Quality Assurance		
4.4	Formulation		
4.5	Identification Markings		
4.6	Minimum Life Expectancy		
4.7	Product Conformity		
5.1	Requirements for Type Tests at Suppliers Premises		
5.2	Requirements for Routine Tests at Suppliers Premises		
6.1	Battery Type		
6.2	Battery Capacity		
6.3	Accessories and Labelling		
6.4	Battery Accommodation		
6.5	Charging and Distribution Equipment Enclosure		
6.6	Temperature Range		
6.7	Charger Input Power Supply		
6.8	Charger Output Voltage		
6.9	Charger Output Current		
6.10	Charging Equipment		
6.11	Charging Equipment – Small Wiring		
6.12	Alarms		
6.13	DC Distribution Board		
6.14	Battery Saver		
6.15	Instruments		
6.16	Drawings and Documentation		

\* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.

**Additional Notes:**



## APPENDIX C

### CURRENTLY APPROVED EQUIPMENT TYPES

#### 1. APPROVED EQUIPMENT

Batteries – Powersafe 6V105

Racking – None currently approved

Battery Alarm Unit – Alstom BA300

Fuses, bases and carriers – Red Spot fuse holders