

Company Directive

ENGINEERING SPECIFICATION EE SPEC: 24/3

Relating to Substation 30V Battery Systems for Protection and/or Circuit Breaker Tripping

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Approved by 
Policy Manager

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1.0 INTRODUCTION

This Engineering Equipment Specification defines the requirements of substation 30V DC batteries, battery chargers and associated distribution boards.

Schedules are provided towards the end of the document to enable the Purchaser to define the detailed requirements for a given application. If there is a conflict between the details in the Enquiry / Ordering Schedule and the requirements of the main body of this specification the Enquiry / Ordering Schedule shall take precedence.

2.0 GENERAL REQUIREMENTS

2.1 General

30V battery systems are normally only used within 11kV and 6.6kV master substations, switching stations and other distribution substations.

For the purposes of this document, substations with 10 or less circuit breakers and a standing drain of 0.5A or less are called “distribution substations”.

Substations with more than 10 circuit breakers or a standing drain above 0.5A are called “master substations”.

Battery systems shall comply with EA Technical Standard 50-18, except where modified by this Specification.

Schedule 1 and, where appropriate, Schedule 2 and 3 of this document, are used by the purchaser to specify requirements for a given enquiry or order.

The tenderer shall:

- Fill in and return Schedule 3
- Provide, in writing, details of any differences between the offered equipment and the specification / schedules.
- Provide details of battery sizing calculations (if requested by WPD).

2.2 Environmental Conditions

All equipment shall, under float and boost charging, be suitable for operation in ambient conditions as defined in EA Technical Standard 50-18.

Tenderers shall, unless otherwise specified in the Schedules, assume:

- (a) an average air change rate for the room containing the battery of 1.0 air changes per hour.
- (b) a temperature of 5°C shall be assumed for the purposes of rating the battery system.

If there are any special environmental conditions to be met these are defined in the Enquiry / Ordering Schedule.

2.3 Cubicles

2.3.1 General

All cubicles shall:

- satisfy the requirements of EA Technical Specification 50-18.
- be constructed from sheet-steel.
- be painted throughout in semi-gloss paint (light grey shade 631 to BS 381C) in compliance with EA Technical Standard 50-18.
- have a maximum height of 2100mm
- be fitted with protective bushes or similar protection, where wiring is taken through division sheets, shelves or side walls.
- Include adequate ventilation for both float and boost charge conditions.

2.3.2 Master Substations

The battery and charger shall, unless otherwise specified, be provided in the separate compartments of the same cubicle. The Charger / battery cubicle shall be of a free standing type capable of being placed against a back wall.

The cubicle shall provide unrestricted access to the:

- battery charger via a front mounted hinged and lockable door.
- battery and battery connections via either, front mounted hinged and lockable doors or via easily removable, bolted panels.

The distribution board shall, unless otherwise specified be a separate wall mounted type.

2.3.3 Distribution Substations

The charger, batteries and distribution circuits shall, unless otherwise specified, be combined in the same wall mounted cubicle. The cubicle shall provide unrestricted access to the charger and batteries via one or more front mounted, hinged doors.

2.4 Earthing

Earthing shall comply with EA Technical Standard 50-18. Provision shall be made for the connection of metal cubicles to the substation earth-bar.

2.5 Labeling

All items of equipment mounted externally shall be suitably labelled. Components within the charger shall be labelled to indicate their function. All labelling shall be in accordance with EA Technical Standard 50-18.

2.6 Drawings and Instructions

Drawings shall bear the substation name and Western Power Distribution contract reference, as appropriate. A copy of all drawings shall be provided in .dwg (CAD) format unless otherwise specified.

2.6.1 Tendering Requirements

A copy of the schematic / circuit drawing and the general arrangement drawing shall be submitted by the tenderer as part of the tendering process.

2.6.2 Ordering Requirements

When WPD place an order for equipment the supplier shall submit a copy of the schematic/circuit and general arrangement drawings for approval. Once the drawings have been approved by WPD a final copy of the drawings shall be provided. Manufacture of the equipment should not commence until the drawings are approved.

2.6.3 Site Requirements

A paper copy of the schematic / circuit drawings, general arrangement drawings, installation / commissioning instructions and maintenance instructions shall be supplied with each battery charger, battery and/or distribution board.

2.7 Electromagnetic Compatibility

The battery system shall comply with requirements of the Electromagnetic Compatibility Regulations.

Immunity requirements shall be in accordance with IEC TS 61000-6-5. In addition, the battery charger shall not be damaged by temporary over-voltages of the type shown in Figure 1, lasting for 3 seconds.

Emission requirements shall satisfy the requirements of BS EN 61000-6-4.

3.0 BATTERY

3.1 Battery Type

The following standard battery types shall be used for 30V systems unless otherwise agreed by WPD's Policy Section. Alternative battery types may be submitted to WPD's Policy Section for approval.

3.11 New Systems

The following battery type shall be used for all new battery / charger systems:

- (a) EnerSys Powersafe SBS Pure lead, thin plate type complying with BS EN 60896-21 and BS EN 60896-22.

3.1.2 Existing Systems

The following battery type may be used to replace existing cells of a similar type, where the existing charger is to be retained:

- (a) Alcad MC or HC vented pocket-plate nickel-cadmium type to BS EN60623.
- (b) Energys Powersafe high performance vented lead acid (Planté) to BS6290 Part 2.

3.2 **Battery System Requirements**

The following requirements apply to all batteries, unless otherwise amended in the schedules:

- Normal working voltage is 34V for valve regulated lead acid batteries.
- Maximum permissible voltage at battery terminals is 37.5V
- Minimum permissible voltage at the battery terminals is 28V
- Duration of standby duty is 24 hours
- Number of cells is 15 (e.g. 3 x 10V blocks or 5 x 6V blocks) for a valve regulated battery and 24 for a nickel cadmium battery.

Boost charging facilities shall not be provided (or shall be disabled) where the charger is used for sealed or valve regulated lead acid batteries.

3.3 **Battery Accessories**

The battery shall be supplied with accessories appropriate for the battery type.

3.4 **Battery Accommodation**

Sufficient space shall be provided to enable batteries to be replaced without dismantling or removing other equipment.

For master substation applications, sufficient space shall be provided to enable voltage and high impedance measurements to be taken, discharge tests to be carried out, and, in the case of vented cells, fluid levels to be checked and topped up.

3.5 **Protection and Testing Facilities**

Each battery shall be protected by two fuses (one in the positive circuit and one in the negative circuit).

For master substation applications:

- Battery fuses shall comply with BSEN60269-1, BSEN60269-2 and BS88-2 reference A or B.
- An 175A Anderson type connector shall be installed between the fuses and the battery, for battery testing purposes.

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3.6 Labels

A label shall be placed on the front of each block / cell specifying either the 1 hour, 2 hour or 3 hour discharge current that will drop the cell voltage to 1.8V per cell (for lead acid batteries) or 1.0V per cell (for nickel-cadmium batteries).

The 1 hour discharge current shall be provided on the label as standard. If this value is above 100A then the two hour discharge current shall be listed instead, unless this also above 100A. If both the 1 hour and 2 hour discharge currents are above 100A then the 3 hour value shall be provided instead.

For valve regulated batteries, a label shall be placed on the front of each block that specifies the replacement date of each battery. This date shall be 8 years from the date of supply (to the nearest month).

4.0 BATTERY CHARGER

4.1 General

The charger shall be an automatic constant voltage charger comprising either a thyristor controlled charger or a switch-mode charger. Boost charging facilities shall not be provided.

The battery charger shall operate from a 230V a.c. single phase 50Hz supply, include current and voltage limiting circuitry and shall incorporate frequency interference suppression to comply with BS EN 55014-1 under all operating conditions. All 230V a.c. terminals shall be fully shrouded.

4.2 Voltage Control

The float voltage setting shall be adjustable about the set value, accommodating the range of float voltages recommended by the battery manufacturer.

4.3 Current Control and Rating

The charger output current shall be adjustable between 20% and 100% of the current rated output current.

The charger rating shall be:

- (a) Sufficient to supply $0.1C_{10}$ current for lead acid batteries plus the maximum continuous DC burden.
- (b) Sufficient to supply $0.1C_{r5}$ current for nickel-cadmium batteries plus the maximum continuous DC burden.

4.3.1 Master Substation

Where a switch mode type battery charger system provides tripping supplies within a master substation, it shall include sufficient redundancy to enable the charger to continue to satisfy the above current requirements should one switch mode rectifier fail (i.e. an N+1 system shall be provided). The charger shall be constructed so that the switch mode units can be easily removed and replaced.

4.4 **Performance**

On float charge, the output voltage shall not vary by more than +1% to -1% under the following conditions:

- (a) Frequency varying between +1% and -1% of 50 Hz.
- (b) AC input voltage varying between +10% and -6% of 230V.
- (c) Charger DC current output varying between 0% and 100% of the nominal rating.

The AC ripple permitted on the battery system output shall not exceed 2% of rated voltage and shall not exceed levels that have an adverse effect on battery life.

4.5 **Accommodation**

The general cubicle requirements given in Clause 2.3 apply.

Cable entry facilities shall be from the base of the unit via un-drilled, removable gland plates. These shall be situated 100 mm above the floor level.

4.6 **Wiring and Terminations**

All interconnecting control wiring, terminations and terminal blocks shall be in accordance with ENA Technical Specification 50-18.

Terminal blocks for alarm facilities shall be screw clamp type, to EATS 50-18 with a hinged link for isolation purposes.

Consecutively numbered ferrules to ENA Technical Specification 50-19 shall be fitted to each cable end. This numbering shall be shown on the circuit diagram.

4.7 **Charger Input / Output Protection**

The input and output of the charger shall be protected by suitable miniature circuit breakers (MCBs). Residual current devices (RCD) shall not be used.

4.8 **Charger Control Module and other Electronic Components**

All electronic components shall be chosen such that they should not require replacement during the claimed life of the system.

4.9 Alarm and Indication Requirements

The following alarm and indication functions shall be provided by a multi-functional alarm relay mounted on the front of the charger door. LEDs shall be provided (either on the relay or separately mounted on the front of the charger door for each of these functions.

LED Indications:

- (a) Charger healthy - (Green LED)
- (b) Charger Fail – (Red LED)
- (c) Mains Fail - (Red or Amber LED)
- (d) D.C. Low Voltage - (Red or Amber LED)
- (e) D.C. High Voltage - (Red or Amber LED)
- (f) Battery Earth Fault - (Red or Amber LED)
- (g) Battery Fault - (Red or Amber LED)

4.9.1 Low Voltage Alarm

The low volts alarm shall monitor the charger output voltage and shall be adjustable between 25V and 35V. The alarm shall be set to operate when the voltage drops to 30V or less for more than 30s - 60s.

Operation of the low voltage alarm shall turn off the Battery / Charger Healthy LED and close an Urgent Battery Alarm contact.

4.9.2 High Voltage Alarm

The high voltage alarm shall monitor the charger output voltage and shall be adjustable between 30V and 40V. The alarm pick up shall be set to 38V with a 30-60s definite time delay.

Operation of the high voltage alarm shall turn off the Battery / Charger Healthy LED and close an Urgent Battery Alarm contact.

4.9.3 Battery Earth Fault

The earth fault alarm shall function as follows:-

- (a) With battery voltage at its normal float voltage, an alarm shall be given when the insulation of the wiring connected to one battery pole drops to 50,000 ohms or less with the insulation resistance of the wiring connected to the other battery pole at 1,000,000 ohms.

- (b) With battery voltage between the minimum and maximum levels an alarm shall be given when the insulation level on either pole drops below +10% or -10% of the set value.
- (c) With one pole directly connected to earth then no more than 5 mA earth fault current shall flow.
- (d) Operation of the battery earth fault alarm shall operate the Non-urgent Battery Alarm contact.

4.9.4 Battery Fault

Approximately once in each 23 hour period the battery shall be actively tested (using an automatic routine) to detect faulty cells and poor connections. If a fault is detected during then the Urgent Battery Alarm contact shall be operated.

The test method shall not adversely affect the life of the battery.

One method of carrying out this test is to reducing the charger output for a short period of time during which the battery voltage is monitored. If the drop in battery voltage is above appropriate limits (during a number of consecutive tests) a possible fault is indicated.

The tenderer shall submit details of their test method / routine to WPD for approval.

4.10 **Continuous DC Load**

The tenderer shall state in the Schedule 3 the continuous load imposed by the charger control module, alarms etc, but excluding the connected DC load.

4.11 **Generator Connection**

For master substation systems only, a 230V 2 phase and earth socket (to BS EN 60309-1 and BS EN 60309-2) and an appropriate A.C. change-over switch shall be provided to allow a mobile generator to be connected.

5.0 **DC DISTRIBUTION BOARD**

5.1 **Accommodation**

The general cubicle requirements are specified in section 2.3.

5.2 **Circuits and Test Facilities**

The incoming circuit (from the battery) shall be terminated on a suitably rated isolation switch.

Each outgoing distribution circuits (in accordance with the schedules) shall incorporate two fuse carriers and bases and fuse-links (one for the positive lead and one for the negative lead). The live input circuit to the bases shall be connected to the bottom terminals of the bases.

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5.2.1 Master Substations

Distribution boards used in master substations shall include an Anderson Type 175A connector on the outgoing side of the isolation switch to enable a temporary battery and charger to be connected.

The fuse carriers and bases shall be coloured black and shall be suitable for fuses to BS88-2, reference A. Fuse-links and fuse-holders shall also be in accordance with EA Technical Standard 50-18.

5.3 Distribution Wiring and Terminations

All distribution wiring, terminations and terminal blocks shall be adequately rated and in accordance with EA Technical 50-18. Terminal blocks shall permit connection of two cables to each distribution terminal, thus permitting DC ring mains.

SCHEDULE 1**ENQUIRY / ORDERING SCHEDULE****Substation Name:** _____**Substation Type:** Master / Distribution***Substation Operating Voltage:** _____ kV, **Substation Standing Drain:** _____ A**All Equipment shall be in accordance with EE SPEC 24/3**

EQUIPMENT	REQUIREMENTS			
Battery*	Manufacturer and Type: Battery Voltage: 30V			
Charger*	Requirement: Either, (i) to match the battery specified above, or (ii) in accordance with schedule 2*			
Distribution Board*	Type: Wall Mounted			
	Circuit No.	Description	Fuse Carrier / Base Rating	Fuse-link Rating
	1		32A / 63A*	
	2*			
	3*			
	4*			
	5*			
	6*			

ENVIRONMENTAL REQUIREMENTS:

In accordance EE SPEC: 24/3, except where modified below.

PHYSICAL CONDITIONS AND REQUIREMENTS:

(e.g separate battery room, utilize existing battery stand etc.)

*** Delete as appropriate.**

SCHEDULE 2

REPLACEMENT CHARGER REQUIREMENTS

Battery charger shall be in accordance with EE SPEC 24/3 except where modified by this schedule.

EXISTING SYSTEM	
Cell Manufacturer and Type	
Number of Cells	15
Float Voltage	34 Volts
Charger Rating	_____ Amperes
Continuous DC Burden	_____ Amperes
ADDITIONAL REQUIREMENTS	
Compatible with existing battery but amended as follows:	

SCHEDULE 3**TENDERED SYSTEM (TO BE COMPLETED BY TENDERER)****Substation Name:** _____

BATTERY	
Cell Manufacturer and Type:	
Cell Standard (BS, EN, IEC etc.):	
Number of Cells:	
Rated Battery Capacity (Ah):	(based on a temperature of 20°C and a 10 hour discharge rate to 1.80 V/cell for lead acid and a 5 hour discharge rate to 1.0V/cell for NiCad cells).
Battery 1 hour Discharge Current (A):	(based on a temperature of 20°C and a final voltage of 1.8V/cell for lead acid systems and 1.0V/cell for NiCad systems)
Maximum Acceptable Ripple:	
Electrolyte Topping-up interval (If Applicable):	
Claimed Service Life (at 20°C):	
CHARGER	
Charger Rating (A):	
Charger Output Ripple:	
Charger Module DC Burden (mA):	
Alarm & Indication DC Burden:	
DECLARATION:	<p>I confirm that the offered equipment complies with the Western Power Distribution Engineering Equipment Specification EE SPEC 24/3.</p> <p>Signature: _____</p> <p>Name & Designation: _____</p>

APPENDIX A

SUPERSEDED DOCUMENTATION

Engineering Specification EE SPEC 24/2 dated December 2007 is superseded by this Engineering Equipment Specification.

APPENDIX B

ANCILLARY DOCUMENTATION

ENA TS 50-18	Design and application of ancillary electrical equipment
ENA TS 48-4	DC relays associated with tripping function in protection systems
ENA TS 50-19	Standard Numbering for Small Wiring
BS 88-2	Low Voltage Fuses
BS 381C	Specification for colours for identification, coding and special purposes
BS 6290:Part2	Lead-acid stationary cells and batteries
BS EN 50014	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus
BS EN 60051	Direct acting indicating analogue electrical measuring instruments and their accessories
BSEN 60255	Electrical relays
BS EN 60269	Low voltage fuses
BS EN 60309 (part 1 and 2)	Plugs, socket outlets and couplers for industrial purposes
BS EN 60623	Vented nickel-cadmium prismatic rechargeable single cells
BS EN 60694	Common requirements for high-voltage switchgear and control gear standards.
BS EN 60896-21	Stationary Lead Acid Batteries Part 21 – Valve regulated types – Methods of test

BS EN 60896-22	Stationary Lead Acid Batteries Part 21 – Valve regulated types – Requirements
BS EN 61006-4	Electromagnetic compatibility – Generic emission standards Industrial environment
IEC TS 61000-6-5	Electromagnetic compatibility – Generic standards – Immunity for power station and substation environments
ST:TP6K	Substation battery and charger selection.

APPENDIX C

POLICY IMPLEMENTATION

This Engineering Equipment Specification shall be applied with immediate effect.

Managers shall notify all staff involved in specifying, buying, installing, commissioning or maintaining 30V battery / charger systems, that this specification has been issued.

APPENDIX D

POLICY IMPACT

This Engineering Equipment Specification modifies the requirements for 30V battery / charger systems. The following changes have been incorporated:

- References and Standards have been updated.
- Alarm and indication requirements have been modified.
- Charger limit for DC ripple has been reduced to 2% of charger rating.

It is acceptable to replace existing nickel-cadmium batteries with the same type, where the existing battery charger is to be retained and where it is economic to do so.