RAND WATER	STRATEGIC ASSET MANAGEMENT ELECTRICAL ASSET MANAGEMENT ELECTRICAL ENGINEERING STANDARD	
TITLE: STANDARD FOR 110VDC AUXILIARY AND BATTERY CHARGING SYSTEMS		SECTION: EAM
STANDARD No: RC 01475	EFFECTIVE DATE: 30 JULY 2015	REV. NO: 00
AUTHOR: Robert Leggott ..... Consultant Electrical Technologist	REVIEWED BY See Compilation committee	AUTHORISED BY: Mehmood Haffejee ..... Acting Electrical Asset Manager

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

TABLE OF CONTENTS

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

1. PURPOSE

1.1. The purpose of this document is to provide a standard to which 110VDC auxiliary and battery charging systems are to be designed, manufactured, installed and commissioned, where required, on Rand Water operational sites.

2. SCOPE

2.1. This specification covers the design, manufacture, testing at works, preparation for delivery, delivery and offloading of 110VDC auxiliary and battery charging systems. The system shall be used for circuit breaker tripping (under voltage and shunt trip coils), indication, closing, spring rewind motor power supplies, magnetic actuator breaker power supplies and power supplies to protection and metering relays.

3. REFERENCES

3.1. The 110VDC auxiliary and battery charging systems shall be designed to fully meet the requirements of the latest revisions and amendments of the following Acts, Regulations, Standards and Recommendations:

Occupational Health and Safety Act (No 85 of 1993) and regulations as amended

SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 1632-1	Batteries Part 1: General information- Definitions
SANS 1632-2	Batteries Part 2: Vented-type stationary lead-acid cells and batteries
SANS 1632-4	Batteries Part 4: Valve regulated type stationary lead-acid cells and batteries
SANS 1652	Battery chargers - Industrial type
SANS 60896-11	Stationary lead-acid batteries. General requirements and methods of test Part 11: Vented types
SANS 60896-2	Stationary lead-acid batteries - General requirements and methods of test Part 2: Valve regulated types
SANS 60086-1	Primary batteries Part 1: General
SABS 763	Hot dip (galvanized) zinc coating
SANS 60529	Degrees of protection provided by enclosures (IP code)
SANS 1091	National colour standard for paint
BS 4190	Specification for ISO metric black hexagon bolts, screws and nuts
SANS 60623	Vented Nickel Cadmium batteries (prismatic type) rechargeable

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

IEC62259	Vented Nickel cadmium batteries (recombination type)
SANS 60099-1	Surge arresters Part 1: Non-linear resistor type gapped surge arresters for a.c systems
SANS 60099-5	Surge arresters Part 5: Selection and application recommendations
SANS 10191	Acoustics - Determination of sound power levels of noise sources - Guidelines for the use of basic standards
SANS 60529	Degrees of protection provided by enclosures (IP Code)
ISO 9001	Quality Systems Part I, II and III
SANS 60044-1	Instrument transformers Part 1: Current transformers
SANS 60044-2	Instrument transformers Part 2: Inductive voltage transformers
SANS 156	Moulded case circuit breakers

3.2. No claims for extras in respect of failure by the Contractor to comply with any of the above regulations or specifications will be entertained by Rand Water.

3.3. Where conflict exists between any of the above regulations, the said conflict must be referred to the Engineer for a ruling.

3.4. Where conflict exists between any of the above regulations and the detailed technical specification or notes on drawings, the said conflict shall be referred to the Engineer for clarification.

4. TERMS, DEFINITIONS & ABBREVIATIONS

The following definitions shall apply, where applicable:

AC	Alternating Current
AMSL	Above mean sea level
ADS	Application data sheet
BS	British Standards
CACA	Circulated Air Circulated Air
CACW	Circulated Air Circulated Water
CD	Compact Disk
CMR	Continuous Motor Rating
CSI	Current Source Inverter
CT	Current Transformer
DC	Direct Current
DOL	Direct-on-line
DVD	Digital Versatile Disk

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

EMC	Electromagnetic Compatibility
FAT	Factory Acceptance Test
FBA	Factory Built Assembly
HVAC	Heat, Ventilation and Air-conditioning
Hz	Hertz
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organization for Standardization
IGBT	Insulated Gate Bipolar Transistor
kA	kilo Amps
LED	Light Emitting Diode
mA	milli Amps
MCC	Motor Control Centre
MLMST	Multi Level Inverter, Multi Secondary Transformer
MV	Medium Voltage
OEM	Original Equipment Manufacturer
PDS	Power Drive System (SANS 61800-4)
PFSC	Process Fail Safe Controller
PLC	Programmable Logic Controller
PWM	Pulse Width Modulation
PT100	Platinum resistor element with a nominal resistance of 100 Ohm at 0°C
QA	Quality Assurance
QAP	Quality Assurance Plan
QCP	Quality Control Plan
RMS	Root Mean Square
RFQ	Request for Quotation
RW	Rand Water
SABS	South African Bureau of Standards
SANS	South African National Standard
SHEQ	Safety, Health, Environment and Quality
SPIR	Spare Parts Interchange-ability Record
TEFC	Totally Enclosed Fan Cooled
V	Volts
VSD	Variable Speed Drive
VSI	Voltage Source Inverter
VT	Voltage Transformer
Accredited Test House	A Third-Party Organization duly authorized by an Accreditation Authority who has the necessary test plant to perform type-tests in accordance with ISO 17025 requirements.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

Data Sheets	The drawings, tabulations and sketches, which clearly indicate the technical, electrical and physical requirements of the equipment.

Note: Not all abbreviations listed above appear in this document.

5. OPERATIONAL REQUIREMENTS

5.1. General

5.1.1. Electrical Performance Requirements for continuous operation at full rating

5.1.2. The temperature of any component or compartment, under the following power supply and environmental conditions, shall not exceed the lesser of either the maximum temperature recommended by individual equipment suppliers, or the maximum temperature indicated in the relevant SANS, IEC or BS standard.

5.2. Environmental Conditions

5.2.1. The equipment shall be designed for the following environmental operating conditions:

Altitude (for design purposes)	1 800 metre above sea level
Maximum air temperature	+40 degrees Celsius
Minimum air temperature	-10 degrees Celsius
Maximum humidity	95% (non-condensing)
Location	Indoors unless otherwise stated but subject to insect and vermin depredations

5.3. Electrical Supply

5.3.1. Power Supply Details

Nominal supply voltage:	231/400VAC, 3 phase 4 wire
Variations:	+ 10% to -15% on nominal voltage
Phase rotation	RWBR
Frequency:	50Hz
Variations on frequency	±2%
Negative phase sequence voltage	2%
Total harmonic distortion	<3% (up to 25th harmonic)
Neutral earthing (secondary)	Solid
Fault level	kA rating for 1 second as specified
Peak fault factor	2.1

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4. Battery Charger Requirements

5.4.1. An automatic, constant voltage type charger with current limiting facilities shall be provided.

5.4.2. The output shall be kept within 1% of the float charger voltage designed for maximum charge conservation and a maximum battery life unless in boost mode.

5.4.3. The float charge voltage shall be less than the gassing voltage.

5.4.4. The ripple content in the output of the charger shall be less than 2% RMS V with battery disconnected.

5.4.5. The charger capacity shall be adequate to supply any standing load on the battery plus a charging current, which will recharge a fully discharged battery at the maximum charge rate recommended for the specific battery used. (The nominal charge rate in amps is C/5 for a battery discharged to between 10% and 85%, C/10 for a battery charged to between 85% and 95%; and C/15 for a battery charged to greater than 95%).The charger shall be able to supply the full rating of DC output when in BOOST and mains are at – 15% of AC nominal voltage.

5.4.6. The charger shall be of the constant voltage type, fully automatic in operation and suitable for continuous trickle and automatic boost charge operation.

5.4.7. The charger shall be suitable for operation from a nominal 231/400VAC, 50 Hz, three phase, four wire (or single phase) solidly earthed power supply.

5.4.8. The charger shall have the following as a minimum:

5.4.8.1. Mains AC and DC isolating switches as well as a dc contactor for disconnecting the battery bank from the load. The dc load shall be automatically disconnected from the battery bank should the battery voltage fall below a preset level. The voltage at which the load shall be disconnected shall be adjustable between 80 to 120 volts. The circuit shall have an adjustable operating delay of between 60 and 600 seconds. A suitably labeled pushbutton, located internally to the charger, shall be provided to momentarily energize the dc contactor for a set timed period of up to 30 minutes, overriding the opening signal, to allow for breaker closing operations.

5.4.8.2. The charger shall have the following protective devices:

5.4.8.2.1. Suitably rated circuit breakers to isolate the mains power supply to the charger.

5.4.8.2.2. Suitably rated DC circuit breaker to isolate the charger from the battery bank and from the load (see Note in clause 5.4.8.2.4).

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.8.2.3. Rectifier diodes and thyristors used in the AC/DC converter stage shall be protected either by high-speed, high-rupturing capacity (HRC) fuses or by current limiting circuit breakers.

5.4.8.2.4. NOTE: only DC breakers shall be used for switching DC currents. The charger shall be fitted with two fully rated circuit breakers for the output DC load.

5.4.8.3. Battery Management System

5.4.8.3.1. The charger unit shall be provided with a Battery Management and multi – alarm system for supervisory, control and alarming functions.

5.4.8.3.2. A Battery Management System, that forms part of an analogue alarm system with LED indications, is acceptable.

5.4.8.3.3. The charger control system must be capable of being manually changed should RW choose to use a different technology battery.

5.4.8.3.4. Automatic boost function: voltage sensing system performs automatic boost charge after deep discharge. Automatic return to float charge when battery voltage has been corrected.

5.4.8.3.5. Auto load test function: the charger automatically performs a daily load test on the battery bank thereby testing the integrity of all batteries and connections.

5.4.8.3.6. Manual boost function: charger is placed in manual boost mode by operator after deep discharge. The charger shall automatically override the manual boost function and return to float charge when battery voltage has been corrected.

5.4.8.4. Alarms

The following alarms shall be indicated by means of LEDs on the front door of the charger.

5.4.8.4.1. Earth fault alarm: Identifies a positive or negative fault operating on a calibrated resistance to earth measurement.

5.4.8.4.2. Mains fail alarm: Identifies the absence of mains supply.

5.4.8.4.3. Loss of charging supply: Immediately identifies if the circuit breaker feeding the battery bank (for charging purposes), has tripped. Auxiliary contacts to be installed on this circuit breaker to raise an alarm should the circuit breaker trip.

5.4.8.4.4. Auto battery test alarm: Identifies that the battery circuit or the test circuit has failed.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.8.4.5. Charger fail alarm: Identifies a charger failure.

5.4.8.4.6. Undervoltage alarm: Identifies that the battery system is below the minimum voltage.

5.4.8.4.7. Overvoltage alarm: Identifies the charger has gone above the set voltage.

5.4.8.4.8. Manual boost function: Identifies if the manual boost function, mentioned in 5.4.8.3.6, has been activated.

If any of the above-mentioned alarms are generated, the charger shall switch a minimum of two (2) separate potential free contacts, indicating "Charger fail". These contacts shall be wired to suitably labeled terminals for connection to the PLC panel.

5.4.8.5. Metering indication

The following information, as a minimum, shall be displayed on the front door of the charger:

5.4.8.5.1. AC input voltage (analogue meter).

5.4.8.5.2. Battery DC voltage and load current (analogue meters).

5.4.8.5.3. +ve and -ve earth leakage (LED indication).

5.4.9. Mechanical construction

5.4.9.1. All sheetmetal shall be a minimum of 2mm mild steel, bent and welded to form a substantially rigid and sturdy unit.

5.4.9.2. The battery charger and battery cabinet shall be of the indoor, totally enclosed, floor-standing type, shall each be fitted with a suitable plinth of at least 100mm in height, shall be vermin proof and where possible dust proof. Degree of protection recommended is IP31.

5.4.9.3. The battery bank shall be housed in a battery cabinet and not inside the battery charger. The battery cabinet shall be manufactured from sheetmetal and shall have a hinged sheetmetal front door.

5.4.9.4. The battery cabinet shall be of the front access type with proper vermin proofed ventilation apertures/louvers. The battery cabinet shall be sufficiently sized to allow for access to all cells, for maintenance/removal, without removing any additional cells.

5.4.9.5. A 4 pole, suitably rated, DC circuit breaker shall be installed in the battery cabinet to allow for isolation of the outgoing battery supply.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.9.6. Equipment Mounting Plates (Chassis Plates)

5.4.9.6.1. Chassis plates shall be sufficiently rigid to carry the components mounted thereon without deflection.

5.4.9.6.2. Chassis plates shall be powder coated Gloss White.

5.4.9.6.3. The drilling and tapping of holes for the mounting of components is not acceptable on chassis plates, "hank" captive nuts shall be used to secure components.

5.4.9.7. Gland Plates

5.4.9.7.1. Sectionalised removable gland plates shall be provided and secured by means of "hank" captive nuts or screws and so located that ample space is afforded for the satisfactory entry and termination of cables.

5.4.9.7.2. Cable entry shall normally be from the bottom. Top entry (or side entry) will only be permitted at the discretion of the Engineer.

5.4.9.7.3. Gland plates shall be mounted at least 300 mm above ground level.

5.4.9.7.4. Gland plates shall be manufactured from mild steel and shall be galvanized.

5.4.9.8. Screws, nuts and bolts

5.4.9.8.1. All screws, nuts and bolts shall be hexagonal to ISO metric, commercial standards and shall be rust proof. Nuts protruding from exterior surfaces shall be domed and either chrome or cadmium plated.

5.4.9.9. Control and Instrument Wiring

5.4.9.9.1. Control and instrument wiring shall be carried out using 600V grade flame retardant PVC insulated, multistranded wire with a minimum of 19 strands. The minimum wire sizing for control circuits shall be 1 mm^2.

5.4.9.9.2. All wires shall be terminated using compression crimp lugs unless the wire terminates in a pressure pad type terminal in which case compression ferrules shall be used.

5.4.9.9.3. All wires shall be numbered at both ends using international colour coded Legrand CAB 3, Memocab type ferrules or the Grafoplast numbering system. Numbering shall be strictly in accordance with the relevant schematic diagrams.

5.4.9.9.4. The cables going to and between the battery's cell blocks shall be clearly distinguishable between positive and negative.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.9.9.5. The positive and negative cables, going to the battery charger load terminals, shall be clearly marked with coloured heat shrink sleeving. The positive cable with red and the negative with black heat shrink sleeving at least 30mm in length.

5.4.9.10. Colour Coding of Wiring

5.4.9.10.1. Power circuits shall be phase colour coded or else shall be identified L1, L2, L3 for red, white and blue phases respectively and black for the neutral.

5.4.9.10.1.1. Control Circuits

AC live	-	brown or red
AC neutral	-	black
110V DC positive	-	grey
110V DC negative	-	grey
24V DC +ve	-	pink
24V DC –ve	-	orange
4-20 mA	-	purple
Earth	-	green with yellow trace

5.4.9.11. Terminals For Control And Instrumentation Wiring

5.4.9.11.1. On any terminal block, or assembly, terminals shall be provided for all spare cable cores. Thereafter an additional 10% spare terminals shall be provided as determined by the schematic diagrams.

5.4.9.11.2. A maximum of two wires per side of the terminal is permitted and bridging devices between terminals shall be used where more than two wires are required to be connected.

5.4.9.11.3. Terminals shall be arranged in a logical, numerical sequence. Random organisation of terminals is not permitted. Each terminal shall carry a number on both input and output side, and each terminal strip shall be numbered in accordance with the relevant schematic diagrams and shall have a group carrier label.

5.4.9.12. Terminals for Power Circuits

5.4.9.12.1. Terminals shall be provided for the termination of power circuit wiring.

5.4.9.12.2. Terminals utilized for the main AC supply to the battery charger and for all battery cable connections, shall be sized for a minimum of 16 mm^2 conductors.

5.4.9.12.3. The terminals shall be rated for the maximum continuous circuit current.

5.4.9.12.4. Pressure pad terminals may be used up to conductor of 16 mm^2 and terminals for larger conductors shall be the bolted type requiring the use of crimp lugs.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.9.13. Trunking And Control Of Wiring

5.4.9.13.1. Wiring trunking shall be used for the control of wiring. The trunking shall be sized such that after all cabling has been completed the trunking shall be no more than 75% full.

5.4.9.13.2. Wiring to devices mounted on doors shall be so arranged that when the door is opened, a twisting rather than bending motion is imparted to the wires.

5.4.9.13.3. Wiring to the doors shall be secured and controlled using spiral bindings where it passes over the door opening. Wiring may run in slotted trunking fitted to the inside of the door.

5.4.10. Panel Covers

5.4.10.1.1. All covers shall be held in place with suitable bolts.

5.4.10.1.2. The use of domed nuts is not acceptable.

5.4.10.1.3. All covers providing access to chambers containing live equipment shall be provided with warning labels.

5.4.11. Doors

5.4.11.1.1. The doors shall be secured by means of square key type catches that shall be padlockable.

5.4.11.1.2. The doors shall be suitably braced and stiffened to carry the weight of equipment mounted on the door and to prevent warping.

5.4.11.1.3. Doors shall be fitted with non-hardening rubber or neoprene seals.

5.4.11.1.4. Doors with mounted electrical equipment shall be bonded to earth with a stranded copper earth conductor. Arrangements shall be made to ensure effective metallic contact between the earth conductor and the panel door.

5.4.11.1.5. All connectors and other live parts shall be shrouded to avoid inadvertent contact when servicing/accessing the charger unit interior.

5.4.12. Painting Of Sheetmetal

5.4.12.1.1. Surface Preparation

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.12.1.1.1. Before the application of paint all traces of grit, grease, oil, rust, mill scale or other contaminants shall be removed by means of shot blasting or acid pickling and washing.

5.4.12.1.1.2. Immediately after cleaning, all surfaces shall be covered by an electrolytically applied rust inhibiting, tough, unbroken metal phosphate film and thoroughly dried.

5.4.12.1.1.3. The preferred final paint finish is epoxy powder.

5.4.12.1.2. Epoxy Powder Finish

5.4.12.1.2.1. Within 48 hours of phosphating the metal parts shall be heated and then covered by a SABS approved external microstructured paint powder applied electrostatically.

5.4.12.1.2.2. The paint shall then be baked on according to the paint manufacturer's specification. The minimum final paint thickness shall be 70 micrometers.

5.4.12.1.3. Quality of Final Finish

5.4.12.1.3.1. The application of the paint shall be uniform so as to prevent running.

5.4.12.1.3.2. Careful attention shall be applied to the application of paint to sharp edges and corners to prevent cracking or peeling of paint. Any surfaces exhibiting these symptoms shall be rejected and shall be stripped and completely repainted.

5.4.12.1.4. Touch Up Paint

5.4.12.1.4.1. The manufacturer shall supply at least 500 ml of each colour of paint and matching primer used for touch up purposes after the battery charger has been installed on site.

5.4.12.1.4.2. Tenderers may offer their standard metal preparation and powder coating specifications (subject to the approval of the Engineer if necessary)

5.4.12.1.5. Paint colours

5.4.12.1.5.1. The battery charger and battery cabinet shall be painted Light Orange-B26 structured, to SANS 1091.

5.4.13. Earthing

5.4.13.1. All non-current carrying, conductive parts, including relays, switches, instruments and transformers, etc shall be effectively connected to the earth bar by their mounting arrangements on the panel or by means of a special earthing conductor fitted with crimped lugs for attaching to the earth bar.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.4.14. Labelling

5.4.14.1. All equipment and component labels internal to the battery charger shall be manufactured from white- black-white traffolyte with 3 mm engraved lettering.

5.4.14.2. The battery charger designation labels shall be engraved on white-black-white traffolyte sandwich board with a letter height of 20 mm and fitted into an aluminium slide.

5.4.14.3. The battery charger designation label shall also carry the respective WKS equipment and circuit number. Rand Water will provide the numbering information to the Contractor.

5.4.14.4. Safety labels shall be provided as required.

5.5. Battery Bank

5.5.1. The battery bank shall be Hawker Energy blocks (or equivalent technology) with pure lead cells, sealed, low maintenance and shall be supplied complete with inter-block connectors, connections to the battery charger, battery cabinet and all other components necessary for their proper functioning.

Or

5.5.2. The batteries shall be of the Alcad ultra low maintenance (or maintenance free) type of the Vantage or Vantex type recombination Nickel Cadmium (pocket plate type).

5.5.3. The battery bank shall be rated as specified herein and shall have a life expectancy of not less than 15 years.

5.5.4. The nominal voltage of the battery bank shall be 110 Volts.

5.5.5. The number of cells and capacity shall be determined according to the voltage requirements of the circuit breaker closing and tripping and spring charging operations and the standing load discharge duties required by the switchboard.

5.5.6. The battery capacity shall be the larger of the following:

5.5.6.1. 140 Ampere hour at the 10 hour discharge rate

OR

5.5.6.2. A single tripping and reclosing operation of all the circuit breakers on the switchboard plus supplying all the standing loads on the battery for at least 10 hours.

5.5.6.3. Where possible, RW shall provide a load profile for the DC application to the Tenderer

5.5.6.4. Calculations to substantiate the battery capacity shall be presented to the Engineer for approval.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.6. Quality Assurance Requirements

5.6.1. Tenderers shall be certified compliant with the requirement of ISO9001:2008 (Quality Management System), SANS/ISO14001:2004 (Environmental Management Systems) as well as OHSAS 18001:2007 (Occupational Health and Safety Management System).

5.6.2. The manufacturer shall submit a Quality Assurance Plan (QAP) in accordance with ISO9001:2008.

5.6.3. The manufacturer shall submit to Rand Water a short form copy of its quality assurance procedures manual for appraisal by the Engineer at time of tendering.

5.6.4. After award of the order the manufacturer shall submit a full quality assurance plan for approval by the Engineer. Rand Water shall be given the opportunity to indicate hold and witness points on the plan.

5.6.5. Inspection during manufacture

5.6.5.1. The Engineer or his appointed representative shall be permitted to carry out, during normal working hours, periodic inspections of the equipment covered by this specification over and above the witness and hold points indicated on the QAP.

5.6.6. Inspection and testing before delivery

5.6.6.1. The Engineer or his appointed representative shall be permitted to witness final factory tests of the equipment before delivery will be permitted. Tests shall include but shall not be limited to:

5.6.6.1.1. Checks to determine that the components fully and strictly comply with this specification.

5.6.6.1.2. Full functional tests of all mechanical and electrical components and electrical circuits.

5.6.6.2. The manufacturer shall provide all power supplies, testing equipment, means of simulating related remote devices and competent personnel to conduct the tests.

5.6.6.3. All component parts of the equipment shall be subject to type tests and routine tests in accordance with the relevant SANS, BSI or IEC Standard Specifications.

5.6.6.4. A complete discharge test, as recommended by the battery manufacturer, shall be carried out as part of the commissioning tests and the results shall be submitted in duplicate to the Engineer. An artificial/dummy load shall be provided by the Contractor for the purpose of such a test.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.6.6.5. The complete battery charging unit shall be tested by the contractor at his works, at full load.

5.6.6.6. The manufacturer shall give at least 5 (five) working days notice of readiness for final inspection and factory tests.

5.6.6.7. A list of defects and deviations will be provided by the Engineer on completion of the inspections. The issue of such list does not relieve the manufacturer of his responsibility to ensure full compliance with this specification.

5.6.6.8. All test results shall be recorded on the manufacturer's standard test certificates, 3 (three) copies of which, duly approved, shall be supplied to Rand Water within 1 (one) week of the factory tests being completed.

5.6.6.9. Equipment may not be delivered to site until the manufacturer has cleared all defects listed by the Engineer and the Engineer has re-inspected the equipment to confirm rectification of work on the defect list.

5.7. Delivery, Offloading And Installation On Site

5.7.1. Preparation for delivery

5.7.1.1. The Battery charger and battery cabinet, to be transported to site, shall be wrapped in suitable materials to prevent damage during shipment, both from mechanical and environmental damage.

5.7.2. Off loading

5.7.2.1. This includes the provision of all equipment and apparatus for lifting the battery charger and battery cabinet off the transport vehicle and positioning them in their final installation location. The Contractor shall ascertain the exact position of the battery charger and battery cabinet.

5.7.3. Installation on site

5.7.3.1. Site installation shall include for all suitable skilled labour, lifting apparatus and materials necessary for the complete installation and readying for service of the equipment. It shall include all shims, hold down bolts and nuts.

5.7.3.2. The contractor shall supply, install and terminate a suitably rated armoured cable, from the battery charger to the battery cabinet.

5.7.3.3. The battery charger and battery cabinet shall be rendered vermin-proof after the installation of all cables and other terminations.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.8. Site Inspection And Tests

5.8.1.1. The manufacturer or his appointed agent shall carry out site inspection and tests to determine that the equipment have satisfactorily withstood the effects of shipment and have been properly prepared for service.

5.8.1.2. Testing shall include, as a minimum, full checks on the functioning of mechanical and electrical components and electrical circuitry.

5.8.1.3. Any other tests, which may be required to ascertain the correct functioning of the equipment, shall be completed.

5.8.1.4. Particulars of these tests and checks and their results shall be recorded and incorporated in site reports, three copies of which, duly signed, shall be supplied to the Engineer within one week of the site tests being completed.

5.9. Test Certificates

5.9.1.1. Copies of the test certificates shall be submitted together with the tender.

5.9.1.2. Copies of all other tests, i e routine tests and on-site tests shall be forwarded to the Engineer on completion of the tests.

5.10. Spares

5.10.1.1. The manufacturer shall submit a list of recommended spares with prices with the tender document.

5.10.1.2. Each battery charger shall be supplied with at least 100% spare fuses and consumable items.

5.11. Operating And Maintenance Manuals

5.11.1. Three paper copies and three soft copies, on CD or DVD, of the maintenance and instruction manuals, general arrangement drawings and wiring diagrams are to be provided.

5.11.2. The operating and maintenance manuals shall contain the following information as a minimum:

5.11.2.1. A final schematic diagram with all parts suitably identified.

5.11.2.2. A wiring diagram showing the "as installed" connections.

5.11.2.3. Installation instructions.

5.11.2.4. An instruction manual containing comprehensive instructions for the operation of the battery charger, fault tracing guide and maintenance instructions.

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911

5.11.2.5. A detailed list of parts and equipment incorporated in the battery charger, together with the ratings, part number, type and manufacture, and dimensioned outline drawing.

6. Record of Revisions And Approvals

Rev	Details of revision	Date
0	Draft	30 July 2015

Approvals for this document

Name	Position	Signature
M Haffejee	Acting EAM	

Committee responsible for compilation of this document

Name	Section
Corni Jacobs	ZB - Electrical Maintenance
John Philip	RV- Projects
Koos Van Der Mescht	RV- Electrical Assets
Mehmood Haffejee	RV- Electrical Assets
Robert Leggott	RV- Electrical Assets
Theo Smit	RV- Electrical Design
Walther Schwellnus	RV- Electrical Design

Copyright © Rand Water. All rights reserved. No part of this document may be reproduced or transmitted in any form, electronic, mechanical, recording or otherwise without the prior permission of Rand Water. Contact +27 11 682 0911