Technical Specification - Batteries and Chargers

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Revision details

Version No.	Clause	Description of revision
1.0	All	General revision
2.0	All	General revision
3.0	All	General revision
4.0	All	Format update, changing ‘shall’, ‘should’ and ‘may’ to must where relevant to Sydney Water, ‘approved’ replaced with ‘accepted’, minor editorial changes elsewhere.

Introduction

This Specification is for the design, supply and installation of Batteries and Chargers for Sydney Water assets.

Sydney Water makes no warranties, express or implied, that compliance with the contents of this Specification shall be sufficient to ensure safe systems or work or operation.

It is the user’s sole responsibility to ensure that the copy of the Specification is the current version as in use by Sydney Water.

Sydney Water accepts no liability whatsoever in relation to the use of this Specification by any party, and Sydney Water excludes any liability which arises in any manner by the use of this Specification.

For the purpose of this Specification “Sydney Water” is the nominated person or organisation that has written authority to act on Sydney Water’s behalf.

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Acronyms

Term	Definition
AC (ac)	Alternating current
AI	Analogue input
ANSI	American National Standards Institute
AO	Analogue output
AS	Australian Standard
AUD	Australian Dollars
CB	Circuit breaker
c/w	Complete with
DC (dc)	Direct current
DI	Digital input
DO	Digital output
ELV	Extra Low Voltage (i.e. ≤ 50 V AC or ≤ 120 V DC)

Term	Definition
EN	European normalised standard
GA	General Arrangement (drawing)
HMI	Human machine interface
HV	High Voltage (i.e. > 1000 V AC or > 1500 V DC)
IEC	International electrotechnical commission
IEEE	Institute of Electrical & Electronic Engineers
I/O	Inputs/outputs
ISO	International standards organisation
ITP	Inspection and Test Plan
LV	Low Voltage (i.e. greater than ELV but ≤ 1000 V AC or ≤ 1500 V DC)
MCB	Miniature circuit breaker
MSDS	Material safety data sheet
pu	per unit
PCB	Printed circuit board
SAA	Standards Association of Australia
SCA	Short circuit analytic
Sec.	second
SLD	Single line diagram
TBA	To be advised
TBC	To be confirmed
UPS	Uninterrupted power supply

1. General

1.1 Introduction

This specification defines the minimum technical requirements for the design, manufacture, supply and delivery of Batteries and Chargers.

1.2 Scope

This specification ensures that Sydney Water will be delivered with installation to the minimum acceptable requirements.

Key stakeholders for this specification include the Sydney Water Electrical Operations team, maintenance providers, and delivery partners.

This specification does not apply to the installation / erection, commissioning or performance testing of the equipment.

1.3 Proprietary items

Nomination of a proprietary item by Sydney Water does not imply preference or exclusivity for the item identified.

Alternatives that are equivalent to the nominated items can be submitted to Sydney Water for acceptance. The submission must include appropriate technical information, samples, calculations and the reasons for the proposed substitution, as appropriate.

2. Technical requirements

2.1 General

Unless otherwise specified all batteries and chargers supplied must be identical and capable of operating in parallel.

The batteries and charger system must incorporate reliable modern equipment selected to provide a minimum service life of 10 years for batteries and 20 years for chargers.

The product is to be from a standard range, which can be demonstrated as having provided several years of service.

The Batteries and Charger system must consist of a battery bank and battery charger capable of 125% duty.

2.2 Environmental requirements

The Batteries and Charger system must be designed to operate and meet all performance requirements whilst in an environment as defined in Clause 8 of AS 4044 unless otherwise stated by Sydney Water.

2.3 Key ratings and features

The systems must be designed to conform to the following criteria:

Ref	Rating or feature	Requirement
1	Class	Indoor
2	Access	Front access
3	Material of enclosure	Steel (Indoor) / Stainless Steel (Outdoor)
4	Enclosure Rating	IP4X minimum (Indoor) IP54 minimum (outdoor)
5	Mounting arrangement	Free standing floor mounted on a hot dipped galvanised plinth (if the plinth is not an integral part of the battery charger from the manufacturer)
6	Accessibility of compartments	Charger compartment - padlock compatible Batteries compartment - padlock compatible
7	Cable Entry	Bottom/Top (bottom entry only for outdoor installations)
8	Gland Plate	3 mm aluminium (undrilled)
9	Input Voltage Rating	240 V ±10%, 50 Hz ± 5%
10	Output Voltage Rating	48 V DC (New Sites) 32 V DC or 110 V DC (for existing sites. Refer to the need specification for the individual project.)
11	Battery Type	Sealed Lead Acid
12	Digital IO voltage	48 V DC
13	Analogue IO	4-20 mA
14	Communication	Industrial Ethernet and/or Modbus

- Note: Indoors refers to inside a pressurised switchroom. All other environments are to be treated as outdoors.

2.4 Standardisation

Equipment must be designed with standard parts and components readily available within Australia. Parts and components must be standardised as much as possible. All replaceable and consumable equipment must be standard supply equipment. The use of “one off” special designs is not permitted.

3. Technical requirements - construction

3.1 General

The batteries and charger system must be supplied in one floor mounted cubicle where practical. Each cubicle must provide separate compartments for batteries electrical equipment (charger and distribution equipment) and be fitted with hinged front doors to provide access to each compartment.

The enclosures must be fabricated from new rust free sheet steel with a coating suitable for the environmental conditions. The steel must have a minimum thickness of two mm. Structural panels must be suitably reinforced to prevent warping or buckling. Cubicles must be mounted on a 75 mm galvanised steel channel plinth, if the plinth is not an integral part of the battery charger design from the manufacturer.

All electrical connections and equipment within the cubicles must be shrouded to a minimum of IP2X standard. The equipment shrouding standard must be maintained with the cubicle door open.

For equipment mounted on hinged panels all rear terminals or active parts must be effectively shrouded by clear Perspex covers or equivalent insulation to provide safe working access to equipment located behind such panels.

Lifting lugs must be provided where necessary in the top of the enclosure.

All cubicles must be suitably protected during transport.

3.2 Compartment doors

All compartment doors must be suitably designed and braced to prevent sagging or drumming, taking into account the weight of all mounted instruments and equipment. All panel seams and joins must be continuously welded.

All compartment doors must be fitted with hinges that swing through 120 degrees and be fitted with a latching mechanism to prevent the door from self-closing.

All compartment doors must have earth studs welded on the back of the doors and be equipotentially bonded to the panel frame with minimum 4 mm^2 earth conductors.

Compartment doors must be sealed with soft closed cell neoprene sealing gaskets. Cubicle compartments containing electronics must be sealed to a minimum category IP51 to AS 1939 whilst battery compartments must be to at least IP31.

All full height cubicle doors must be provided with a three point latching system with an opening swing of 120 degrees.

All compartment doors must be accessible via the front of the panel and must be fitted with door handles that have padlocking facilities.

3.3 Surface preparation and finish

All exposed stationary metal surfaces must be prepared and painted to provide adequate protection against the adverse effects of the site conditions specified in Section **Error! Reference source not found.**.

Surface preparation and paint systems must be selected to give a life of not less than 15 years to first maintenance.

All Metal finishing, the preparation, pre-treatment of surfaces and painting must be carried out strictly in accordance with Sydney Water Standard specification WSA201 - Manual for selection and Application of Protective Coatings and WSA201 - Sydney Water Supplement and PCS100 - Protective coating standard.

Preferred paint colours	
Electrical Cabinets (Indoor)	RAL7035 (Light Grey) for external surfaces N14 (White) for internal surfaces

Preferred paint colours	
Electrical Cabinets (Outdoor)	G66 (Environmental Green) for external surfaces N14 (White) to AS 2700 for internal surfaces

3.4 Fixings

All metal handles, hinges, screws and nuts must be of manufacturer's standard finish and suitably protected against corrosion.

Externally fitted fixings must be hot dipped galvanised.

Cadmium plated fixings must not be used.

All current carrying connections must be with conical washers. Bolt length is to be selected so that approximately two threads protrude on final installation.

All equipment located on equipment mounting plates must be fixed via drilled and tapped holes in the mounting plates.

3.5 Battery cubicles

The enclosures must provide full width tiered shelves arranged so that it allows routine maintenance to be carried out without the need to remove cells.

3.6 Ventilation and filters

The cubicle enclosures must be designed to ensure adequate ventilation of the battery compartments and screened drip proof pressed louvres must be provided for this purpose.

Cubicles must have removable filters fitted behind louvres to prevent ingress of dust into the cubicle. All filters must be replaceable without the use of tools or removal of equipment or shrouds.

3.7 Outdoor applications

For equipment specified to be installed outdoors the following additional requirements must be included.

Cubicles must be constructed from stainless steel and must be protected by weather shades. Weather shades must be of stainless steel, stood off 50 mm from the top of the cubicle and must overhang all four sides of the cubicle by 80 mm minimum.

Folding around door openings must be such that dust or water lodged on top of the doors does not enter into the inside of the panels upon opening of the doors.

3.8 Low voltage (LV) cable termination

All LV cables must be top or bottom entry through earthed, removable gland plates. The LV gland plates must be suitable for the fitting of cable glands for the nominated cable types.

3.9 Earthing

The charger and battery power supply cubicles must be fitted with a hard drawn tinned copper earth bar (minimally 25 mm x 6 mm) installed at the bottom of the cubicle.

A commercially available brass link bar with 20% additional spare tunnels must be mounted on the earth bar. Each Tunnel must have 2 screws, and tunnel sizes are to suit the expected wire sizes.

The earth bar must not obstruct cable entry into the cubicle or into internal ducting.

All exposed metal parts must be earthed via the earth bar.

4. Technical requirements - batteries

4.1 Battery design standards

Design and battery sizing must use the IEEE1115 method with an additional 20% capacity as the safety margin. Battery sizing calculation must be available for Sydney Water during detail design, and it must also be included in the handover documents.

The DC load profile as detailed in section 4.2 is defined by one or more load currents and cumulative durations during the specified battery discharge cycle. The DC load profile will typically be a continuous load for the full discharge duration with a short intermittent load at the end of the discharge duration.

The battery system must be designed to be fully functional within the following temperature parameters:

Minimum operating temperature	10 ºC
Maximum operating temperature	35 ºC (average over 24 hours)
Maximum operating temperature	45 ºC (indoor absolute maximum)
Maximum operating temperature	60 ºC (outdoor absolute maximum)

4.2 Battery cells

Unless otherwise specified the type of battery cell supplied must be the sealed lead-acid type batteries to AS 4029.

The battery cells supplied must be selected from the range of manufacturers' standard sizes.

All battery cells and cases must be identical. The weight of a single removable battery cell must not exceed 20 kg, Sydney Water Manual Handling procedure must be considered to remove battery cells for maintenance.

The battery terminal voltage fluctuations caused by normal discharge duty must be within ten per cent (10%) of the nominal output voltage with AC power available.

Unless otherwise specified, the performance of batteries must comply with following requirements:

- Maintain nominal outage voltage for a minimum of four hours without primary AC supply
- Within this four hours standby time, the batteries must have sufficient capacity to complete full operation of the installation for a minimum for two times
- At the end of the four hours standby time, the batteries must have sufficient capacity to complete a minimum of consecutive trip, consecutive close operations and spring charging of 50% of the circuit breakers of the installation
- At the completion of above operation steps, the final terminal voltage of the batteries must be greater than 85% of the nominal output voltage.

The cell container material must be of translucent non-aging polypropylene or of other plastic material with similar or superior properties such as high impact resistance, chemical resistance and temperature resistance.

Bolted solid link connections must be provided between all cells on the same tier. Two independent cable connections must be provided between banks of cells on different tiers.

5. Technical requirements - battery charger

5.1 General

Unless otherwise specified all batteries and chargers system supplied must be identical and capable of operating in parallel.

Each batteries and charger system **must** contain a continuous type automatic float/boost battery charger permanently connected to a set of battery cells. Isolating links must be provided.

The operating handles of all circuit breakers and fuse carriers must be suitable for, or provided with suitable adapters for the attachment of warning tags and padlock lockout.

The emission of electromagnetic interference generated by the whole unit must conform to the requirements of AS 4044.

5.2 Chargers requirements

The batteries and charger system must be specifically designed for and be capable of operating in parallel with another unit of the same type and sharing the load current.

The batteries and charger system must operate as a floating output unit.

Under normal operating conditions the charger must maintain a constant float voltage output.

In the event of the battery voltage being low, the charger must be able to provide a constant boost voltage to fully charge the battery. When selected to boost charging mode the battery charger must revert to constant voltage float charging after a pre-set time. The boost charge time period must be adjustable.

Settings of float and boost voltage must be adjustable and facilities must be provided for selection of manual or automatic boost charging. The float voltage must be set to maintain the battery fully charged with minimal overcharge and water loss and such that regular boost charging is not required.

Values of normal in-service float voltage, boost voltage and current limit settings must be clearly marked on the charger cubicle.

Where the battery charger utilises microprocessor control with settings and parameters entered digitally, the entered data is to remain in the memory whilst unpowered for a minimum of one year without the use of a battery.

The float and boost voltages must be maintained in a range of ± 0.5% for simultaneous changes in mains input of ± 5% and load variations of zero to one hundred per cent (0 to 100%).

The incoming power supply must be provided with a current limiting thermal magnetic type moulded case circuit breaker that operates on all active conductors and has a minimum interrupting capacity of 10 kA.

Unless specified otherwise the battery charger must be a Type 3 with the battery connected in parallel in accordance with AS 4044. The charger must be of the constant voltage type with automatic control for regulating the required trickle and equalising rates and must be capable of totally satisfying the battery manufacturers requirements.

No transformer/rectifier based power supplies must be accepted. Each charger must be self-protected against overload and must be capable of being connected to fully discharged batteries without fuse rupture or component failure and restore the batteries to a charged state without manual intervention

Battery chargers must protect their internal components against harmful transients from the power supply to the rectifier and output, high inrush and overload currents, overcharging to batteries and short circuit conditions.

Battery chargers must limit the output voltage to the maximum specified float voltage when the battery load is not connected or open circuited.

Battery chargers must have reverse polarity protection on the charger output.

Printed circuit boards (PCBs) must be removable with plug and socket type connectors. All PCBs must have a suitable means to match polarising inserts in receptacles to prevent the wrong card being inserted. Each PCB must be identifiable by being engraved with the Contractor charger type and drawing number. All PCBs used in cubicles must be suitably conformal coated. All PCBs must be interchangeable with other cards of the same type for the same type and model of charger.

A suitably rated DC isolator must be provided for the connection of the charger output to the battery of a parallel unit in the event of a charger failure in the parallel unit. The isolator operation is an emergency manual function only.

Each charger must include an earth-fault detection module with an adjustable setting range.

5.3 Charger loads

The continuous load on the battery charger will comprise the battery, high voltage switchboard tripping, closing, and racking of equipment, protection equipment, remote operation, indication devices and PLC equipment.

An intermittent load will comprise the circuit breaker tripping and closing solenoids, circuit breaker spring charging motors, increased operating loads of high voltage switchboard protection equipment.

The battery charger must be adequate to provide the continuous and intermittent loads as detailed for the batter operating duty and also provide these loads while charging a fully discharged battery to ninety (90%) capacity in 12 hours.

5.4 DC output distribution

Each DC load circuit must be individually isolated from all other load outputs by a diode and protected by a suitably rated double pole circuit breaker.

All circuit breakers must have a minimum short circuit breaking capacity exceeding the battery fault level and must be of the two pole thermal magnetic type.

Protective devices such as circuit breakers and fuses must be selected to provide correct discrimination of operation in the event of faults in the main DC circuits of the charger and battery power supply cubicle.

Circuit breakers for DC isolation must be installed for each bus bar section with additional circuit breakers for each switchboard panel unless otherwise specified in Design Specification the DC load circuit breakers must be selected to provide correct discrimination with a 16 A circuit breaker as the largest downstream protective device.

All MCBs must be supplied with a means for locking in the “OFF” position. The locking device should meet the following requirements:

a) Robustness - The locking device should be able to withstand a reasonable force without failing and should be able to support the weight of a multilock device with up to 6 padlocks attached (approximately 1 kg)

b) Compatibility - The locking device should be suitable for fitting at least 6 mm (shank size) padlocks and multilock devices

c) Security - When an MCB is padlocked, the locking device cannot be defeated.

All MCBs must have durable “OFF” and “ON” labels in addition to the international “0” and “1”, and have no ambiguity as to which position they are in.

Any modification to the device (e.g. fitting of locking attachments), will only be acceptable if the Supplier has written approval from the manufacturer that the modified device will function to specification.

Where fuses are nominated, fuses and holders must be provided for each pole and equipped with fuse supervision suitable for remote indicators using voltage free auxiliary contacts.

All protective devices must be installed in a compartment, but must be accessible from the front of the cabinet without the need to remove any protective covers or shrouds.

5.5 Controls and indications

Each charger must be fitted with a voltmeter and ammeters to show charging current (output) and discharging (load) current, a test facility to indicate the stage of charge of battery cells and an automatic/manually selected boos charging facility. The metering may be analogue or digital display.

All controls, indications, meters and operation adjustment controls must be installed inside a lockable compartment that is readily accessible from the front of the unit. All indications must be visible via a perspex window in the compartment door.

The following minimum controls must be provided:

a) Alarm Reset

b) Manual Boost Push Button

c) Incoming Moulded Case Circuit Breaker

d) Output Moulded Case Circuit Breakers - to isolate the DC load

e) Manual termination of boost charging (push button)

f) Battery Test Facilities.

A digital display or individual LED indicating lamps, fitted to the front panels of the enclosures, must be provided for the following as a minimum:

a) AC Input ON

b) Boost Charge Voltage ON

c) Charger Fail

d) Battery Fail

e) Low Battery Voltage

f) High Battery Voltage

g) Earth Fault

h) DC Circuit Breaker Tripped/Fuse Operated

i) High temperature warning

j) Over temperature shutdown.

Auxiliary relays must be provided with voltage free changeover contacts to allow remote monitoring of each of the conditions listed above. All contacts of the auxiliary relays must be wired to a terminal strip for connection to a PLC system.

The fault indicating lamps and auxiliary relay contacts must remain latched following fault indication and must only be capable of being reset from the latched condition by a manual reset switch fitted to the charger unit after clearance of the initiating fault.

The “Charger Fail” alarm circuits must be arranged to operate only when no current flows into the batteries and the batteries are below ninety-six per cent (96%) of the pre-set float voltage level.

The indicating lamps must be the manufacturer's standard LED type.

5.6 Wiring

All LV and EL wiring is to be installed in a neat and logical manner following standard industry practices.

All LV and ELV wiring must fully comply with the requirements of AS 3000 Wiring Rules.

Where the ELV cable is connected to a battery, the cable must comply with AS 4044.

All conductors must be flexible stranded tinned copper wire.

Minimum conductor sizes must be:

Item	Wire type	Wiring and/or Conductors	Colours
Extra Low Voltage (AC or DC)	1.5mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active/Positive Neutral/Negative	Light Grey (LtG)
All battery connections	1.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Positive Negative	Red Blue/Black(BK)
240 V AC control when supplied from same compartment or SCA In all other cases	2.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active Neutral Active Neutral	Brown (BN) Black (BK) Orange (O) Black (BK)
Earth conductors	Minimum 4 mm^2 Cu, 0.6 / 1kV PVC insulated type V75 to AS 3147		Green-Yellow (G-Y)
Instrumentation twisted pair conductors		Positive Negative	White (w) Black (BK)
Ethernet	CAT 6		Blue
Conductors connecting voltage free relay contacts where the voltage is undefined	1.5 mm^2 Cu, 0.6 / 1 kV PVC insulated type V75 to AS 3147	Active/Positive Neutral/Negative	Violet (V)

All LV and ELV wiring is to be installed in plastic cable duct with clip-on covers, flexible conduit is to be provided from panel to door. Cable ducts are to have 30% spare capacity. Panel to door wiring must include a loop to relieve stress and must be anchored at the panel and the door.

No joints in runs of wiring (i.e. at locations other than at terminals) must be permitted.

All LV and ELV wiring is to be arranged so that the line side is connected to the top of the respective device.

Adhesive wiring supports are unacceptable.

Where wiring is to pass through cut-outs in panelling, the hole must be bushed.

All terminal strips and individual terminal blocks must be labelled using proprietary labelling/numbering systems.

All conductors must be terminated at both ends with pre-insulated crimp terminations. They must be of the correct size for the conductor and must be applied with the terminations manufacturer's tool.

- Ring type termination lugs must be used for terminating to stud-type terminals
- Lip blade termination lugs must be used for terminating to rail-type terminals
- U shaped termination lugs must be used on selector switches and similar small equipment.

Solder connections are not acceptable.

All conductors must be uniquely numbered at both ends in accordance with the respective schematic diagrams.

All field wiring must be marshalled at terminal strips.

Terminals must comply with the following requirements:

a) Tunnel type connectors

b) Only one conductor must be terminated on each side of each terminal

c) All terminal strips must maintain a degree of protection of IP2X

d) All field cabling must be terminated on one side of each terminal strip and all panel wiring must be terminated on the other side of the terminal strip

e) For clarity, provide barriers between groups of terminals having different functions (e.g. between terminals for 240 V AC supply, DC output and signal terminals)

f) Provide a separate earth terminal for each field cable

g) All terminal blocks must be uniquely numbered in accordance with the respective schematic diagrams

h) All terminals must be uniquely numbered in accordance with the respective schematic diagrams.

MCBs must be provided for isolating all auxiliary power supplies.

5.7 Interfaces with external systems and equipment

Interfaces between the batteries and charger system and external systems and equipment must be provided in accordance with Sydney Water SCADA/IICATS requirements.

The following hardwired signals must be included as a minimum:

a) HV Battery Major alarm (Charger fail, Battery fail)

b) HV Battery Minor alarm (Low Battery Voltage, High Battery voltage, Earth fault).

6. Identification and labelling

All electrical equipment forming part of the batteries and charger system must be readily identified in the English language by a label in accordance with the relevant standard and this Specification.

All labelling and nameplates must be in accordance with nomenclature used on the relevant electrical Drawings and Schedules provided by Sydney Water.

All labels must be permanent, free from fading, engraved, embossed or pressed multi-layered thermosetting plastic or metal. Labels must be secured suitable coated machine screws into tapped holes. Departures from these requirements must require the written pre-approval of Sydney Water.

All equipment labels must be mounted on a fixed portion of the enclosure directly adjacent to the device.

Terminal block group labels must be manufactured of the material and mounted in accordance with the standard procedures adopted by the terminal strip manufacturer. Terminals must not be made of brittle material.

Generally, labels must be manufactured to the following specification.

Label function and location	Typical label size (mm)	Text colour / Background colour	Label description	Text height (mm)
Batteries and Charger Cubicle main label - Mounted at the front top centre of the cubicle	400 L x 100 H	Black / White	Battery designation Substation Name 48 V PROTECTION DC SUPPLY	20 20 10
Battery Cubicle Label - Mounted at the front top centre of battery compartment door	120 L x 4 0H	Black / White	48 V DC XX off Sealed Lead Acid Cells Cell Manufacture / Cell type FAULT CURRENT: xxxA	7 7 5
All compartment door mounted equipment labels (e.g. Controllers, indication lights, selector switches, pushbuttons etc) - Mounted on front and rear of LV compartment door below equipment		Black / White		3
All compartment internally mounted equipment labels (e.g. control relays, control MCBs, Terminals etc) - Mounted below equipment		Black / White		3

6.1 Safety labels

Warning labels must be attached as required by AS 4044, AS 2676 and where any potentially hazardous or unusual operational situation may exist.

These labels must comply with the requirements of AS1319.

As a minimum, the following labels must be provided:

- **Danger** - Risk of battery explosion as per AS 2676.1 clause 8.4.a and Appendix J
- **Caution** - Battery voltage and prospective fault level as per AS 2676.1 clause 8.4.b
- **Emergency Information** - Instructions for dealing with electrolyte burns as per AS 2676.1 clause 8.4.c and Appendix J.

In addition, all incoming AC circuit breakers, fuses or other isolating devices must be labelled as follows:

e.g.

DC battery charger 240 V AC Supply

Not to be switched off without permission

6.2 Label schedule

A label schedule showing details of each label must be submitted for approval prior to manufacture of the relevant labels.

7. Testing requirements

7.1 Factory inspection

Sydney Water must be provided with opportunities to witness factory tests. The Contractor must advise the Sydney Water representative in writing six weeks prior to any scheduled testing.

7.2 Routine (factory) testing

Prior to shipment, the equipment must be completely assembled and tested by the Contractor in accordance with the relevant Australian Standards and the following minimum test requirements:

a) Capacity test on each different type of cell. Alternatively, type test certificate may be accepted in lieu of factory test results.

b) Insulation resistance tests on all equipment and wiring

c) Load test on the complete battery/charger unit

d) Operational tests to check the function of all items of equipment

e) Test to ensure compliance with requirements in section **Error! Reference source not found.** of this specification.

Sydney Water reserves the right to call for a demonstration of the ability of the equipment to withstand a short circuit of the charger output for a specified duration.

The Contractor must supply certified copies of all test results for each charger and battery unit with the equipment manuals.

These tests may be repeated on site, and if any defects in workmanship, design or materials appear, which were not apparent during factory testing and it must remain the responsibility of the Contractor to rectify such defects on site, free of charge.

8. Quality assurance and inspection and test plans

The Contractor must implement a quality system that complies with the requirements of ISO 9001 for the equipment.

The Contractor must submit for approval two project-specific Inspection and Test Plans (ITPs) for the Batteries and Charger System:

a) **Factory ITP** - covering all off-site activities i.e. engineering, design, supply, testing, resolution of factory defects/punch lists, release for delivery, preparation for transport, etc.

The ITPs must identify the standards and/or procedures as well as the acceptance criteria that must apply for each stage in the ITPs.

Unless approved otherwise by Sydney Water, all standards, procedures and acceptance criteria included in the ITPs must comply with the requirements defined in this specification.

Perform all work on the batteries and chargers in accordance with the approved ITPs.

Sydney Water may apply witness points and/or hold points on various stages of the ITPs.

Sydney Water must be given the option of witnessing all inspections and tests including type tests, (routine) factory tests and site tests. Sufficient notice (14 calendar days for tests on site, 42 calendar days for test elsewhere in Australia, 42 calendar days for tests outside Australia) must be given to enable the necessary travel arrangements to be made. Sydney Water may elect to appoint third party inspector(s) to witness inspections and tests.

9. Spare parts

The Contractor must provide a list of all spare parts and/or tools for commissioning, routine and scheduled maintenance up to end of the defects liability period.

Sydney Water reserves the right to include any or all of the spare parts offered.

This list must include part numbers and prices for the following as a minimum:

a) Printed Circuit Boards - one complete set

b) Main Diodes - one complete replacement set

c) Thyristors - one complete replacement set.

The spare parts list must be prepared with regard for the need to rapidly restore the charger to service following any failure.

10. Manuals and drawings

Two paper copies of erection, maintenance and operating manuals in accordance with Clause 10 of AS 4044 must be supplied.

One electronic copy of all manuals, drawings and test results must be provided on suitable electronic media in PDF file format as a minimum.

Where a programmable microprocessor-based controller is used in the charger, the Contractor must provide an electronic copy of any settings files, any proprietary software required to program the controller and interface cable.

Where a password is required to access the settings, this password must be provided in the manual.

Equipment manuals provided must contain details of all aspects of the operation and maintenance of the supplied equipment, a detailed parts list of all major components and copies of all factory test results.

Electrical circuit diagrams must be supplied either with the manuals or as separate A3 size drawings. All drawings must be supplied electronically in an AUTOCAD compatible format.

Equipment manuals and drawings must not contain descriptions or details of alternative equipment not specifically used in the supplied equipment.

Maintenance manuals and regimes must be specific for each site installation, in particular with respect to the maintenance timeframes required for the environmental conditions of the specific site.

11. Packaging and delivery

The Contractor must pack all equipment for delivery such that it will not be subject to any damage, or deterioration due to any environments through which the equipment may pass during delivery. Refer to AS 2676 section 5 for specific battery cell requirements.

The Contractor must make good any damage or deterioration that has resulted from the delivery.

The Contractor must provide for Sydney Water, documents detailing the following information:

a) Number of crates to be delivered

b) Items that are in each crate

c) Total weight of each crate

d) Any special lifting requirements for each crate

e) Any obligation that Sydney Water may have when the items are delivered, such as immediate unpacking, storage requirements etc.

12. Reference documents

The Batteries and Chargers and all associated equipment and materials must be designed, manufactured and tested in accordance with the latest revisions of the Federal and State statutory requirements, applicable Australian and IEC Standards, as well as the Sydney Water standard specifications.

Document type	Title
Legislation	- Latest edition of the Work Health and Safety Act - Latest edition of the Service and Installation Rules of New South Wales
Policies and procedures	- WSA201 - Manual for Selection and application of protective coatings - Supplement to WSA201 - Manual for Selection and application of protective coatings. - PCS100 - Protective Coatings - Sydney Water Emergency Stop Policy
Other documents	
Standards	- AS ISO 1000: The International System of Units (SI) and its application (ISO 1000) - AS1044: Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus - AS 1627: Metal finishing - Preparation and pre-treatment of surfaces - AS1939: Classification of Degrees of Protection for Enclosures for Electrical Equipment - AS 2676: Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - AS 2700: Colour standards for general purposes - AS/NZS 3000: Electrical installations (known as the Australian/New Zealand Wiring Rules) - AS 3111: Approval and test specification - Miniature overcurrent circuit-breakers - AS 3947 series: LV switchgear and control gear - AS 4029: Stationary Batteries - AS 4044: Battery Chargers for Stationary Batteries - AS 60038: Standard voltages - AS 60146: Semiconductor Converters - AS 60269 (IEC 60269): Low-voltage fuses - AS 60529 (IEC 60529): Degrees of protection provided by enclosures (IP Code) - AS/NZS 60898.1 (IEC 60898): Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for AC operation - AS 60947 (IEC 60947): Low-voltage switchgear and controlgear. Please note: Some parts still exist as AS/NZS 3947 - AS62040: Uninterruptible power supplies (UPS)

12.1 Conflicts between specification, standards and/or codes

Review the above standards and make use of them where they are applicable. Identify any conflicts between the above standards and recommend which criteria to use. The Contractor must refer any conflicts in the information to Sydney Water for clarification.

Ownership

Ownership

Role	Title
Group	**Integrated Systems Planning - Liveable City Solutions**
Owner	Manager of Urban Design and Engineering
Author	Lead Engineer Electrical

Change history

Version No.	Prepared by	Date	Approved by	Issue date
1	Robert Lau / Andrew Manganas / Paul Zhou	05/12/2014	Norbert Shaeper	05/12/2014
2	Robert Lau / Andrew Manganas / Paul Zhou	21/09/2016	Norbert Shaeper	21/09/2016
3	Robert Lau / Paul Zhou	14/09/2018	Ken Wiggins	14/09/2018
4	Paul Zhou	20/02/2020	Steve Keevil-Jones	20/02/2020