Standard Specification

Engineering Standard E-SPE-STD-004 AC Uninterruptable Power Supply (UPS)

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2	19/12/2025	Updated for CMS compliance				
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(Refer Controlled Document in REX for Author, SEM, Owner and Approver details)

Contents

1. Purpose

This document is part of a suite of Seqwater Engineering Standards which are in alignment with the Seqwater Quality Management System. Their purpose is to provide a consistent approach to the development, modification, and management of Seqwater infrastructure that is fit for purpose, economic over the life of the asset, and meets Seqwater's risk appetite and compliance requirements including Work Health and Safety obligations.

This Standard Specification provides the minimum requirements and recommendations for AC Uninterruptible Power Supply (UPS) systems. This standard does not cover requirements of DC UPS systems.

This document must be used in conjunction with the documents it references to assist in ensuring fit for purpose infrastructure. This Standard Specification is not intended to be relied on solely for design, supply, and installation works; advice from specialist engineers and/or manufacturers may be required on a case-by-case basis.

2. Scope

This Standard Specification applies to all Seqwater employees, contractors, suppliers and consultants working for or on behalf of Seqwater unless otherwise stated. It applies to all new assets and to all existing assets undergoing refurbishment or modification. It must be used in conjunction with other relevant Seqwater Engineering Standards and project specific documents to define the technical requirements for infrastructure design and construction.

Where single or discrete components of an existing non-compliant system are to be replaced, refurbished or modified, this standard should not automatically be applied to the entire system retrospectively, however consideration should be given, in consultation with relevant stakeholders, to the extent of the application of the standard outside of the components requiring replacement, refurbishment or modification, to ensure safe, economic, and fit for purpose infrastructure.

Seqwater Engineering Standards include Standard Specifications, Drawings, Procedures, Templates, Forms and Preferred Equipment Lists. Together they detail Seqwater's minimum requirements and recommendations to provide infrastructure that will be fit for purpose, safe, and cost effective to operate and maintain. However, compliance with these requirements and recommendations does not remove, and cannot be relied on as meeting, the designer's overarching responsibility for ensuring infrastructure designed is fit for purpose and safe to construct, operate, maintain, and demolish. The designer must exercise appropriate due diligence to identify and manage hazards so far as is reasonably practicable.

Designers must also ensure compliance with relevant Australian Legislation, Standards, Codes and Guidelines (including those produced by Water Services Association of Australia). Where no Australian Standard exists for a particular application, work must conform to the most current version of an industry accepted international standard.

Deviation from meeting the minimum requirements in this Standard Specification requires written agreement from Seqwater as per the deviation process detailed in Procedure X-PRO-STD-008 Asset Standards Management and Application. That process includes completion of an X-TMP-STD-022 Asset Standards Deviation Request Form together with relevant supporting documentation, and submission by the Seqwater Project Representative to the Seqwater Engineering Mailbox. Where noted in this Standard Specification that Seqwater approval, agreement, or

acceptance shall/must be sought, such approval, agreement or acceptance must be gained through the Seqwater Asset Standard Deviation process, as outlined above.

Responsibility for ensuring compliance with Seqwater Engineering Standards lies with those engaged in the management and execution of design, construction, and modification of Seqwater infrastructure. This includes modifications to the functional design of the infrastructure including technical changes made which would extend an asset outside of its design operating envelope and/or approved operation and maintenance practices.

Any ambiguities or conflicts identified between specific requirements within this Standard and project documents, another Seqwater Engineering Standard or Australian Legislation, Standards, Codes or Guidelines, these must be brought to the attention of the Seqwater Document Owner, via the Engineering Mailbox, for clarification. Where it is proposed to proceed without meeting the requirements of this standard, agreement must be obtained via the Deviation Process, as outlined above.

Seqwater undertakes regular updates of its Engineering Standards. Before utilising this Engineering Standard the complete list of Seqwater Engineering Standards should be reviewed to ensure currency and applicability of standards to be applied to the works. These can be accessed on the Waternet Engineering and Asset Standards page or using the REX Saved Search “Engineering Stds Controlled Documents by CD Owner”.

3. Design Criteria

3.1. Site Climatic Conditions

For information regarding the Site Climatic conditions, refer to Standard Specification - E-SPE-STD-001, Electrical Design and Construction.

3.2. Design Life

The equipment supplied shall have a physical life of at least 10 years before major overhaul or replacement is required. Battery design life of at least 5 years before replacement.

All equipment, excluding batteries and filters, shall be designed for periodic maintenance of greater than 2 years of continuous operation.

3.3. Operating Conditions

UPS systems are to be used to power PLC controller and RIO cabinets, SCADA servers and network cabinets. The UPS supplying process related equipment such as PLCs, RIO and instrumentation shall be separate to UPSs supplying communications equipment, SCADA servers, ICT and corporate network switches located within server racks. Details on UPS systems being mounting within server rack assemblies can be found in SPE-00321 Server Rack Assembly Specification.

UPS systems and associated battery enclosures may be mounted within electrical rooms or within outdoor enclosures.

Unless otherwise specified, climate-controlled rooms will be weatherproof and air-conditioned at an average temperature of 25 °C. UPS systems in climate-controlled rooms must be a minimum of IP42 enclosure rating.

In the event of a room air conditioning system failure, the UPS may be required to operate at reduced capacity for a short period at a maximum room temperature greater than 25 °C. To cater for this, UPSs selected for indoor use shall be capable of operating at 40 °C.

UPS systems in outdoor environments must be within an IP54 (minimum) enclosure. In these situations, the battery enclosure and UPS enclosure are to be designed to suit the site-specific climatic requirements.

Battery cells shall be sized to provide the full output throughout the specified temperature range.

3.4. Availability and Redundancy

UPS systems shall be designed to support the project specific availability and utilisation requirements as per Standard Specification – E-SPE-STD-001 Electrical Design and Construction. The UPS may consist of single (N) or redundant units (N+1) connected in parallel. Specific redundancy requirements will be provided within the project specific documentation.

For redundant systems (N+1), the UPS shall include the two (2) UPSs with a separate battery bank for each UPS. A single external Maintenance Bypass Switch (MBS) shall be provided for the entire system. The systems will be capable of operating in parallel or independently. Under normal conditions the two units will share the load. All components of one UPS system shall be mechanically and electrically separated from the other.

3.5. Electrical System

The UPS shall be suitable for continuous operation from the supply specified and shall not be damaged or malfunction with any of the voltage/frequency variations or voltage transients stated above.

The UPS input supply may be either:

- 3-phase, 400 V +/- 10%, 50 Hz +/-2%.
- 1-phase, 230 V, +/- 10%, 50 Hz +/-2%.

Refer to project specific design for confirmation of input voltages.

The UPS output supply may be either:

- 3-phase, 400 V +/- 10%, 50 Hz +/-2%.
- 1-phase, 230 V, +/- 10%, 50 Hz +/-2%.

Refer to project specific design for confirmation of output voltages.

The earthing system shall be TN-S in accordance with AS/NZS 3000.

4. Technical requirements

4.1. General

The UPS system design shall be such as to minimise the risk of short circuits and shall ensure operational and personnel safety under all conditions of operation, inspection and maintenance.

The UPS shall be a double conversion, online and electronically regulated type utilising solid state equipment. The UPS shall be of the manufacturer's standard design, modified only as required to meet the requirements specified in this Specification.

All parts exposed to voltage higher than ELV within UPS shall be designed with a minimum IP2X degree of protection.

The UPS shall be of floor mountable unit or rack mountable type.

The UPS shall be compliant to AS 62040.1 Uninterruptible Power Systems (UPS) – Part1.1: General and safety requirements for UPS used in operator access areas.

UPSs having a capacity from 0 – 10 kVA shall be capable of being either the pluggable type or permanently connected (hardwired connection using screwed terminals or similar). UPSs having a capacity greater than 10 kVA shall be permanently connected (hardwired connection using screwed terminals or similar).

4.2. UPS System

The UPS shall include, as a minimum, the following items:

- Surge protection Electro-magnetic Interference (EMI) and Radio Frequency Interference (RFI) filters.
- One rectifier/charger.
- One battery bank.
- One inverter.
- One static by-pass facility.
- One external maintenance by-pass switch (MBS).

Following are the technical requirements in addition to the requirements listed above for selecting UPS for various applications:

a. The UPS shall be capable of being connected to the control system for monitoring of status.

b. The MBS shall be a make-before-break bypass switch for maintenance purposes. The MBS shall be separate from the UPS and be suitable for wall mounting adjacent to the UPS. When the manual switch is in the 'Bypass' position, there shall be no hazardous voltages present anywhere inside the UPS cabinet.

c. A three position (UPS / Test / Bypass) MBS shall be provided for all AC UPS systems with a capacity of 6 kVA or larger. The MBS shall be installed such that switch can be operated in any position independent of UPS state.

d. A two position (UPS / Bypass) MBS shall be provided for all AC UPS systems with less than 6 kVA capacity. The MBS shall be installed such that switch can be operated in any position independent of UPS state.

The UPS shall be capable of withstanding a short circuit at its output terminals and shall be capable of returning to normal operation upon removal of the short circuit.

The inverter will current limit to 200 % for enough time to transfer load to bypass without operating internal output protective devices.

All components shall be rated for at least boost charging plus the full load requirements at continuous operation. This shall be for the specified life of the UPS system in the specified ambient conditions.

Isolators and switches shall be rated for at least 150 % of the maximum continuous load rating of the UPS and any short-term overload rating. They shall have load-break, fault make capability and be fitted with ON/OFF indicators.

Electrical protection shall be designed for all major components and to give discrimination under design inrush at all fault conditions.

If the electrical design requires isolation transformers, then the system Neutral at the output shall be earthed as an MEN connection so that the RCD's on the downstream will operate in the event of earth fault or earth leakage.

The UPS output shall be protected by a suitably rated circuit breaker or fuses.

The UPS shall incorporate the overload and short circuit protection in each of the charger and by-pass supplies. The protection shall be designed with consideration for the following situations:

- From no load to rated load.
- Over the power factor range stated.
- With DC voltages over the range from battery boost charge to the battery discharged condition.

4.3. Harmonics

The Total Harmonic Distortion (THD) shall be less than 5 % when at 100 % load.

The harmonic distortion generated at the input of the system shall be of sufficiently low level so that it will not cause problems to the operation of other electrical equipment within the installation. Systems with total current harmonic distortion content more than 5 % (at 100 % load) shall not be accepted, unless a filter, providing attenuation of the 5th and higher harmonics, limiting the total current harmonic distortion content. Harmonics in the mains supply caused by the equipment shall not exceed the limits specified in AS 61000.

Electromagnetic compatibility shall conform to AS 62040-2 2nd Ed (Cat 2 – Table 6)

4.4. Noise

The audible noise level of each UPS module with 100 % load shall be lower than 65 dBA at 1 m from the equipment.

4.5. Circuit Voltage Drop

The UPS system shall be designed to supply the full rated inverter input together with all its auxiliaries for a minimum period of the backup time at rated capacity specified in the data sheet with a maximum voltage drop of 2 % below the rated output voltage at the output terminals during that period.

4.6. Radio Frequency Interference

Radio frequency interference from equipment shall not exceed the limits specified in AS/NZS CISPR 14.1.

Externally produced electromagnetic fields having intensities of 10V/m in the frequency range 27 - 500 MHz shall not cause any spurious malfunctions or variations in the specified performance of the UPS.

4.7. Operating Modes

4.7.1. Normal Mode

Under normal operation the load shall be continuously supplied by the inverter. The rectifier/charger shall be powered from the commercial AC mains source and shall supply DC power to the inverter while simultaneously float-charging the battery.

4.7.2. Emergency Mode

Upon loss of the primary AC source, the UPS load shall continue to be supplied without interruption by the inverter obtaining its power from the battery. The nominal system voltage and frequency shall be maintained.

4.7.3. Recharge Mode

Upon restoration of the primary AC source, the rectifier/charger(s) shall power the inverter(s) and simultaneously recharge the battery supply at the rate determined by the rectifier/charger(s) capacity and the battery voltage. The battery chargers shall be sized to carry 1.2 times the rated maximum load plus charging fully discharged batteries to 80% of the nominal load within 8 hours. This shall be an automatic function causing no interruption of power to the load.

4.7.4. Static Bypass Mode

For continuity of power in the event of inverter malfunction, the static transfer switch shall automatically transfer the UPS load to the bypass AC source. In the case of two inverters, this transfer shall only take place on the failure of both the inverters.

Transfer of the load from the bypass supply to the inverter supply shall be initiated manually following an automatic transfer of the load from the inverter supply to the bypass supply. An alarm shall be given upon automatic transfer to the bypass supply.

Details on the triggers for load transfer are given in section 4.11.

4.7.5. Maintenance Bypass

A MBS shall be provided to allow the UPS to be removed from service for maintenance without any interruption to the supply. When on maintenance bypass, it shall be possible to remove the charger, battery, inverter, or static bypass switch for maintenance without interruption of supply. The bypass supply shall be from an external connection point on the MBS enclosure.

Information or signage shall be supplied identifying the process for utilising MBS. The process will typically entail the following but needs to be tailored to suit the selected unit:

- Taking UPS out of service:
    - Use front keypad of UPS to put it into ‘Static Bypass’ mode.
    - Switch MBS from ‘UPS’ selector to ‘Bypass’ selector.
    - Disconnect UPS and remove from service for maintenance.
- Putting UPS back into service:
    - Reinstate UPS into service position with MBS on ‘Bypass’ selector.
    - Turn on UPS and use front keypad of UPS to put it into ‘Static Bypass’ mode.
    - Switch MBS from ‘Bypass’ selector to ‘UPS’ selector.
    - Use front keypad of UPS to put it into ‘Normal’ mode.

This process is critical to ensure there is continuity of supply throughout the procedure without connecting unsynchronised outputs from the mains and UPS together.

The arrangement and procedures for maintenance of UPS systems operating in parallel needs to be defined on a case-by-case basis. The system needs to have a procedure in place such that a single UPS can be placed in maintenance mode without connecting mains to the output of the parallel UPS. This can be achieved by isolating the mains supply to the UPS being maintained and then placing the UPS in maintenance mode.

Details on the MBS are given in section 4.12.

4.7.6. Battery Maintenance Mode

If the battery is taken out of service for maintenance, the UPS shall continue to operate and meet all specified performance criteria except for the reserve time capacity.

4.8. Rectifier/Charger

The rectifier/charger shall be a constant voltage, current limiting, and self- regulating, static semiconductor type and shall be sized to supply the fully loaded inverter dc input current as well as to recharge the battery. All rectifiers shall be full wave rectifiers. All controllable rectifiers shall be of the fully controlled type.

All rectifiers shall provide harmonic elimination either by using Power Factor Correction (PFC) type controlled active rectifiers or by use of separate filters.

Each rectifier/charger shall be provided with an input circuit breaker or protective fuses, and surge suppressors to protect against supply side switching transients.

The rectifier/charger output (voltage regulation and AC ripple) shall be compatible with the battery requirements in every respect. The DC voltage ripple shall be 1% or better.

Both rectifier/charger and inverter shall be protected against reversed battery polarity.

Protection shall include over-voltage surge protection and current limiting circuits, to allow charging at flat batteries, and to prevent damage to the rectifier/charger or batteries in the event of short circuit of the rectifier output.

Output regulation shall provide a maximum ripple output of +10% of voltage and maintain a charging voltage accuracy of ±1% for both booster and float charging. Boost and float charges voltages to be consistent with voltages recommended by the battery manufacturer.

Output capacity shall be sufficient to supply the fully loaded inverter and simultaneously recharge the battery bank within 15 times the discharge time.

The maximum earth leakage shall be limited to below 30 mA for UPS systems up to 10 kVA and 100 mA for UPS systems 10 kVA and larger.

High DC voltage alarm and charger shutdown alarms shall be provided.

4.9. Batteries

4.9.1. Rating

The battery shall be sized to supply the full rated inverter input together with all of its auxiliaries for a minimum period of the backup time i.e. to provide at least 2 hours operation without supply from the mains (at full rated UPS capacity) at rated capacity specified in the datasheet unless otherwise specified, for an adjusted design life of 5 years. The design life shall be adjusted for the UPS's installation environment and associated temperature degradation of the batteries

4.9.2. Isolation

Each battery bank shall have a double pole circuit breaker for isolation in both the positive and negative supply. Isolation facilities shall be mounted as close as possible to the battery terminals.

4.9.3. Battery Cells

The battery shall be supplied with the UPS. Preference shall be given to designs with ergonomic access to batteries.

Battery cells shall be:

- Sealed maintenance free VRLA Gel or AGM type.
- Nickel Cadmium (not applicable to rack mounted UPSs)

For rack mounted UPSs, batteries shall be supplied as separate rack mountable enclosures.

For UPS systems with standalone battery enclosures, batteries shall be housed in free ventilated cubicles. Preference will be given to designs where there is a common charger/inverter, and the output and the number of batteries used determines time rating of the system. Each battery shall comprise a group of cells connected in series to give specified nominal voltage. Wet cells shall have transparent thermoplastic containers to permit easy checking of the electrolyte levels and explosion-resistant vent caps shall be provided. All cells shall be made of flame-retardant material of high impact strength.

The battery installation shall be in accordance with AS 3011, and AS 2676.2.

Ventilation calculations shall be completed as per AS 2676.2 to demonstrate hydrogen release is within tolerable limits and does not create a potentially hazardous atmosphere due to hydrogen release.

Battery cells shall have individual numbers on the battery container or rack. Batteries shall be provided with all intercell connectors, bolts, nuts, washers and terminal grease. Bolted connections shall be provided for intercell connectors.

Batteries shall have all live surfaces insulated or shrouded to avoid accidental contact with intercell connectors.

Battery section isolation facilities shall be provided where required, in accordance with AS 3011.

Batteries shall be supplied filled with electrolyte and fully charged with a minimum shelf capacity of 6 months without detrimental of charge or capacity when stored at 25 °C and 3 months without detrimental of charge or capacity when stored at 30 °C.

Batteries shall have a minimum design life of 5 years at 25 °C from installation. The batteries shall be classified as “High Performance”. The aging factor shall be 25%.

Battery systems shall be sized based on full kW load rating listed on the data sheet(s) and required battery backup time.

Site acceptance test of batteries shall be carried out to verify the battery condition and test results to be produced.

4.9.4. Battery Storage

Batteries shall be stored indoors and in a dry, clean, free from vibration, cool location with a temperature of 0 °C to +30 °C and well ventilated on open shelves protected from direct sunlight or expose to excessive heat.

4.10. Inverter

The inverter shall continue to supply the load without any change in the supply upon

mains supply failure.

The inverter shall be a self-commutating solid-state static unit with electronic voltage regulation. The output shall be sinusoidal. It shall be possible to start up the inverters with power only available from the associated batteries.

The inverter output voltage transient response for any of the following disturbances shall not be more than 5 % under the following conditions:

- A step load change of 100%.
- Switch to by-pass or return from by-pass.

The inverter output frequency shall be normally and automatically synchronised and phase locked to the bypass AC source over a selectable frequency range. The inverter shall revert to its internal frequency control when outside these limits, and shall not be synchronised with the bypass circuit.

The inverter is to be capable of withstanding a short circuit on the output without incurring any damage to any component in the UPS. After removal of the short circuit, the inverter is to immediately return to normal operation.

The inverter shall be current limited to a maximum of 200 % of rated output in the event of a load fault. For overloads of 125 % or higher on UPS systems 10 kVA or larger, the static switch shall transfer and latch the load to the by-pass source if it is available in order to prolong the lifespan of the inverter equipment. If the bypass source is not available, the inverter shall supply the following overloads without sustaining damage. The inverter shall shutdown if overload limits are exceeded:

- 1 min - 125% of UPS full load output
- 10 s - 150% of UPS full load output
- 500 ms - greater than 150% of UPS full load output

The inverter shall be capable of operating without the battery connected and meet all the specified performance criteria.

The inverter shall be supplied with input and output circuit breakers or fuses.

Low voltage cut-out is to be provided. The inverter is to operate with battery voltage down to a point where further discharging will harm the batteries. The inverter is to shutdown at this point until the battery voltage is raised above the cut-out level.

Input over-voltage protection to the inverter input stage is to be provided.

4.11. Static Transfer Switch

During normal operation, the inverter output will be connected to the load through the static transfer switch. The static transfer switch shall automatically transfer the UPS load from the inverter to the bypass AC source, with no more than 10 ms interruption of power to the load.

Automatic transfer of load to static bypass supply shall be initiated when:

- Inverter output voltage falls below 95% of nominal output voltage.
- Inverter output exceeds 105% of nominal output voltage.
- Inverter output current limit is exceeded (load current exceeds overload rating and time).
- Inverter failure.
- Battery discharge voltage limit reached.
- Manual initiated from UPS panel.

Transfer of load from inverter supply to static bypass supply shall only be possible when:

- Mains voltage is within 15% of rated UPS output voltage.
- Mains frequency is within acceptable tolerances.
- Inverter and mains voltages are synchronised.

Transfer of load from static bypass supply to inverter supply shall only be possible when:

- Inverter output voltage is within 3% of the nominal output voltage for more than 5 seconds.
- Inverter and static bypass circuit voltages are synchronised.

The static transfer switch shall be inhibited from transferring the load to the by-pass AC source when the by-pass AC source voltage is not available.

Front panel indicators shall be provided to indicate that the static switch is supplying the load from the inverter or the by-pass AC source.

If transfer was due to inverter failure, battery discharge limit, or was manually initiated, the static transfer switch shall latch into bypass and require a manual transfer to return to inverter supply.

Load transfer switching devices shall be continuously rated static elements in both inverter and bypass circuits.

4.12. Maintenance Bypass Switch

The MBS shall be manually operated make-before-break type and continuously rated at 150 % of the UPS output rating. The MBS shall be make-before-break in both directions. It will operate as a fault make/load break type.

The MBS shall be capable of withstanding an 800 % surge for at least 20 ms without damage.

The MBS is to be lockable in all positions to allow maintenance access to the UPS.

For UPS systems up to 10 kVA, the MBS may be an integral type unit. If this facility is not available for the selected UPS, then the MBS is to be housed in a separate enclosure to the UPS to allow for disconnection and removal of the UPS without interruption to supply or the need for any temporary connections. This enclosure shall have an IP rating suitable for the installation environment.

For UPS systems 10 kVA or larger, the MBS is to be housed in a separate enclosure to the UPS to allow for disconnection and removal of the UPS without interruption to supply or the need for any temporary connections. This enclosure shall have an IP rating suitable for the installation environment.

Whenever, there is a changeover from Maintenance bypass to UPS, an interlock to be provided to the UPS, so that the UPS is ready by synchronising with the Mains.

Suitable instructions and caution labels for operation of the switch shall be mounted adjacent to the MBS.

4.13. Instruments and Alarms

All controls, indication, meters and fasciae shall be flush mounted on the front panel and shall demonstrate in a comprehensive manner the status of all major UPS items continuously.

Ammeters on the output shall be of a type that suits the output waveform anticipated.

Each alarm shall be supplied with local indication (annunciator or individual LED) and communications to a remote control location via Ethernet/IP.

4.13.1. Status Indications

The UPS shall be capable of providing the following indications and alarms to the control system:

- Status Signals
    - Load on Inverter supply.
    - Load on Static Bypass supply.
    - Inverter on Battery supply.
    - MBS in UPS position.
    - MBS in Test position (where applicable).
    - MBS in Bypass position.
    - Mains supply available.
- Fault signals:
    - UPS Battery Low.
    - UPS Fault (for smaller systems this will be inclusive of any fault i.e rectifier/charger fault, inverter fault, inverter overload however additional signals may be required on larger systems as per project specific requirements).
    - UPS On Battery.
    - UPS On Bypass

The indications and alarms can either be hardwired to the PLC or can be made available through communication protocols between UPS and PLC system. As a minimum, the unit shall be capable of TCP/IP or SNMP. Refer to project datasheet for specific requirements. The UPS shall include a facility to hardwire the following signals:

- UPS On Battery.
- UPS Battery Low.
- UPS Fault.

A LCD panel shall be located on the front of the UPS and illustrate the power flow through the unit.

Fault alarms shall be hand reset. A first failure feature shall be provided.

Battery system DC earth fault protection and alarm facilities shall be provided where required, in accordance with AS 3011.

4.13.2. Local Controls

The following control facilities shall be provided as a minimum:

- Rectifier on/off control switch.
- Inverter on/off control switch.
- Manual load transfer control switch.
- Rectifier input isolation switch.
- Inverter output isolation switch.
- Battery isolation switch.
- Battery test facilities shall be provided.

4.14. Construction

4.14.1. General

The UPS shall be entirely built and tested in the works of a manufacturer where regular assembly of UPS systems takes place.

The UPS system shall include all required equipment to ensure the integrity and reliability of the system.

Personal protection complying with AS/NZS 3000 Clause 1.7 shall be included.

All insulation materials shall be non-hygroscopic.

The equipment shall allow the removal of components without special tools. The design shall be such as to facilitate rapid repair/replacement.

4.14.2. Enclosures

4.14.2.1. General

The UPS and associated equipment enclosures shall be suitable for indoor or outdoor service. UPS and battery enclosures must be vermin/insect proof.

Cooling shall be by natural convection, or fan forced and suitable for installation location.

The enclosure shall provide a degree of protection of not less than IP42, in accordance with AS 60529. The floor shall not form part of the enclosure. The electronics compartment shall be completely segregated from the battery bank enclosure to prevent hydrogen gas emission from batteries entering the electronics compartment.

Panels shall be provided with gland plates or cable clamps for entry of cables. All power cables shall enter from the bottom of the UPS unless specified otherwise in the Project Documentation. Gland plates shall be made of 6 mm thick brass and shall be earthed directly to the earth bar. Gland plates for external cables shall have adequate space for gland accommodation and be removable. The plates shall be suitable for and shall be located to provide ease of access for terminating the required size and type of cable and shall be of sufficient section to provide mechanical support. Sufficient space shall be provided for the glanding, spreading, routing and termination of field cables.

Equipment and components shall be supported from mounting pans and shall not be mounted on the walls of the enclosure. The location and grouping of components shall permit easy identification and access for operational, maintenance and repair purposes. Suitable barriers between individual items or shrouding of live terminals shall be provided to allow adjustment and inspection to be carried out safely.

All low voltage (LV) exposed parts within the enclosure shall have a minimum IP2X degree of protection.

Cable entry shall be through gland plates and provision shall be included for cable support and IP2X termination of all cables. Terminals shall be labelled and for voltages over Extra Low Voltage (ELV) shall be covered with shrouds labelled with the warning of the voltage.

The enclosure and all switches shall be labelled with a description of their purpose, the point of isolation of the bypass supply and clear instructions for the use of the maintenance by-pass switch must be included on the escutcheon panel. A warning label must be included on the front door regarding the two sources of power supply within the enclosure must be included.

4.14.2.2. Battery enclosure or Room

Battery enclosures shall be naturally ventilated to disperse any gaseous products. The battery bank shall be positioned so that possible leakage of electrolyte or emission of gaseous products shall not cause damage to other equipment or create potentially explosive atmospheres.

Battery enclosures must be suitably sized for battery size and weight.

Batteries shall be arranged such that any cell can be removed without disturbing other cells.

Hydrogen emissions for VRLA batteries shall be calculated in accordance with AS 2676.2 and a suitable ventilation system implemented to meet the requirements of AS3 3011 and AS 2676.2. This may require the installation of additional ventilation equipment, such as fans etc. In the event a fan is required, an air flow sensor shall be installed to initiate an alarm should the ventilation fan be inoperative. Where battery enclosures are indoors, the exhaust shall be piped outside of the room.

The average hydrogen concentration by volume in a battery room or enclosure shall be maintained below 2 %.

4.14.2.3. Maintenance Bypass Switch enclosure

MBS enclosures shall be minimum IP42, wall or floor mounted. The enclosure front door will be fitted with securing mechanism as per Standard Specification – E-SPE-STD-001 Electrical Design and Construction, escutcheon panel behind and gear mounting behind the escutcheon panel. Cut-outs will be made in the escutcheons suitable for presenting switches and circuit breakers, no cut-outs will be made in the front door.

4.14.2.4. Earthing

A safety earth rail with suitable number of earthing bolts or screws shall be provided in a position close to the external cable gland plate to facilitate termination of cable earth conductor, earth braids and earthing of all metalwork, in accordance with AS/NZS 3000. Individual connections for all earth wires shall be provided.

4.14.3. Wiring

Unless otherwise stated, all wiring related to the UPS system shall comply with the Standard AS 620401.1 and E-SPE-STD-001.

4.14.4. Terminal Strips

Separate terminal strips shall be used for AC and DC connections.

Only one conductor per terminal is permitted unless agreed with the Seqwater Electrical Subject Matter Expert.

Wiring terminations at different voltages and of different systems shall be segregated and clearly marked. Terminals shall be numbered, rail mounted, tunnel type, minimum 4 mm² and sized for the conductors to be terminated.

Terminal blocks shall be supplied and clearly marked for wiring that will be installed by others. The Contractor's wiring for external connection shall be terminated to one side of terminal blocks.

4.14.5. Busbars

Busbars where applicable shall be covered with insulation, alternatively busbars shall be protected from inadvertent contact to a minimum standard of IP2X (finger-proof). Power supply terminals and terminals live from outside sources shall be shrouded (guarded).

4.14.6. Nameplates and Labels

In addition to the manufacturer nameplate, the UPS shall be identified with a UPS nameplate with the equipment number. The MBS enclosure shall be identified with a nameplate and instructions on how to place the system in maintenance bypass mode using the external MBS.

A rating plate with the data specified in AS 4044 and AS 60146 shall be provided on the UPS. Refer to Standard Specification – E-SPE-STD-001 Electrical Design and Construction.

Each electrical component shall have a label fitted alongside, with description or item number and any significant data. Battery nameplates shall also include battery voltage and type.

Nameplates shall be fitted at each UPS main assembly and shall include the following:

- Name and manufacturer, and year of manufacture.
- Type of equipment.
- Input and output ratings, voltage, phases and frequency.
- Maximum short circuit current.
- Purchase order number.
- Manufacturer's serial numbers.
- Equipment Number.

Danger/warning labels shall have white lettering on a red background. All other labels shall have black lettering on a white background. All labels shall meet requirements of AS 1319.

Termination points for all wiring brought to the UPS from an external power source shall be identified by means of a label with 6 mm high lettering as follows:

"240 V or 400 V AC ISOLATE ELSEWHERE"

Where "230 V or 400 V AC " shall be defined as the voltage the equipment is normally energised at, "ELSEWHERE" shall be defined as the source of supply i.e. substation and when fed from a circuit breaker or fuse, the distribution board and circuit number.

Warning labels to be provided where multiple sources of supply i.e. substation and when fed from a circuit breaker or fuse, the distribution board and circuit number for dual UPS or redundant UPS configuration.

4.14.7. Finish

The colour and finish of enclosures shall be X15 orange in accordance with AS 2700.

There is no specific colour needed for off the shelf UPS.

4.14.8. Accessories and Special Tools

No special tools shall be required for operating, maintaining or testing the equipment by Site personnel.

5. Inspection and Testing

Each UPS shall be factory acceptance tested in accordance with the manufacturer's standard factory acceptance testing specification, any project specific requirements and in accordance with Table 3 of AS IEC 62040.3, 2012.

All type tests in accordance with referenced standards shall have been carried out on similar equipment. When appropriate type test certificates do not exist, the tests shall be made at the time of manufacture of the equipment to which this specification refers and shall be separately priced in the quotation.

The Supplier shall perform all standard routine tests in accordance with the referenced standards and the Contract.

The Supplier shall provide evidence of satisfactory completion of all routine tests and shop inspection in accordance with the General Conditions.

Tests shall be performed on complete assembled items under electrical conditions equivalent to those specified for the Site. Test results shall be extrapolated to allow for the specified Site environmental conditions.

As the batteries sourced from a different factory they shall be inspected and tested separately in accordance with the manufacturer's standard. UPS's shall be tested without the supply batteries in accordance with the manufacturer's standard factory acceptance testing by simulating the battery.

6. Preparation for Transport

The equipment shall be shipped in the largest practical sections whilst permitting ease of handling for transportation and installation.

Each shipping section shall be provided with supports in the form of steel sections, lifting eyes etc. to maintain alignment of parts during shipping, handling, hoisting and installation. Location of lifting points shall be clearly marked on all shipping containers and on drawings. Each shipping section shall have its weight and centre of gravity clearly marked on the container.

Preparation for shipment shall protect the component parts against corrosion, dampness, breakage or vibration injury during transportation and installation.

Each shipping container shall be identified with the contents, purchase order number and item number.

Where equipment must be split for shipping, instructions shall be provided for reassembly. Materials and special tools shall be provided if necessary for reassembly at Site.

All batteries shall be packed and transported in a matter which precludes the creation of sparks or generation of dangerous quantity of heat. The following additional safety precautions shall be taken:

- Provide "spark proof" covers for terminals.
- Provide instructions on the safety issues involved with batteries in transport.

7. Definitions and Abbreviations

Table 1 Definitions and Abbreviations

Term	Definitions
AC	Alternating Current
AGM	Absorbent Glass Mat
AS/NZS	Australian / New Zealand Standard
CISPR	International Special Committee on Radio Interference
Contractor	An entity engaged by Seqwater to undertake work in accordance with an agreed contract with a defined scope of work.
CMS	Seqwater Content Management System
DC	Direct Current

Term	Definitions
ELV	Extra Low Voltage (AS/NZS 3000 definition)
EMI	Electro-magnetic Interference
Employees	Means persons employed directly by Seqwater in a permanent, temporary or casual capacity.
Fit for purpose	Suitable for the intended purpose and meets the performance requirements set out in this standard and other project documents.
IEC	International Electrotechnical Commission
IP	Ingress Protection
LCD	Liquid Crystal Display
Leader	Means any Level 1, 2, 3 and 4 Leader with responsibility for managing a functional area of the business, including people management responsibilities within their functional area.
LED	Light Emitting Diode
LV	Low Voltage (AS/NZS 3000:2018 definition)
Manufacturer / Supplier / Vendor / Original Equipment Manufacturer (OEM)	The entity that manufacturers or supplies equipment to meet the specifications of the Contractor.
MBS	Maintenance Bypass Switch
MEN	Multiple Earth Neutral
Owner / Principal / Seqwater	The entity that engages the Contractor to undertake the work and takes custody of the outcome. The Owner may delegate responsibilities to other entities to act on its behalf (e.g. a consultant).
PFC	Power Factor Correction
PLC	Programmable Logic Controller
RCD	Residual Current Device
REX	Seqwater Electronic Document and Records Management System.
RFI	Radio Frequency Interference
SCADA	Supervisory Control and Data Acquisition
Seqwater Approval / Agreement / Acceptance	Written sign-off gained via the deviation process, as detailed in X-PRO-STD-008 Asset Standards Management and Application Procedure.
Seqwater Engineering Standard	Includes Standard Procedures and Standard Specifications and associated supporting documents such as Standard Drawings, Guidelines, Lists, Datasheets, Manuals, Registers, and Templates.
shall / must	Indicates a mandatory requirement.
should	Indicates a recommendation.
THD	Total Harmonic Distortion
UPS	Uninterruptible Power Supply
VRLA	Valve Regulated Lead Acid

8. Roles and Responsibilities

Table 2 Roles and Responsibilities

Role	Responsibility
Leaders	In addition to the responsibilities of a worker, ensure compliance with this Standard Specification by those they lead.
Workers / Employees	Be aware of and comply with this standard specification

9. References and Related Materials

The documents listed in Table 3 below, and the requirements therein, are relevant to this Standard Specification In their latest editions, these documents form a part of this document. Note that this is not an exhaustive list of documents relevant to the works.

Seqwater undertakes regular updates of its Engineering Standards. Before utilising this document, the complete list of Seqwater Engineering Standards should be reviewed to ensure currency and applicability for the proposed works.

Table 3 References and Related Material

Description	Location
AS 2676 Installation, maintenance, testing and replacement of secondary batteries in buildings. Part 1: vented cells & part 2: sealed cells.	Intertek Inform
AS 2700 Colour standards for general purposes	Intertek Inform
AS 3011 Electrical installations – secondary batteries installed in buildings – part 1: vented cells & part 2: sealed cells.	Intertek Inform
AS 4044 Battery chargers for stationary batteries	Intertek Inform
AS 60146 Semiconductor converters all parts	Intertek Inform
AS 60529 Degrees of protection provided by enclosures for electrical equipment (IP Code)	Intertek Inform
AS 62040.1 Uninterruptible Power Systems (UPS) – Part1: Safety requirements (IEC 62040-1	Intertek Inform
AS IEC 60622 Secondary cells and batteries containing alkaline and other non-acid electrolytes	Intertek Inform
AS IEC 62040.2 Uninterruptible Power Systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements	Intertek Inform
AS IEC 62040.3 Uninterruptible Power Systems (UPS) – Part 3: Method of specifying the performance and test requirements	Intertek Inform
AS/NZS 3000 Electrical installations (known as the Australian/New Zealand wiring rules)	Intertek Inform

Description	Location
AS/NZS 3008 Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions	Intertek Inform
AS/NZS 3017 Electrical installations - Verification guidelines	Intertek Inform
AS/NZS 4029.2 Stationary Batteries – Lead Acid – Valve Regulated Type	Intertek Inform
AS/NZS 4836 Safe Working on low-voltage and extra-low voltage installations and equipment	Intertek Inform
AS/NZS 60269.1 Low-Voltage fuses - General requirements	Intertek Inform
AS/NZS 60269.4 Low-Voltage fuses - Supplementary requirements for fuse-links for the protection of semiconductor devices	Intertek Inform
AS/NZS 61000 Electromagnetic compatibility (EMC) [note: supersedes AS 2279 disturbances in mains supply networks]	Intertek Inform
AS/NZS CISPR 14.1 Electromagnetic compatibility - part 14.1: requirements for household appliances, electrical tools and similar apparatus - emission	Intertek Inform
IEEE 485 Recommended practice for sizing lead acid batteries for stationary applications	Intertek Inform
PRO-01617 X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance	REX
PRO-01872 X-PRO-STD-002 Engineering Drawing Number Procedure	REX
PRO-01873 X-PRO-STD-001 Asset Standards Documentation Classification and Naming Structure	REX
PRO-01874 X-PRO-STD-004 Development and Review of Asset Standards	REX
PRO-02140 X-PRO-STD-013 Engineering Technical Hazard Study	REX
PRO-02187 X-PRO-STD-007 Drawing and Spatial Data Standards	REX
PRO-02190 X-PRO-STD-006 Equipment Numbering and Naming Convention	REX
PRO-02205 X-PRO-STD-008 Asset Standards Management and Application	REX
PRO-02234 X-PRO-STD-015 Management of Change – Technical	REX
REG-01074 X-LST-STD-001 Seqwater Preferred Equipment Register	REX
SPE-00321 Server Rack Assembly Specification	REX
SPE-00342 I-LST-STD-001 Control Systems Prescribed Equipment	REX
SPE-00352 Engineering Standard Electrical Design and Construction	REX
SPE-00361 Engineering Standard Control Systems Design and Construction	REX
TEM-00224 Asset Standards Deviation Request Template	REX
TEM-00304 AC Uninterruptable Power Supply (UPS)- Datasheet	REX

10. Changes from previous version

This Standard Specification will be regularly reviewed in accordance with the requirements of the Seqwater Controlled Document Management Procedure. Reviews will include consideration of suggestions for alteration or improvement made in accordance with Seqwater Procedure X-PRO-STD-004 Development and Review of Asset Standards. Changes made from the previous version are summarised in Table 4 below.

Table 4 Changes from previous version

Section Number	Change
All	Rewritten to align with new Seqwater Engineering Standard Specification Template.
All	Minor grammar and formatting corrections.
All	Compliance check for latest Seqwater standards and external standards
4.13.1	Aligned fault signal wording the same as I-SPE-STD-013 alarm table.