

Table of Contents

- 1. ABRREVIATIONS & DEFINITIONS 3
 - 1.1 Abbreviations 3
 - 1.2 Standards and Specifications 4
- 2. BACKGROUND 5
- 3. SCOPE 6
- 4. MAIN OBJECTIVES..... 8
- 5. SITE AND EXISTING SERVICES 9
 - 5.1 Sites 9
 - 5.2 Existing Services 9
 - 5.3 Site Tidiness 9
- 6. SITE AND EXISTING SERVICES 11
- 7. PRODUCT SPECIFICATION 12
 - 7.1 UPS System 12
 - 7.2 Batteries 21
- 8. PRODUCT SPECIFICATION 23
- 9. DRAWINGS AND DOCUMENTATION 24
 - 9.1 Tender Stage 24
 - 9.2 Award Stage 24
 - 9.3 Installation Stage 24
 - 9.4 Handover Stage 25
- 10. TESTING & COMMISSIONING 26
 - 10.1 Factory Acceptance Test (FAT) 26
 - 10.2 Prior to Final Testing & Commissioning 26
 - 10.3 Final Testing & Commissioning and Handover..... 26
- 11. PROGRAMME OF WORKS..... 28
- 12. TRAINING..... 29
- 13. WARRANTY 30

Table of Figures and Tables

- Figure 1..... 10

- Table 1..... 4

Table 2..... 4
Table 3..... 9
Table 4.....21

1. ABBREVIATIONS & DEFINITIONS

1.1 Abbreviations

ABBREVIATIONS	DEFINITIONS
AR	Apparatus Room
AC / AC	Air-conditioning / Alternating Current
BOC	Book of Circuits
BOQ	Bills of Quantities
CB	Circuit Breakers
CPU	Central Processing Unit
CSE	Chief Signal Engineer
CTC	Centralised Traffic-control Centre
Cu	Copper
DC	Direct Current
DTS	Data Telecom System (Cloud)
ECSA	Engineering Council of South Africa
FAT	Factory Acceptance Test
HMI	Human Machine Interface
I/O	Input / Output
kVA	kilo volt-ampere
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LV	Low Voltage
NC	Normally Closed
NO	Normally Open
PRASA	Passenger Rail Agency of South Africa
RES	Regional Engineer (Signals)
RM & TCC	Rail Management & Train Control Centre
SANS/SABS	South African National (Bureau of) Standards
SAT	Site Acceptance Test
SER	Signal Equipment Room
SIL	Safety Integrity Level
TE	Test Engineer
UPS	Uninterruptable Power Supply
VRLA	Valve Regulated Lead Acid
WC/WCR	Western Cape / Western Cape Region

Table 1

1.2 Standards and Specifications

Standard/Specification	Description
EN 62040 – 1	EN 62040, Uninterruptible power systems (UPS) – <i>Part 1: Safety requirements</i>
EN 62040 – 2	EN 62040, Uninterruptible power systems (UPS) – <i>Part 2: Electromagnetic compatibility (EMC) requirements</i>
EN 62040 – 3	EN 62040, Uninterruptible power systems (UPS) – <i>Part 3: Method of specifying the performance and test requirements</i>
SANS 10142	The wiring of premises – <i>Part 1: Low-voltage installations</i>
CSE 1154_001_CAT_E48	<i>Environmental specification for spoornet railway signalling systems</i>
CSE 1155_500_CAT_N48	<i>Electrical signalling installation specification for testing of signalling installations</i>

Table 2

2. BACKGROUND

PRASA Western Cape Region makes use of a modern electronic interlocking signalling system for safe movements of trains across its rail network. The new interlocking system was supplied and commissioned on between 2018 – 2020 in phases, fully equipped back-up power systems for safety critical signalling loads.

The back-up power systems make use of various topologies across the Region however bulk of the installations are modular UPS systems inclusive of a battery cabinet equipped with 40x maintenance free batteries in various sizes and amp-hour ratings.

With some of the systems being non-functional for more than a year and with COVID-19 lockdown restrictions, acts of vandalism on the main power supply infrastructure have risen, therefore leaving the system extremely vulnerable. Ongoing vandalism continues while parts of the systems are offline due to initial vandalism and inability to restore the system due to the massive damaged caused by perpetrators on the infrastructure.

The unavailable or continuous interruptible power feeds to the load and UPS has led to batteries not being able to fully charge to its full capacity and draining the stored capacity faster than it was designed for. This quick and fast drainage of batteries and inability of not achieving full charge capacity has led to battery banks failing to maintain loads for 2 hours as it was designed for.

3. SCOPE

Rehabilitate back-up power system by replacing the discharged faulty battery bank with like for like battery back-up at sites specified in this RFQ.

Replace existing modular UPS including VRLA batteries with enhanced UPS capable of charging lithium-ion batteries external lithium-ion battery bank.

See Annexure A at the end of this document for the schedule of drawings and revert to the As-Built design drawings related to the UPS systems.

The entire bid includes the complete rehabilitation and upgrades of existing UPS systems and battery back-up systems at various locations and rooms for signalling applications which includes, supply, delivery, installation, functional testing, commissioning and handover in proper working order of the entire back-up system as specified in this specification.

NOTE: Tenderers to quote rates for consumables, wiring and sundries to complete the installation of such works.

With the above being said, this tender calls for the procurement, replacement/repairs, upgrade, supply, deliver of a UPS with batteries and the testing and commissioning of the complete UPS and lithium-ion battery back-up systems, as per the BOQ, technical specifications and design drawings.

The works for this installation includes:

- 3.1** Supply, install and commission an enhanced 3Ø UPS capable of handling lithium-ion batteries system complete as per the design drawing requirements.
 - Replace underperforming 3Ø modular range UPS machines.
 - Configure new UPS operations to allow for continuous loadshedding occurrences where possible
- 3.2** Supply, install and commission Lithium-Ion battery bank to the enhanced UPS via the external battery cabinet as per the design drawing requirements.
- 3.3** Supply, install and commission new VRLA battery bank to the existing modular UPS via the external battery cabinet as per the design drawing requirements.
- 3.4** Decommission and handover existing UPS units complete.
 - Decommission existing UPS units and batteries (useable/functional)

- Create a pool of spare fully functional UPS units of those that were decommissioned to rehabilitate or replace faulty units at other sites
- Dispose existing battery banks via the standard battery disposal protocols

The following broadly defined work breakdown structure are as follows:

- Making safe and removal of the existing indoor installations.
- Removal off-site of materials and plant and return to PRASA's Salt River site in Cape Town.
- Re-use of existing installations, material, equipment and services elsewhere required.
- Re-use of existing signalling, power, telecommunications fibre and cable infrastructure where necessary.
- Making use of special plant and machinery for equipment and UPS installations
- Wire count tests and SAT including hardware where required.
- Labelling, notices and signage.
- Earthing and bonding of metalwork.
- Carrying out of tests and submission of test records and certificates.
- Maintenance & Guarantees.
- Training
- Complete on AutoCAD As-Built drawings where changes were implemented

4. MAIN OBJECTIVES

- 4.1** The main aim of this project is to restore the signalling systems back-up power back to its design requirements and better.

- 4.2** Rehabilitate and upgrade existing UPS and battery back-ups.

- 4.3** The secondary aim of this project is to mitigate total system failure in the event of loadshedding.

- 4.4** Have longer lasting battery technology at core sites to ensure total system failure across the network does not occur.

- 4.5** Avoid cancellation of train services due to power interruptions

5. SITE AND EXISTING SERVICES

5.1 Sites

The works shall take place at Hazendal, Simonstown and Retreat SER/ARs respectively.

Figure 1 shows a map layout of the Western Cape Region and all the stations. The two sites are also pointed out on the map.

Site	Location	UPS Type	Battery Type
Hazendal SER	Cape Flats	Modular UPS with two modules	External battery cabinet
Retreat SER	Southern Suburban / Cape Flats	Modular UPS with single module	External battery cabinet
Simonstown AR	Southern Suburban	Modular UPS with single module	External battery cabinet

Table 3

NOTE: All assets shall be the responsibility of the contractor until its successfully commissioned and handed over to PRASA. PRASA shall only take accountability for maintenance once assets are fully commissioned and operational upon handed over.

5.2 Existing Services

The contractor shall be responsible for all damages attributed by the contractor of existing services within the rail reserve or of the third-party service providers.

The costs when services are damaged shall be for the account of the contractor who damaged the existing functional, services.

A plan will be compiled between the client and contractor, highlighting plans indicating existing services and which procedures will be followed in the event of an incident affecting existing services.

5.3 Site Tidiness

The contractor shall continuously clear and dispose of rubbish, debris, waste and surplus materials to maintain the site in a tidy state.



Figure 1

6. SITE AND EXISTING SERVICES

Most of the activities pertaining to the works will be executed on, over, under or adjacent to railway lines and near High Voltage equipment.

The contractor shall at all times be responsible for the safety of his personnel on the site of the works while paying special attention to the danger of them being over-run by passing trains. The contractor is required to appoint a full time safety coordinator on-site who shall be responsible for safety on-site and liaise with PRASA on the various safety related matter occurring on-site

The following generic (Standard) PRASA specifications are applicable to this contract:

- 6.1** E7/1: Specification for works on, over, under or adjacent to Railway lines and near High Voltage equipment. (Also referred to as the SPK7/1 specification).
- 6.2** E.4E Transnet (Jan 2004 - As adapted for PRASA): Safety
- 6.3** Arrangements and procedural compliance with the Occupational Health and Safety Act (Act 85 of 1993) and applicable Regulations. (Also referred to as the E4E specification).

7. PRODUCT SPECIFICATION

7.1 UPS System

The UPS shall be used to provide a continuous power to the signalling load in the event of a mains power failure for a minimum of four (4) hours.

The UPS shall be a standalone apparatus designed to deliver high quality and reliable.

In the event that the UPS malfunctions at a component level than the load should automatically be transferred to the bypass switches being triggered simultaneously. The batteries shall be configured to have a single or dual string so that once a string becomes faulty, it can isolate itself from the system that will result in the functional string being operational, however with a shorter back-up duration.

Maintenance should be possible to be done on the faulty UPS without disturbing the critical signalling load by means of static and/mechanical bypass. The UPS system shall be able to withstand a minimum 4kV electrostatic discharge without affecting the critical load.

7.1.1 UPS operational modes

- a) Normal mode – The signalling load must be supplied by the UPS as per the design configuration. The AC power will serve as a input to the UPS and this will charge the batteries with the rectifier. The batteries shall maintain a float-charge on the batteries.
- b) Failure mode – In the event of a failure occurrence on the supply from the mains supply from the COP, the signalling load shall be supplied by the inverter via the lithium battery banks. There shall be no interruptions in the signalling load application.
- c) Total outage – Should the back-up power be completely dissipated by means of the batteries, the UPS shall restart and resume supplying to the signalling load.
- d) Bypass – Alternative paths to the signalling load shall be done in the following manner:
 - Automatic: Internal UPS failure or should the power to the signalling load be exceeded
 - Eco-mode: The UPS shall be able to operate in eco-mode, the normal mode shall return if the bypass source is not within the permissible tolerances. Transfer of load shall occur in $\leq 2.5\text{ms}$ and should not affect the signalling load connected.
 - Manual: The signalling load shall be transferred from the inverter to the bypass source via a manual transfer

-

7.1.2 Rectifier

- a) The COP panel shall serve as an input into the UPS and will be converted to a regulated DC output by the input rectifier/converter. The converter/rectifier must also provide input power factor and input current distortion correction.
- b) The input converter/rectifier shall be provided with AC input over current protection.
- c) On the primary and bypass source, the UPS shall have protection against:
 - Undervoltage
 - Overcurrent
 - Overvoltage
 - Low energy surges

7.1.3 DC-DC bidirectional converter/ rectifier

- a) The UPS must be equipped with an incoming DC-DC converter/rectifier that is independent from the input converter/rectifier. The purpose is purely for regulating the incoming DC voltage from the batteries and supplying DC voltage to the inverter. When the input converter/rectifier as stated above is connected then the DC bidirectional converter/rectifier must supply energy to charge the batteries.
- b) To prolong battery life, the UPS shall contain temperature-compensated battery charging. The battery charger shall be ripple-free avoiding premature battery ageing and must be able to supply a minimum battery charging current of 40A (this must be complied to in the event of battery runtime being extended in the future).

7.1.4 Inverter

- a) The basic functionality of the inverter is to invert DC power from the input converter/rectifier output, or from the DC-DC battery converter/rectifier output into regulated sine wave AC power for supporting the signalling load.
- b) The inverter must be capable of supplying current and voltage overloads exceeding 100% and 150% of full load current. It shall be able to supply 120% continuous overload without transferring the load to static bypass. Visual and audible alarms shall indicate overload operation and possible interfaces. Electronic current limiting protection devices shall prevent damages to components. The inverter must also be self-protected against any magnitude of connected output overload.

The inverter control logic must sense and disconnect the inverter from the signalling load without the requirement to clear protective fuses or CBs.

If any of the above conditions are exceeded the load shall be transferred to bypass.
- c) The output frequency is controlled by an oscillator which shall hold this frequency to $\pm 0.1\%$ for steady and transient conditions. The inverter must continuously track the bypass providing that the bypass source maintains a frequency within the user

required synchronization range. Should it fail to remain within these limits, the inverter shall revert to the internal oscillator.

- d) The output protection of the UPS inverter shall employ electronic current limiting.
- e) The UPS control logic controls the shutdown voltage set point to prevent any battery damage as a result of over discharging. This is dependent on the rate of discharge.
- f) In the event of an inverter's IGBT short circuit failure, the UPS must offer the capability to isolate the inverter from the load in no more than 200µs.

7.1.5 Display and controls

- a) The front panel shall be an individual panel and consist of multiple status LEDs and a graphical LED/LCD display for additional alarm/configuration. The UPS displays components with its converter/rectifier, inverter, batteries and bypass and the current status of operation. The display must be green in colour and indicates the following:

Mains/Line 1 (AC input converter/rectifier)

Battery (Load supplied from battery)

Bypass/Line 2 (AC input bypass)

Alarms

Fault conditions shall be supported by additional indicators and audible alarms to inform the PRASA personnel that a UPS fault condition has occurred. Upon mains input failure, the status of the LED shall be as follows:

Mains/Line 1 (AC input converter/rectifier) Off

Battery (Load supplied from battery) green colour

Bypass/Line 2 (AC input bypass) off

Alarm (red colour)

In the event of a UPS fault condition the UPS shall maintain power to the signalling load or at a minimum transfer it to bypass.

Should any UPS module fail there shall be an indication to indicate replacement/repairs or maintenance required.

The UPS is equipped with a data logger, logging all faults. The logger must record 300 faults at a minimum with the oldest events discarded first. The PRASA staff should have access to the logs via the LCD/LED display. All logs shall be time stamped inclusive of a severity indicator.

- b) The audible alarms shall be 65dBA/m. Audible alarms shall be in conjunction with the LCD/LED display indications to indicate a change of state in the UPS.

The audible alarms shall be for mains input power loss or low battery voltage. The LCD/LED display shall be used as an interface to determine the cause of the said alarm on the UPS. Alarms shall be able to be muted or fault must be rectified to be silenced. The UPS should be able to display all the currently active alarms on the LCD/LED display for better diagnosis. The alarm should not be audible again until the presence of a new fault, but the LED flashing indication still alerting the alarm status.

In addition to the on/off switch, the user interface shall include an audible 'Reset' switch. If the alarm silence (Reset) switch is pressed for one second, all current audible alarms shall be disabled. If a new alarm occurs, or a cancelled alarm condition disappears and then re-appears, the audible alarm is re-enabled.

- c) The LCD/LED display shall serve as a user interface to typically display the following measurements:

Voltages	(AC input rectifier)	Phase 1-2-3/N
	(AC input bypass)	Phase 1-2-3/N
	(UPS output)	Phase 1-2-3/N
	(Battery)	+ and -
Current	(UPS output)	Phase 1-2-3
	Battery charging/discharging	
Frequency	UPS input/output	
Battery	Remaining back-up time (in minutes)	
	Capacity (%)	
	Temperature (°C)	
Others	output active power (kW)	Phase 1-2-3/N
	output reactive power (kVar)	Phase 1-2-3/N
	output apparent power (kVA)	Phase 1-2-3/N
	Load (Phase 1-2-3)	Phase 1-2-3

7.1.6 The automatic battery test

- a) The monthly periodic battery test must be self-initiated by the UPS as per the configured date and time upon installation as prescribed by the PRASA Engineer. The PRASA staff should be given access to enable or disable the test.
- b) Any battery failure, the UPS shall revert to normal mode and indicate via visual, audible and remote communication (if applicable). No indication shall be communicated during the automatic battery test run.
- c) The automatic battery test shall be able to operate only if no alarms conditions affect the UPS and if the battery is at least 90% of its full capacity.
- d) During the battery test, the UPS must not disconnect from the mains voltage supply.

7.1.7 Remote shutdown

- a) In the event of an emergency the remote feature should allow the operator to disable the UPS outputs. NC contacts should be available for remote interfaces with a terminal block type connector.
- b) The Remote shut down function shall not operate if no system control modules are present in the UPS or if the manual bypass switch is in the bypass position.
- c) The existing design parameters to be consulted for remote interfaces.

7.1.8 Bypass

- a) The bypass circuit has a back-feed protection which will form part of the UPS as an integral module. The bypass has its own transfer control logic that senses the status of the inverter logic signals. This control circuit shall provide a transfer of the load to the bypass source, without exceeding the transient limits specified herein, in the event of UPS overload or malfunctioning.
- b) The transfer control logic must automatically activate the bypass, transferring the signalling load to the bypass source, should it sense the following conditions:
 - Inverter overload capacity exceeded
 - Inverter over temperature
 - UPS fault condition (non-redundant setup)For inverter overload conditions, the transfer control logic shall inhibit an automatic transfer of the signalling load to the bypass source if one of the following conditions exists:
 - Inverter/Bypass voltage difference exceeding preset limits
 - $\pm 30 \dots \pm 10\%$ (Voltage) (According to VFI-SS-111)
 - Bypass frequency out of preset limits ($\pm 4\%$ or $\pm 2\%$ of nominal frequency)
- c) Retransfer of the signalling load from the bypass source to the inverter output shall be done automatically unless inhibited by a manual control. The automatic transfer of the signalling load shall be permissible if:
 - Bypass out-of-synchronization range with inverter output
 - Overload condition exists in excess of inverter full load rating

- UPS fault condition présent (non redundant configuration)
- d) The UPS shall be able to interface with an in-electrical distribution (external to the UPS bypass) Bypass by means of a NO contact. The transfer to Bypass shall be activated when a pair of 'SELV' contacts, external to the UPS, are activated. The external transfer to bypass connection shall be through a terminal block type connector and must be previously configured by the used during UPS installation. The existing design parameters to be consulted for remote interfaces.
- e) Internal bypass shall have manual bypass functions. A switch positioned on the UPS's bottom-front will enable the manual bypass feature, to access it, the lower front bezel must be removed.
In case of wrong manual by-pass manipulation (transferring the load on manual bypass when the load is supplied by the inverter (Normal-mode), the UPS module(s) shall be auto protected avoiding any UPS damage.
- f) When the trigger for a manual bypass is activated, an audible alarm must sound and should allow the PRASA staff to silence the alarm. The alarm shall continue to sound whilst in bypass mode where it shall provide a reminder that the load continues to be powered from the mains input supply only.

7.1.9 Communications

The UPS should allow for all types of communication protocols as specified. The minimum ports allowed for communication shall be four (4) at a minimum, simultaneously. The media of either port may change without disruptions of the UPS operation. Relay contacts should also not affect the communication ports operation.

- a) Relay contacts.
 - Max 250Vac/250mA or 30Vdc/1A shall be available
 - Phoenix spring terminals with 1mm² wiring
 - Availability to communicate via five (5) relay contacts and should provide mains present, mains failure, load on inverter, load on bypass, battery status OK, battery status LOW, alarm presence in the system

Each of these signals should be present in the available relays and where PRASA should be able to choose and specify.

- The relay in which the signal should be communicated.
- The corresponding NC or NO contact in which the signal should be present.
- For instance:

Relay 1

NO COMMON_ALARM common alarm (System)

NC ALARM NO alarm condition

C common

Relay 2

NO LOAD_ON_INV load on inverter
NC Message (Load on mains bypass)
C common

Relay 3

NO ALARM battery OK
NC BATT_LOW (battery low)
C common

Relay 4

NO LOAD_ON_MAINS load on bypass (Mains)
NC Message (load on inverter)
C common

Relay 5

NO MAINS_OK Mains present
NC ALARM Mains failure
C common

7.1.10 Firmware

Firmware updates shall be available through the communication channels.

7.1.11 General requirements

The UPS shall be of the floor standing type in a steel enclosure with its power, control and switchgear systems. All interconnections must be adequately protected and isolated.

The UPS system must be constructed to prevent injection current harmonics from entering the COP power supply. The UPS maximum total input current harmonic distortion should not exceed 2% TDHi when the UPS machine is operating at the manufacturer's specified rating.

The UPS system cabinet shall comprise of a floor standing steel enclosure to house the power system, control systems, battery connections, batteries and all associated necessary connections for the correct operation of the UPS in accordance with the requirement of the specifications. All switchgear and interconnections must be adequately protected to enable an isolated section to be safely maintained or repaired whilst the remaining system supports the load.

The UPS cabinet should be equipped with a service manual bypass, independent bypass fuses, MCB's for battery DC protection.

The UPS system shall be accessible from the front only.

The UPS system shall be equipped with fans for internal air-cooling and shall be controlled by the UPS logic and be accessible for maintenance.

Power Rating - kVA		32 – 35
Power Rating - KW	< 25°C	30
	< 40°C	30
Input	Nominal Voltage	380/22, 400/230, 415/240 Vac (3 Phase, 4-wire + G)
	Voltage Range	208 ~ 477 Vac (line – line)/ 120 ~ 276 Vac (line – neutral)
	Current Harmonic Distortion	< 3% (full load)
	Power Factor	> 0.99
	Frequency	50 or 60 ± 5 Hz
Output	Voltage	380/220, 400/230, 415/240 Vac (3phase, 4–wire +G)
	Voltage Harmonic Distortion	< 3% (linear load)
	Voltage Regulation	± 1% (static)
	Frequency	50 or 60 Hz
	Frequency	± 0.05 Hz (interior oscillator)
	Regulation	± 2 Hz (synchronized, adjustable in steps of 0.1 Hz) (selectable for bypass operation) or < +/- 4 % Free running ± 0.1%

	Overload Capability	≤ 125%: 10 minutes; ≤ 150%: 1 minute				
	Unbalanced load	100%				
Interface and communication	Standard	RS232 × 1, RS485 × 1, SNMP slot × 2, Dry contact output × 6, Dry contact input × 2				
		Wireless interfaces and communication				
	Management Peripherals	Battery cabinet temperature × 4, Battery cabinet status detection × 1, Parallel port × 1, REPO × 1				
		SNMP card, Modbus card, Relay I/O control card, EnviroProbe				
		SNMP + 4 port hub, Battery cabinet temperature sensor, Battery cabinet status cable				
Conformance	Safety & EMC	CE, EN62040-1, EN62040-2 Class A				
Other Features	Emergency Power Off	Local and remote				
	SRAM Event log	500 records				
	AC – AC	> 94%				
Efficiency	ECO Mode	> 96%				
	Operating Temperature	0 ~ 40°C				
Environment	Protection	IP20				
	Relative Humidity	0 ~ 90% (non – condensing)				
	Audible Noise (at one meter)					
	UPS	Not to exceed 850mm		60 dBA		

All UPS shall supply the full rated critical loads also known as the signalling loads or equipment that are within the signalling rooms.

7.2 Batteries

The Contractor is responsible for the removal and disposal of all batteries used in the PRASA Metrorail region that are unable for reuse.

The Contractor will issue PRASA with a disposal certificate for each battery/battery bank that was removed from site.

7.2.1 Lithium-ion solution

The batteries shall be of the lithium-ion type and shall be sized to support a load of 30kW for a minimum of 4 (four) hours at an ambient temperature of 25°C. The configuration shall be kept to the same principle of the existing configuration housed in an external cabinet or equivalent proposal to be submitted.

Batteries should also be possible to be housed within the UPS itself.

The supplier shall complete the below table for the battery offered, this shall be approved by the Signals Engineer prior to procurement of batteries.

This is only applicable to the Hazendal SER site.

Cells per unit	
Voltage per unit	
Capacity	
Weight	
Maximum discharge current	
Internal resistance	
Operating temperature range	
Nominal operating temperature range	
Float charging voltage	
Recommended maximum charging current limit	
Equalization and cycle service	
Self discharge	
Terminal	
Container Material	

Table 4

7.2.2 Lead acid battery bank replacement

Both Simonstown and Retreat sites shall have their depleted battery banks replaced unless specifically otherwise specified during the installation stage.

The batteries to be supplied and installed shall be like for like as per the specification provided.

Site	Battery AH	Battery QTY	UPS and Battery Installation Date	UPS Description	Battery Bank Description		
					Amp-hour	Blocks in series	String in Paralel
Retreat	155	40	4/2/2018	Modular 40kVA, 3 phase	75	32	2
Simonstown	38	40	2/1/2019	Modular 20kVA, 3 phase	38	32	1

Table 5

Cells per unit	6
Voltage per unit	12
Capacity	150W-620W @ 15 min-rate to 1.67V per cell @ 25Cn(77F) / 100AH
Weight	Approx 17.6 kg
Maximum discharge current	300A(5sec)
Internal resistance	Approx 5.9 mΩ
Operating temperature range	Discharge: -15°C ~ 50°C (5F ~ 122F) Charge: -15°C ~ 40°C (5F ~ 104F) Storage: -15°C ~ 40°C (5F ~ 104F)
Nominal operating temperature range	25°C ± 3°C (77F ± 5F)
Float charging voltage	13.5 to 13.8 VDC / unit Average at 25°C (77F)
Recommended maximum charging current limit	20A
Equalization and cycle service	14.4 to 15.0 VDC/unit Average at 25°C (77F)
Self discharge	CSB Batteries can be stored for more than 6 months at 25C (77F). Please charge batteries before using. For higher temperatures the time interval will be shorter.
Terminal	I2 – Thread alloy recessed terminal to accept M6 bolt
Container Material	Polypropylene (UL 94-V0/File E50955)*Flammability resistance of (UL 94-HB/File E216959) can be available upon request

Table 6

8. PRODUCT SPECIFICATION

Project Management of the complete SoW including planning, scheduling and reporting verbally to the Engineer in writing by means of reports, updated project schedule etc. as required or requested.

The following general works forms part of the scope of works:

- a) Site surveys (dimensional, layout, checking etc.);
- b) selection of suitable Plant and Materials (where not already specified herein);
- c) offloading of Plant and Materials at site;
- d) safety equipment (guards, notices, etc.);
- e) Installation of specialised indoor equipment

Typical staff and duties required for the successful completion of the project includes but is not limited to:

- a) Project Manager/Project Engineer/Technologist/Technician
 - Project administration
 - Meetings, planning and scheduling
- b) Engineering Technician (UPS Specialist)
 - Site administration
 - Installation and site planning
 - Site resource coordination
 - Site supervision
 - Commissioning and handover of systems
- c) Site Supervisor (Signals Technician)
 - Indoor works installation supervision
 - Cable jointing and testing
- d) General Labour
 - Assist with Indoor UPS installation
 - Assist with Indoor battery installation
 - Connections and terminations
 - Assist with all activities for the successful completion- of all works

9. DRAWINGS AND DOCUMENTATION

9.1 Tender Stage

Please refer to the drawing schedule for a list of design drawing and information.

9.2 Award Stage

Detailed As-Built drawings and BoC of the system functionality will be issued to the awarded bidder for these works.

9.2.1 Health and safety plan.

9.2.2 Detailed Method statements and programme for the individual Works.

9.2.3 Final design detailing all components, systems, circuits, Plant and Works tendered.

9.2.4 Quality Plan

- Include a description of the Supplier/Contractor's project organisation, with key positions and responsibilities identified and individuals named. The organisation structure shall also indicate the resources committed to the management / coordination of QA / QC activities
- Supervision and site management plan
- Quality plan shall also be supported by PRASA method statement guidelines for the installation of signalling products that shall be issued to the winning bidder

9.3 Installation Stage

9.3.1 Existing detailed As-Built data pack will be given to the winning bidder.

9.3.2 The Engineer's scrutiny of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of this Contract, unless the Contractor has informed the Engineer in writing of such deviations at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall this relieve the Contractor of responsibility for errors or omissions in the shop drawings or samples.

9.3.3 After completion of the work and final processing has been done, two prints of all affected / new sheets must be provided, this for the testing and commissioning Engineer/Technologist.

9.4 Handover Stage

9.4.1 Update all applicable drawings and circuits on AutoCAD for Record Information (As-Built).

9.4.2 A CD with a soft copy of drawings (AutoCAD & PDF), manuals, test records, checklists and 3x hard copies of drawings stamped to be provided upon completion of the project.

10. TESTING & COMMISSIONING

Testing and commissioning procedures shall be followed as specified in CSE 1155-500.

The UPS specialist contractor will take full accountability for testing and commissioning the new UPS installation with batteries. This will be done with the aid and assistance of the PRASA Signals Technician/Technologist/Engineer. Should issues and faults arise during testing and commissioning, the Region will expect the contractor to have his/her team to be readily available and equipped to have the faults cleared or fixed.

The complete UPS shall be integrated to the remote centre.

NOTE: Occupations should be scheduled through the Project Manager 21 days in advance to obtain approval.

10.1 Factory Acceptance Test (FAT)

10.1.1 FAT for the UPS specified in this contract shall be conducted at the factory or plant where these materials are to be manufactured and assembled.

10.1.2 FAT shall be for the account of the awarded contractor who shall allow sufficient time before FAT commences. The contractor shall invite PRASA to attend for FAT for approval of the relevant products and shall not be held liable for any delays..

NOTE: The contractor to allow provision for costs of FAT where PRASA has to attend to factories outside a 70km range from Cape Town CBD.

10.2 Prior to Final Testing & Commissioning

PICO (Post-Installation Check-Out) / wire count to be done by the contractor and recordings to be presented to the Test Engineer/Technologist/Technician.

10.3 Final Testing & Commissioning and Handover

10.3.1 Functional Testing :

Contractor shall ensure all circuits are wired, megged and checked as per the designs and wiring diagrams prior to switching online the UPS installation

10.3.2 System Testing :

SAT (Site Acceptance Test) of the entire installation with PRASA.

Contractor's specialist inclusive of his/her team in conjunction with the PRASA signalling personnel (Engineering Technician/Technologist/Engineer) inclusive of his/her team.

Final testing will consist of various tests as set out by the TIC (Tester in Charge), PRASA Test Engineer/Technologist.

Sufficient staff for the final commissioning to be made available by the contractor. The contractor team must be adequate to perform the change-over quickly and efficiently to complete the process, including the final acceptance tests between peaks.

Upon completion and satisfaction of the PRASA personnel the complete installation shall be signed and handed over to PRASA.

NOTE: All equipment, cables and wiring shall be for the responsibility and care of the contractor prior to handover. If the assets, system or elements has not been handed over to PRASA for operational usage than PRASA will not be held accountable for any loss, damage or failure of such equipment and must be for the account of the contractor.

11. PROGRAMME OF WORKS

A detailed programme by the winning bidder to be provided including lead times of all equipment and material.

- 11.1 Detailed scheduled programme shall be submitted within 2 weeks of the bidder being awarded and appointment.
- 11.2 Unless otherwise stated, the Project Manager/Engineer will examine and comment on the programme within 2 weeks of it being formally submitted.
The Project Manager/Engineer return's the commented programme to the Contractor, herein after it is certified as the contract programme.
- 11.3 Revisions to the contract programme maybe be requested by mutual agreement as the projects continues.

12. TRAINING

The Contractor will train all Signals technical staff from the level Technical Worker up to Senior Engineering Technician which in total will consist of 30 technical staff.

Based on the number of staff to be trained the training will be split into more than 1 session to accommodate a comprehensive training session for all.

The Contractor must provide theoretical and practical training.

- The theoretical training will be done in a classroom facility provided by PRASA.
- The practical training will be done on site

Training curriculum, material and notes shall be submitted to the Regional Engineer (Signals) and must be submitted for comment and approval and shall also be included in the manuals.

Training content to cover basic first line maintenance supports which include basic fault-finding and diagnostics on the complete installation.

The training content to include but is not limited to:

- Fundamentals of standby power systems, plant and equipment
- System operation and power failure action run
- System troubleshooting and maintenance
- Emergency procedures
- Routine test runs
- Safety aspects

13. WARRANTY

A 12 month support and guarantee period is required, which shall include replacement of parts, labour, consumables, travel and all other associated costs. The 12 months warranty period shall commence once a section or portion of works has been completed and handed over to PRASA for operational use or a system has been commissioned.

13.1 Warranties shall apply to workmanship of the installation once installed and commissioned for all material, equipment and components.

13.2 Material warranties shall only apply to those components, parts or equipment supplied by the contractor.