



Request for Quotation (RFQ) for the supply, installation and commissioning of a 40kVa UPS to the CSIR

RFQ No. 5333/24/04/2018

Date of issue	Wednesday, 18 March 2018
Closing Date and Time	Tuesday, 24 April 2018 @16h30
Contact details	For submission of quotations or any other enquiries: Email tender@csir.co.za (Please use RFQ No. as subject reference)

1 INVITATION FOR QUOTATION

Quotations are hereby invited for the supply, installation, and commissioning a 40kVa UPS to the CSIR.

2 QUOTATION REQUIREMENTS

Refer to **annexure A** of this document for detailed scope of work. Below is the Bill of Quantities and quotation requirements:

Note: The quotation should be in line with the requirements as stipulated in annexure A of this document.

Service providers are required to submit the following:

- Pricing/quote on your official company letterhead
- Proof of professional registration
- Indemnity Insurance
- Company Profile, including recent jobs of a similar nature and size as well as contactable references
- BBBEE certificate

3 EVALUATION CRITERIA

3.1 Elimination criteria;

Suppliers will be disqualified under the following conditions:

- Late submission,
- Quotation submitted at wrong location or email address,
- If the supplier does not provide three contactable references for doing similar work,
- If supplier does not provide a company profile.

3.2 Selection of suppliers will be based on the 80/20 preference point system.

3.3 Submit a valid B-BBEE certificate with quotation. No B-BBEE status will equal zero points.

3.4 Indicate CSD number (National Treasury Central Supplier Database) on quotation. If not registered yet on CSD, use www.csd.gov.za to register. - **Please ensure that the tax status on CSD is updated and compliant.**

3.5 No order will be issued or no contract will be signed without a valid CSD number.

4 PRICING QUOTATION

4.1 Price needs to be provided in South African Rand (excl. VAT), with details on price elements that are subject to escalation and exchange rate fluctuations clearly indicated. **For VAT registered bidders, the VAT component and the total price including VAT should be clearly indicated.**

4.2 Price should include additional cost elements such as freight, insurance until acceptance, duty where applicable, etc.

4.3 Payment will be according to the CSIR Payment Terms and Conditions.

5 OTHER TERMS AND CONDITIONS

5.1 The supplier shall under no circumstances offer, promise or make any gift, payment, loan, reward, inducement, benefit or other advantage, which may be construed as being made to solicit any favour, to any CSIR employee or its representatives. Such an act shall constitute a material breach of the Agreement and the CSIR shall be entitled to terminate the Agreement forthwith, without prejudice to any of its rights.

5.2 A validity period of 90 days will apply to all quotations except where indicated differently on the quote.

- 6 No goods and/or services should be delivered to the CSIR without an official CSIR Purchase order. CSIR purchase order number must be quoted on the invoice. Invoices without CSIR purchase order numbers will be returned to supplier.**
- 7 Note: This is not a Purchase Order.**

Annexure A

1 GENERAL TECHNICAL SPECIFICATION

This section covers general requirements for the supply, delivery, commissioning, installation and maintenance of Uninterruptible Static Power Supply Machine(s).

The UPS equipment shall provide continuous interference free power to essential equipment.

The equipment requiring the power is a critical load, which is sensitive to frequency deviations, voltage transients and voltage dips. The UPS system shall compensate for the variations in the input supply as any irregularities will affect the load. This aspect shall be carefully considered when proposing UPS machines as the static UPS machines will be deployed to supply computer and processing equipment which has shown to have an extremely aggressive load profile.

Each singular or modular UPS shall comprise of the following major components for each system as enumerated in the Detailed Technical section of this document:

- a. PFC Rectifier
- b. Battery charger
- c. Inverter to position A
- d. Battery
- e. Automatic bypass [via a static switch]
- f. User and communications interface
- g. Battery management system

The UPS shall be based on six-pack IGBT technology with built-in thermal monitoring and a free-frequency chopping mode to dynamically optimise efficiency and power quality.

The UPS shall accept high crest factors (3:1) without derating to ensure correct operation with computer loads.

The total harmonic voltage distortion at UPS output [THDU downstream] shall respect the following limits:

- THDU downstream ph/ph and ph/N 2% for linear loads;
- THDU downstream ph/ph and ph/N 3 % for non-linear loads.

The UPS system shall not draw a level of harmonic currents that could disturb the upstream AC system as such; the UPS shall have a controlled IGBT input rectifier drawing sinusoidal current.

The UPS shall respect the following characteristics at the normal AC input.

Total harmonic current distortion [THDI] upstream of the rectifier not exceeding:

- a. 3% at full rated load for an RCD [computer] load
- b. 5% from 30% to 100% of the full rated load.

Input power factor [pf] greater than or equal to 0.99

Overall efficiency [between the rectifier inputs and the UPS output] shall be greater than or equal to:

94.5% from 50% load to full rated load (In)

1.1 The Contract

The Contract excludes the supply and installation of ventilation equipment for the equipment and battery rooms. Adequate ventilation of all equipment racks utilising air within the plant room, i.e. without forced ventilation from outside the plant room shall be provided as an integral part of the equipment.

The Contractor shall provide details of the equipment heat loads in order that the plant room ventilation, [to be provided by others], can be determined.

The Contract excludes the supply and installation of cabling from the electrical sub-distribution board [installed by others] supplying the UPS system. All interconnecting cables within the UPS system including cables to the batteries, shall be installed as part of this contract. Input mains cables and output cables to the sub-distribution board located in on the computer room floor are excluded from this Contract.

The Contract includes the provision of all connectors, mounting brackets, cable ducts and trays etc., required by the system and indicated on the drawings.

The Contract includes the provision of all test equipment, dummy loads, temporary connections, etc., required to take all measurements and readings specified or stated by the Contractor or as otherwise required to ensure that the installation is handed over in good working order in compliance with the specification. All test equipment remains the property of the Contractor.

The Contract includes the supply and use of all materials and equipment that are not specifically stated in these documents but which are nonetheless necessary to execute the Contract in accordance with the requirements of these documents and all the other Regulations, Statutes and Codes of Practice which are applicable to the installation.

Tenderers must confirm that the space is sufficient for the installation of the UPS and battery and shall indicate the proposed layout of their equipment on the drawing in red ink.

The tenderer must furnish detailed description and illustration of the equipment offered and must complete the questionnaire forming part of this specification.

FAILURE TO SUBMIT ANY OF THE INFORMATION REQUESTED MAY DISQUALIFY THE TENDERER.

1.2 Making Good

The Contractor will be responsible for making good in all trades, and damage or disturbance to the buildings, installation, tarred surface, concrete surfaces, drains and other services, which he or his employees may have caused in the course of the construction of the system. The Contractor will be responsible for keeping the site tidy during the course of the construction of the system, and shall remove from the site all rubble and litter resulting from the construction work.

1.3 Quality and Standards

Maximum system reliability is required and all aspects of the design and installation shall be optimised to this end. All materials and equipment supplied shall be new and of acceptable quality.

All equipment shall comply with relevant SABS specifications or with the requirements or recognised international standards organisations such as NEC, ISO, NEMA and ANSI. The Contractor shall furnish clear details as which of the following standard are applicable standards that are being complied with:

- DIN/VDE 0100
- DIN/VDE 106 part 1
- IEC 536,
- DIN/VDE 0110 01/89,
- DIN 470 part 1 1 11/92
- IEC 529,
- DIN/IEC 721-2-1-09/86.

The entire installation shall be executed in accordance with standard practice for the industry and to the approval of the Engineer or his duly authorised representative.

1.4 System Requirements

Under normal operating conditions, the load shall be supplied through a controlled rectifier and inverter circuit. The rectifier supplies DC power to storage batteries and the inverter. The batteries shall be float charged ready for use.

During a mains failure or disturbances in the mains supply, the batteries shall provide the DC power to the inverter which in turn shall provide an uninterrupted supply to the load.

A static bypass system is required. Although the load shall normally be supplied from the rectifier/inverter, automatic and uninterrupted transfer of the load to the mains supply shall take place in the event of failure of the rectifier/inverter system and the inverter shall be disconnected from the load. Transfer to mains shall also be affected in the event of load switching surges beyond the output capability of the inverter or whenever the output voltage of the inverter deviates beyond the specified output tolerance limits. Transfer of the load to the inverter shall be enabled once the inverter output or load requirements have stabilised.

In order to maintain immediate switching capability to the mains, the inverter frequency shall normally remain synchronised with the mains frequency. Should the mains frequency however deviate beyond the specified frequency tolerance limits, the inverter oscillator shall run independently of the mains and maintain the output within the specified limits? The inverter shall be synchronised with the mains again as soon as the input frequency has stabilised.

Should transfer to the mains become necessary while the oscillator is free running, the automatic operation of the electronic switch shall be inhibited until the inverter output is synchronised with the mains, whereupon transfer shall take place. This synchronisation should be achieved within a few cycles.

A mechanical bypass switch allowing maintenance of the rectifier/inverter and electronic switches, shall be provided. The unit shall be a load break, fault make isolator rated for the full load current and mains fault level. Additional off load isolators to isolate the rectifier/inverter and electronic switches from the mains input and load voltages during maintenance, shall be incorporated in the equipment.

The equipment shall be designed for maximum operating efficiency. The efficiency shall be determined when the system is delivering full load at 0.8 power factor with batteries fully

charged. The load required by the auxiliary equipment (controls, alarms, bypass switches etc.) and rack fan units shall be included in the determination of the overall efficiency.

All cabinets containing thyristors shall be adequately screened and earthed to prevent direct radio frequency radiation. In addition, RFI suppression networks on both the input and output power lines shall be provided to comply with the requirements of BS 800 for Mains Driven Appliances or VDE 0875, Class N.

The inverter shall be able to deliver the following overloads without reduction of output voltage tolerance without the aid of the electronic switch connecting the load to the mains:

Static overloads

110% of full load for 1 hour

125% of full load for 1 minute

150% of full load for 10 sec.

Dynamic overloads

1000% of full load for 100 msec.

The dynamic behaviour of the system is of the utmost importance to ensure stable operating conditions. Some of the aspects to be considered in this regard are:

- The system shall accept 50% step load changes with the associated transient switch on currents, at least up to the dynamic overload stated above.
- Oscillatory load switching between the electronic switch and rectifier/inverter shall be prevented especially during transient load conditions.

The system shall be able to deliver 50% unbalanced phase loads without deviating from the specified voltage tolerance of phase symmetry.

The system shall be able to handle load power factors from 0.7 to unity.

No more noise than a slightly audible hum will be accepted. The noise level, measured as per standard ISO3746, shall be less than 75dBA. The Contractor shall state the noise level, as well as the distance from the unit where the measurements apply.

Following a mains failure, the inverter shall start immediately and automatically upon restoration of input. Manual restart will be acceptable following prolonged mains failure and low DC cut out conditions.

Control, indicating and alarm functions

User interface:

UPS system operation shall be facilitated by a user interface on each of the modular UPS units, comprising:

- a. A graphic display [at least quarter VGA and high resolution are preferable];

- b. ON and OFF control buttons [independent of the display];
- c. Status indications with mimic panel.

Graphic display:

The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations, e.g. bypass. It shall be capable of supervising a given modular UPS unit or a parallel system up to eight UPS units with the external bypass.

Display of measurements:

It shall be possible to display the following measurements for any one of the modular UPS units or for the entire system:

- a. Inverter output phase-to-phase voltages
- b. Inverter output currents
- c. Inverter output frequency
- d. Voltage across battery terminals
- e. Battery charge or discharge current
- f. Rectifier/charger input phase-to-phase voltages
- g. Rectifier/charger input currents
- h. Crest factor
- i. Active and apparent power
- j. Power factor of the load
- k. Battery temperature
- l. Battery percent charge
- m. Available backup time
- n. The remaining battery service life

Display of status conditions and events:

It shall be possible to display the following indications:

- a. Load on battery power
- b. Load on UPS
- c. Load on automatic bypass
- d. General alarm
- e. Battery fault
- f. Remaining battery backup time
- g. Low battery warning
- h. Bypass AC source outside tolerances
- i. Battery temperature
- j. Additional information shall be provided in view of accelerating servicing of the system
- k.

Display of operating graphs:

It shall be possible to graphically display the measurements mentioned above on the screen over significant periods.

Statistics:

Number of overloads, number of transfers to battery power, cumulative time on battery power, maximum power levels, demand power levels.

Log of time-stamped events:

This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of all important status changes, faults and malfunctions, complete with an analysis and display of troubleshooting procedures. It shall be possible to time stamp and store at least 2 500 events.

Controls:

Each modular UPS unit shall comprise the following controls:

- a. ON and OFF buttons:
Located on the front panel of the UPS, they shall control UPS-unit ON/OFF status. It shall be possible to turn OFF the UPS externally via an isolated dry contact.
- b. EPO terminal block:
The UPS shall be equipped with an emergency power off [EPO] terminal block for complete system shutdown following reception of an external control signal.

The EPO command shall result in:
 - Shutdown of UPS units;
 - Opening of the static switches on the bypass line and of the battery circuit breaker;
 - Opening of an isolated dry contact on the programmable card.
- c. Alarm reset button:
This button shall turn off audio alarms (buzzer). If a new alarm is detected after clearing the first, the buzzer sounds again.
- d. Status indications with mimic panel:
Indication of status conditions shall be distinct of the graphic display.
- e. Three LEDs on the control panel on each modular UPS unit indicate the following status conditions:
 - Load protected by the modular UPS unit;
 - Minor fault;
 - Major fault.
- f. The mimic panel shall represent the modular UPS and indicate the status of the load supply using five two-colour [red and green] LED's:
 - Load supplied [LED at UPS output on mimic panel]
 - Inverter on [inverter LED on mimic panel]
 - Operation on battery power [LED between battery and inverter on mimic panel]
 - Bypass activated [bypass LED on mimic panel]
 - PFC rectifier on rectifier LED on mimic panel.
- g. A buzzer shall warn the user of faults, malfunctions or operation on battery power.

1.5 Rectifier and Charger

The PFC rectifier of each modular UPS unit, drawing sinusoidal current shall be supplied by the normal AC source without a neutral. It shall provide power for the load as well as charge or float charge the battery. The battery charger shall be supplied by the rectifier to avoid transmitting any AC fluctuations to the battery. Each unit is independent in terms of its input module, i.e. one unit can operate on battery power, the others on AC power.

The rectifier capacity shall be sufficient to provide the full load output via the inverter and simultaneously recharge a fully discharged battery within the specified time, even during a mains input voltage of 10% of nominal and input frequency of 5% of nominal.

The DC output voltage shall be controlled to an accuracy of $\pm 1\%$ even during a continuous mains voltage variation of $\pm 10\%$ and frequency deviation of $\pm 5\%$ and with any equipment load or battery charging load within the capacity of the rectifier.

The standard charger of each modular UPS unit shall be sufficient to charge the battery rapidly. Battery recharging shall take less than 9 hours [values after discharge to $P_n/2$ and recovery of 90% of total battery charge for a recent battery].

Charger regulation and monitoring:

- The battery recharge system shall include independent regulation and monitoring devices to ensure conformity with standard NFC 58311.
- The battery recharge voltage shall be a function of the ambient temperature in the battery room.

The DC voltage during float charging of the battery shall be chosen to give maximum life to the battery whilst maintaining the maximum charge conservation and minimising gas formation and electrolyte loss.

A current limiting feature shall be incorporated in the rectifier control circuit preventing overloading of the rectifier and ensuring that the maximum charging current which the battery can safely absorb in a fully discharged conditions is not exceeded.

An efficient DC filter shall be incorporated in the rectifier output to limit the ripple current through the battery to less than 1% at any point during the charge/discharge cycle in order to ensure extended battery life.

An input voltage monitoring circuit shall be provided to switch off the rectifier when the r.m.s. value of the mains voltage falls below a preset value.

The rectifier shall be switched off if any of the rectifier phases should fail.

A device shall be provided to limit the inrush currents of each charger. When AC power fails and during genset start, the rectifier shall limit the power drawn by implementing a walk-in for ten seconds.

Over temperature protection of the rectifier shall be provided. Temperature sensing probes shall be mounted on the thyristor housings, thyristor mountings or on the heat sinks close to the thyristors. The sensing of off coming air temperature alone is not acceptable.

The possible effects of "ringing" and harmonics that may be present of the input supply due to non-sinusoidal current waveforms at the rectifier input, phase commutation, etc., shall be taken into account. The input voltage monitoring circuits of the rectifiers shall be adequately filtered and buffered to ensure reliable load control and to prevent continuous on off switching of the rectifiers.

The input current shall be limited, when operating on bypass, to allow battery charging based on the difference between input and maximum output current. Battery charging can preferably be switched from high to low rate charging or de-activated when limited input power is available.

An adjustable device shall make it possible to stagger start-up of the PFC rectifiers when the normal AC source returns to within tolerances [transfer from battery power to normal AC power]. By ensuring sequential start, this device shall avoid overloading a gen-set picking up the supply to all the rectifiers.

1.6 Battery System

A Battery System of sufficient capacity to supply the specified inverter load for the required time shall be provided. Each single/modular UPS unit shall be equipped with its own battery of the sealed lead-acid type, mounted and wired in a cabinet identical in aspect to that of the UPS and shall have a service life of 10 years.

The batteries shall be complete with cell inter-connectors and row inter-connectors. The output terminals shall be robust and adequately dimensioned for the output cable terminations. All terminals shall be covered with silicon grease to prevent corrosion.

The inter-connectors between cells and rows of cells shall be constructed in a manner giving the lowest volt drop and maximum resistance to corrosion

The battery shall be sized to ensure a continuous supply to the inverter for at least 20 minutes, in the event the normal AC source fails, given that the inverter is at full rated load, i.e. kVA for a power factor $PF = 0.9/0.8$.

The Contractor shall state the 10 hour discharge capacity of the batteries and the battery voltage at its terminals under various conditions.

The batteries shall be designed to give satisfactory service for a minimum period of 5 and 10 years. The Contractor shall state the maximum expected lifetime of the batteries. Two alternatives shall be priced as part of the pricing schedule.

The batteries shall be supported on a suitable framework made either from varnish impregnated wood or suitably painted steel frames. The supporting framework shall stand on porcelain feet.

The containers shall be constructed so as to give maximum cooling of each cell and to afford as little likelihood of creepage as possible.

The batteries shall be complete with cell inter connectors and row inter connectors. The output terminals shall be robust and adequately dimensioned for the output cable terminations. All terminals shall be covered with silicon grease to prevent corrosion.

The inter connectors between cells and rows of cells shall be constructed in a manner giving the lowest volt drop and maximum resistance to corrosion.

Each cell shall be numbered consecutively for identification and the positive and negative terminals shall be clearly marked, preferable coloured.

Each battery set shall be complete with a wall mounted battery fused isolator or circuit breaker capable of breaking the full load current drawn by the inverter.

The supply and installation of suitably rated cables and HRC fuse or circuit breaker protection between battery and equipment is included in the Contract.

The Contractor shall conduct a thorough on site commissioning of the batteries. The battery shall undergo a series of charge and discharge cycles.

During this time, cells shall be monitored to detect excessive gassing, water loss or temperature increase. The batteries shall then be fully discharged and the recharged at the predetermined charge voltage for 16 hours. Total battery voltage as well as each cell voltage shall be measured. All batteries found to be faulty during the above process shall be replaced. Finally, with all defective batteries replaced and the battery fully charged, a full load test through the inverter shall be conducted.

Tenderers to submit battery discharge calculations with their tender clearly showing the battery discharge table.

Sizing calculations shall assume an ambient temperature at 25°C.

1.7 Inverter

A solid state DC to AC inverter providing a three phase output within the specified output requirements from a DC source originating from the rectifier or battery output shall be provided. Self-commutated or load commutated and three single phase units phase controlled within 120 electrical degrees or three phase inverter bridges are acceptable. The inverter shall be amply rated to provide the specified output power between the upper and lower battery voltage limits.

The inverter shall be adequately protected against excessive overloads or short circuits that may occur in the load.

The inverter shall be adequately protected against excessive overloads or short circuits that may occur in the load.

The UPS shall be capable of supplying for at least 10 minutes a load representing 125% of the rated load and 30 seconds a load is representing 150% of the rated load.

The overload capacity shall be capable of taking into account temperature conditions for more than ten minutes, by allowing a continuous, 10% overload when the temperature is less than or equal to 20°C.

The output of the inverters is of the transformerless type and the neutral shall be recreated electronically

The IGBT inverter bridge shall contain the necessary auxiliary circuitry to ensure satisfactory operation with non-linear loads such as saturating transformers or other rectifier bridges as well as loads with low power factors.

The inverter shall be switched off as soon as the DC input reaches a predetermined minimum value.

The output of the inverter shall be connected through a very high speed electronic switch to the output busbar. The switch shall be capable of disconnecting the inverter when operating at full load at any power factor from the output busbar in less than 1 msec.

The operation of the electronic switch shall be such that failure of the inverter will cause the switch to isolate the faulty inverter from the busbar without any disturbance to the load.

The AC ripple current that circulates between battery and inverter shall be minimised in order to maximise the life of the battery. The ripple voltage measured across the battery under and condition of charge and with the rectifier disconnected, shall be less than 1% under any load condition from full to no load. The Contractor shall state what precautions have been taken in the design of their equipment to comply with these requirements.

The Contractor shall describe the method by which the load through the IGBT thyristors is controlled. The temperature sensing probes shall be placed on the IGBT inverter stack.

The inverter shall have over temperature protection. The sensing of the off coming air temperature alone is not acceptable.

A "soft start" circuit shall be provided at the input to the inverter to limit inrush current at switch on.

The DC input to the inverter shall be fuse protected.

An isolator shall be provided allowing the inverter and electronic switch to be isolated from the output busbar for maintenance purposes.

The instrumentation, alarms and controls may be placed on either an inverter panel or the bypass switch front panel. All the Controls shall be arranged on a system schematic provided on the front panel to simplify the control and identification.

The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust pipe and silencer inside the plant room must be lagged to reduce heat and noise transmission

1.8 Auto Bypass Switch

A very high speed electronic bypass switch [static switch] shall be connected in parallel to the rectifier/inverter between the mains and output busbar. Transfer shall take place automatically without a break in the event of a major overload or on an internal inverter fault on the condition that the bypass source voltage and frequency are within the specified tolerances and that the inverter is synchronized. Manually initiated transfer shall also be possible.

The static switch shall be equipped with an RC filter for protection against switching overvoltage's and lightning strikes. An input and output isolator shall isolate the switch for maintenance purposes.

The thyristors shall be thermally protected.

The cubicle shall be separately ventilated.

1.9 Mechanical Bypass

A manually operated, quick make, quick break, fault break load make isolator rated for the full output load of the system, shall be provided as a bypass circuit from load to mains, enabling maintenance of the rectifier/inverter system and electronic switch.

1.10 Distribution Panels

The equipment offered shall be complete with input and output distribution panels.

The input distribution panel shall contain the following:

- Suitably rated quick make, quick break isolator as main switch.
- HRC fuse protection for each outgoing circuit as required by the equipment, including bypass circuits. The rating of each fuse and circuit identification shall be provided by means of engraved labels.
- A PM 210 meter shall be used for all current and voltage displays
- 3 x Class 1 current transformers to BS 3938.
- 1 x cyclometer mains failure counter.

The output distribution panel shall contain the following:

- Output circuit breaker.
- Supply circuit breakers to various distribution boards.
- System busbars for interconnection of output circuit breaker, inverter, electronic switch and mechanical bypass circuit.
- A PM 210 meter shall be used for all current and voltage displays
- 3 x Class 1 current transformers to BS 3938.

All equipment shall be clearly labelled in English, indicating function, circuit and rating where applicable.

1.11 Construction of Panels [Cubicles]

All the equipment shall be housed in totally enclosed, free standing, floor mounted metal cubicles, designed to provide adequate ventilation for the equipment. Input/output panels shall match the UPS panel in appearance, size, colour, etc. Degree of protection shall be IP32.

All cubicles shall be rigid with suitably braced doors providing front access.

All cubicles shall be vermin proof.

All equipment with the exception of the instrumentation, shall be mounted on the metal framework suitably arranged to provide safe operation and ease of access. Fuses and switchgear in particular should be safely accessible even under load conditions.

All auxiliary power supplies shall be connected to at least two primary sources of power i.e., mains and inverter output.

Flexible wires shall not be soldered directly onto terminals but shall have a crimped tab which is soldered onto a terminal or post.

All equipment shall be clearly and adequately marked. A single line mimic layout of the switchgear shall be provided on the front of the cubicles providing a graphic display of the circuitry of the equipment involved.

Input and output power cables shall be terminated using approved cable glands, onto a cable gland support bracket not less than 300 mm above the room floor level. The cable conductors shall terminate at connecting busbars or shall be connected directly to the appropriate switchgear. Power cable shall be properly numbered and identified by non-conductive cable markers with punched figures shall be used to identify cables at the termination point. External control, alarm, interlocking, measuring and supply circuits to external equipment shall terminate at numbered terminal strips. Wiring ends shall be fitted with ferrules or lugs that are securely crimped or soldered to the wire before insertion into the terminals.

External control, alarm, interlocking, measuring and supply circuits to external equipment shall terminate at numbered terminal strips.

Each individual wire at the terminal strips (both for internal and external circuits) and all internal wiring shall be fitted with durable cable or wire markers of approved type. These numbers shall appear on wiring diagrams.

Conductors of the internal wiring shall be large enough to carry the current in each respective circuit. The conductors shall be neatly arranged in horizontal and vertical rows and bound by means of suitable plastic bands. Wiring shall be kept free and away from exposed terminals or other un-insulated current carrying components.

The rear terminals of instrumentation mounted on the cubicle doors shall be covered by a removable cover plate or insulating sleeves so that no accidental contact with live terminals is possible when a door is opened.

Equipment cubicles shall be solidly earthed. A flexible (braided) earth bond shall be provided between cubicle frame and door.

1.12 Communication

It shall be possible to remote the following controls, indications and measurements. To that end, each modular UPS unit shall have as standard equipment:

A programmable card with four inputs and six outputs.

Communications options

The UPS system shall be designed to enable the extension of communications, without system shutdown, to the following types of cards that may be installed on each modular UPS unit:

Multi-standard communications card with two outputs:

- An RS485 serial-link implementing the JBus/ModBus protocol for connection to a building management system (BMS)
- Ethernet 10/100 Mbps using one of the protocols below:
- XML-Web for direct UPS connection to an intranet network, without connection to a server, capable of supplying information via a standard web browser SNMP for connection to a computer-network management system

Multi-standard communications card with three outputs:

The two outputs listed above.

- Plus a modem output for communication with a tele-maintenance system.
- The UPS shall be detectable by supervision software for large UPS systems.

Shutdown and administration software shall be available in addition to the communication cards.

1.13 Accommodation

Accommodation for the system is being provided.

Ventilation or air conditioning will be provided for by the building contractor and therefore does not form part of this tender.

Battery rooms will likewise be provided with extraction fans, flame proof electrical fittings and a washbasin with cold water and acid resistant working slab.

The Contractor shall indicate the arrangement of their equipment within the accommodation provided.

1.14 Installation

All installation costs shall be incorporated in the tender.

A system schematic diagram shall be prepared and mounted on the plant room behind clear Perspex.

1.15 Maintenance

The Contractor will be required to maintain the complete system in good running order for a period of twelve [12] months after the plant has been taken over. The cost of this maintenance must be included in the tender price. Maintenance required during the twelve [12] month period is listed and shown separately as part of this document.

After the lapse of this twelve [12] month period, the Contractor may be required to enter into a maintenance agreement. This agreement will initially be for one calendar year, and may subsequently be renewed for yearly periods.

The Contractor must be able to render a twenty-four [24] hour maintenance and repair service at all times, including statutory holidays. Full details of the firm's standby service facilities must be submitted at the time of tendering.

The Contractor shall prepare and submit a pro forma Maintenance and Service Contract. This Maintenance and Service Contract shall be a formal service agreement of the suppliers of the UPS power supply system signed by an authorised employee and shall include the monthly cost of the services to be provided. The Contractor must state to what extent the price quoted will be subject to variation. The Contractor shall take into account that maintenance can only be done on Sundays.

The entering into of a Maintenance and Service Contract shall in no way invalidate the Guarantee above.

The Service Contract shall include the following minimum provisions:

- a. To provide regularly scheduled preventative Maintenance and Service of at least one man day per three month period, i.e., at least four man days per year, by factory trained service representatives of the supplier of the UPS power supply system. At each visit which shall be arranged in advance, a record of maintenance carried out shall be kept. The time and date of visits shall be entered into a log book.
- b. To check the mechanical soundness of all parts.
- c. To check and adjust all the output and control values of the system (voltage, frequency, control voltages etc.).
- d. To take control measurements on the major system components and record these measurements.
- e. To replace all defective components.
- f. Service the batteries.
- g. Service the UPS cabinet ventilation equipment.
- h. Clean all equipment or rooms as required.
- i. To make available, upon request, emergency maintenance service.

- j. To carry out annually a thorough system check with the use of all the testing equipment and instruments required. A detailed report comparing system performance at the time of testing and the time of handing over, shall be prepared and submitted along with comments.

1.16 Drawings

As soon as possible after the award of the contract, the Contractor shall at his expense submit for approval three [3] prints of:

- All general arrangement drawings.
- Detailed dimensioned drawings of all plant and equipment.
- Complete wiring diagrams and block schematic diagrams.

At the same time a list of all equipment designations, labels etc., in both official languages shall be submitted for approval.

The approval of drawings shall not relieve the Contractor of his liability to carry out work in accordance with the terms of the Contract.

On completion of the Contract, three complete sets of "As Built" drawings shall be handed over at the expense of the Contractor.

These final drawings shall include:

A proper and accurate as made wiring diagram of the complete installation showing circuit numbers, terminal strip numbers and conductor colours.

A schematic diagram clearly showing function and component values. A material list showing make, model and characteristic of all components of the control equipment and switchgear is to be included.

Fully dimensioned as made physical layout drawing of the equipment, batteries, and ventilation equipment.

The Contract shall be deemed incomplete until all drawings have been received.

1.17 Instructions of Operator and Manuals

After completion of the installation and when the plant is in running order, the Contractor will be required to instruct an attendant in the operation of the plant until he is fully conversant with the equipment and the handling thereof.

Three copies of a maintenance, fault localising and operating manual are to be handed over on site together with the drawings specified above.

1.18 Tests

The complete testing including the provision of test facilities, instruments, dummy loads and switchgear at both the manufacturer's premises and on site shall form part of this Contract.

For tests at the manufacturer's premises and/or on site, two weeks advance notice shall be given in order that a representative can be sent to witness these tests.

The Contractor shall prove all specified values contained in this document and issued in his own specifications and literature.

On completion of the tests, a full test report shall be issued. The report shall contain all measurements taken as well as photographs of oscillograms or storage scope tracers of voltage waveforms, etc.

The entire system is subject to tests, inspection and acceptance by the Engineer and a representative appointed by the Owner.

The contractor shall make allowance for the requirements of the Green Star Commissioning requirements.

1.19 Availability of Spares

Spares and replacement parts shall be readily available in the Republic of South Africa and a guarantee of availability for a period of ten years shall be furnished.

The Contractor shall submit with their tenders a priced schedule of recommended spare parts which should be carried on site.

1.20 Information

The Contractor is required to submit the following information with his tender:

The information requested in the Schedule of Information.

A paragraph by paragraph schedule of compliance with this specification with detailed description of any deviations from this specification.

If alternative systems are offered, a clear description of the operating characteristics and special features of the equipment along with a motivation for offering the alternative.

Descriptive and illustrated brochures and other information pertaining to the no break system offered.

The proposed layout.

A priced schedule of recommended spare parts and special tools to be maintained on site.

The Contractor shall submit a list of successful installations completed in the Republic of South Africa.

2 DETAILED TECHNICAL SPECIFICATION

2.1 General

The Detailed Technical Specification shall be read in conjunction with the General Technical Specification and the drawings. This part takes precedence over the General Technical Specification and the drawings in respect of any discrepancies in the description of equipment, materials or methods.

2.2 Scope

This specification covers the supply, delivery, installation, commissioning and the free maintenance during the guarantee period of the Uninterruptible Power Supply Machine at

Building 46 on the CSIR's main campus in Pretoria.

The system will comprise of:

- 1 x 40kVA UPS machine with 20 minutes batteries in cabinets

The reader should note the input and output distribution is excluded from the tender and will be supplied by others. More details are provided on the attached drawing.

Note: All changeovers and cut-overs will be carried out after hours.

2.3 Programme

The anticipated completion date for the project will be clarified after appointment and is dependent on the availability of stock.

2.4 System Requirements

The system required will be configured as per this specification.

The UPS machines will be equipped with completely sealed, maintenance free 10 year batteries rated for 20 minutes at full load. The battery bank shall be split into 4 strings each controlled via separate isolators, to allow each string to be serviced independently, without effecting operation the UPS. It is accepted that during this maintenance period, the autonomy will be reduced by one machine at any given moment. The batteries will be housed in cabinets.

Tenderers are to note the following:

The autonomy of the batteries are 20 minutes.

Autonomy to be calculated at 25° Celcius with 20% additional capacity to cater for battery degradation.

Each UPS battery will comprise of 4 strings with individual isolators.

The machines shall be configured as follows:

1 x 40kVA UPS machine with 20 minute batteries in cabinets.

2.5 Ambient Conditions

The equipment shall be rated to operate continuously under the following site conditions:

- Altitude : 1700m above sea level
- Temperature : 40°C maximum, 0°C Minimum
- Relative Humidity : Typical of Pretoria

2.6 System Input Specification

- Nominal mains supply 400/231V \pm 10% 50Hz \pm 5%
- System 3-phase, 4-wire, earthed neutral
- Input fault level 350 MVA at 400V (rms symm)

2.7 System Output Specification

- Nominal load power factor 0.8
- Output voltage tolerance Steady state : 400V \pm 5%
- Transient 400V +8%/-10% (30 cycles duration)
- Frequency \pm 1%
- Load unbalance 30%
- Maximum harmonic content 15%
- Inverter overload capability 150% - 10 sec
 Static
 110% - 1 hour
 Dynamic
 1000% - 100 msec
- Battery capacity As specified

2.8 Standby Supply

The total UPS system will be provided with a supply via the normal incoming cable from the diesel-driven standby plant in the event of a mains failure. The power cables shall be supplied and installed by the electrical sub-contractor.

The contractor shall state the r.m.s content of harmonics generated by the UPS equipment insofar as it may affect voltage regulation of the standby plant.

The UPS control system shall be arranged to limit boost charging of the battery system when the UPS is supplied from the standby supply. A voltage free N/O contact will be provided by the electrical sub-contractor to signal operation of the standby plant.

2.9 Input/ Output panel and associated cabling

A cable suitably rated with a yellow/green insulated earth conductor will be provided by the Electrical Contractor to each of the UPS units and then from the UPS units to the relevant UPS distribution boards.

As noted earlier the reader should note the input and output distribution is excluded from the tender and will be supplied by others. The design of the input and output distribution drawings has been included in the tender document for clarity.

2.10 Plant Rooms

The UPS machines will be located in a room [to be built] adjacent to the current MLV room. The UPS batteries will be installed alongside the UPS machines.

2.11 Ventilation and Air Conditioning

Air conditioning will be provided by the HVAC sub-contractor. Tenderers shall clearly state the heat dissipation of each UPS with the tender documentation.

2.12 Battery System

A battery system conforming to the General Technical Requirements and Detailed Technical Specification of this specification shall be provided.

The battery system shall be of the 10 years sealed, maintenance free type, located in cabinets and shall be of the front terminal type. The contractor shall clearly state the battery warranties. The following battery specifications shall be adhered to:

To allow for end of life oversizing 20% depreciation of the bank shall be allowed for to achieve the specified autonomy of the battery bank.

The selection of the battery bank shall allow for a cut off voltage of 1.7 Volts per cell. Capacity of the batteries shall be disclosed to provide 20 minutes back-up.

A separate price shall be submitted, complete with details, for an extended battery manager system for each unit.

2.13 Operating Training

On completion of all tests, the contractor shall continue to be responsible for the complete operation and maintenance of the plant for a period of three weeks during which time, instructions shall be given to the Employer's staff of the proper operation and maintenance of the plant.

The operation and maintenance of the plant, for the duration of the instruction period, shall in no way relieve the contractor of his responsibility under the terms of contract.

2.14 Drawings

Approval of Drawings

The contractor shall submit, for approval, in principle, copies of all above-mentioned drawings prior to starting work or issue to other parties. Any work started (off site or on site) prior to receiving the Engineer's approval of drawings shall be at the contractor's own risk.

The Engineer may require from the contractor further detailed drawings and/or calculations which clarify features not adequately shown on the layout drawings. The request for additional details shall not be construed as extending the scope of this contract or altering the programme.

The contractor shall submit one electronic copy and one paper print of each drawing to the Engineer for approval.

The Engineer will return to the contractor, within four weeks of their receipt by him, one copy of each drawing marked "APPROVED IN PRINCIPLE" or marked with any changes which are necessary.

The contractor shall modify these details and drawings as required by the Engineer. The nature and date of each modification and distinguishing symbol shall be added and the drawings shall be re-submitted for approval.

Alterations to drawings, by the Engineer, are not intended to change the scope of work unless explicitly stated as doing so. Should any alterations, in the opinion of the contractor, change the scope of work, the contractor shall notify the Engineer immediately of receipt of the altered drawings before any further drawing work or fabrication is carried out. Claims for a change of scope, made after performance of the work constituting the claimed change of the scope of work will not be considered.

The "APPROVAL IN PRINCIPLE" of drawings by the Engineer shall not relieve the contractor of any responsibility in terms of the contract.

The Engineer will check the drawings for design only and approval of the drawings, schedules and catalogues shall not be construed as a complete check.

The contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings or particulars have been approved by the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the contractor.

Six copies of the Final Manufacturing and Installation Drawings shall be issued to the Engineer by the contractor within ten days or receipt of "APPROVAL IN PRINCIPLE". Further copies shall be provided and may be required by the Engineer either before or after final approval.

The contractor shall provide, at his own expense, all copies of drawings required by him in the execution of the work and shall also, at his own expense, supply to the Engineer such drawings and copies thereof as are provided for in the specification.

Record Drawings

On completion of the installation, but before final hand over, the contractor shall provide two transparencies plus the necessary prints of each of the contract drawings showing the installation as fixed:

- a. Complete installation layout
- b. Detailed drawings of all items of plant
- c. Electrical layouts and wiring diagrams
- d. Details of any other items requested by the Engineer

The drawings shall be sufficient in detail to enable the Employer's staff to maintain, dismantle, reassemble and adjust any part of the works.

The layouts shall show the location of all manual and automatic equipment, controls, control panels, outlets, etc.

2.15 Maintenance during Guarantee Period

The contractor shall maintain the entire installation as described in this specification for a period of twelve [12] months from the date of final hand over.

The maintenance visits shall be carried out at regular intervals, as necessary.

The maintenance shall cover all items of plant and equipment and shall include replacement of all expendable items.

In addition to the monthly maintenance visits, the contractor shall carry out all necessary visits due to failure of any item of the system. The contractor shall attend to all complaints by the Employer.

The contractor shall report to the Employer's nominated representative both on arriving and leaving the site. The contractor shall provide the Employer and Engineer with a Service Report for each visit whether scheduled or breakdown. At each maintenance visit, the contractor shall check the function of each item and shall ensure that the equipment is performing to specification. All automatic controls and safety devices shall be checked. All electrical control gear, bulbs, etc., shall be checked and adjusted or replaced as necessary.

The equipment shall be cleaned where necessary at each scheduled visit.

The contractor shall notify the Engineer prior to the final monthly service so that the Engineer may accompany the contractor.

The Engineer may at his discretion allow the maintenance period on any item of equipment or section of the installation start at a date prior to final hand over if it is put into operation for beneficial use of the Employer prior to final hand over. This will not be permitted in cases where final hand over is delayed due to the contractor not carrying out remedial work in good time.

The tender price shall include for a full complement of recommended spares for the total maintenance period as well as the following period of twelve months. Tenderers shall detail the allowance for recommended spares as a detailed breakdown of the total allowance.

2.15.1 Guarantee

The contractor shall guarantee the entire installation, as described in this specification for a period of twelve [12] months from the date of final hand over. The guarantee shall provide for all parts, spares and equipment that become defective during the guarantee period and these shall be replaced free of charge. The guarantee shall cover all costs including material, labour, overheads, travelling, etc.

The complete installation shall be guaranteed against defects whether patent or latent as well as against faulty materials and workmanship.

The guarantee shall cover all materials, plant and equipment whether or not it is covered by a manufacturer's guarantee. The twelve [12] month guarantee, in terms of this contract, on the entire installation shall be affected by the prior expiry of any guarantee provided by the manufacturer of any item of equipment or plant.

The contractor shall cede to the employer the remainder of any equipment guarantee which he has received from his suppliers and which extends beyond the twenty-four [24] month guarantee period. It shall be the responsibility of the contractor to ensure that the guarantee is transferable.

The Engineer may at his discretion allow the guarantee period on any item of equipment or section of the installation start at a date prior to final hand over if it is put into operation for beneficial use of the Employer prior to final hand over. This will not be permitted in cases where final hand over is delayed due to the contractor not carrying out remedial work in time.

2.16 Operating and Maintenance Manuals

The contractor shall provide three copies of the Operating and Maintenance Manuals.

The contractor shall submit, for approval to the Engineer, four weeks before completion of the installation, two copies of the Maintenance and Operating Manuals for the system supplied.

The Engineer will return these to the contractor, within ten working days of their receipt by him, marked with all changes which are necessary.

The contractor shall modify the manuals as required by the Engineer and submit the Engineer, within ten working days, two revised copies of the manuals. On completion of the installation, but before the plant is handed over to the Employer, the contractor shall provide three copies of the final Operating and Maintenance Manuals for the system supplied. The manuals shall be bound in book form with hard plastic covers to withstand constant use.

The manuals shall be properly indexed to facilitate easy reference.

THE MANUALS SHALL INCLUDE:

- A list of recommended servicing tools and specialist equipment.
- A list of spares with price breakdown to be supplied by the contractor to cover the period of warranty.
- A priced list of recommended spares necessary for a period of two years of operation.
- Exploded drawings or detailed spares list from which every item of every piece of equipment can be positively identified for ordering replacements.
- A list giving the name and address of the local agent for each item of equipment.
- A list giving the name and address of the manufacturer of each item of equipment.
- A copy of all test certificates obtained with the equipment.
- A list of recommended lubricants, [if applicable].
- A preventative maintenance programme for all equipment.
- Operating instructions for each item of equipment.
- Performance data and/or characteristic curves.
- Commissioning data.
- Record drawings.

2.17 Information to all contracts

Written guarantees with detailed conditions, [when applicable].

First twelve [12] month guarantee maintenance contract proposal with conditions, [as applicable].

Follow-up guarantee, [if any], and proposal for service/maintenance contract with conditions, [as applicable].

Complete set of documentation, including service instruction manual, [three sets]; one set should be on DVD/CD, [drawings].

List of recommended spares to be purchased immediately. Detailed reference to every supplier of such spares.

List of recommended tools and instruments to be purchased immediately for servicing, repair and testing purposes.

Proposals for possible training to the Employer's staff members, [operational and technical

2.18 Building Management System

A Building Management System [BMS] will be provided by a BMS Contractor and tenderers shall include in their price for the provision of relays, contacts, etc. to allow the BMS System to monitor at least 10 points on each UPS unit.

3 SCHEDULE OF PRICING

40kVA UPS machine with 20 minute each and 10 year batteries

	Description	Amount
	<u>UPS Machines</u>	
1.	1x40kVA machine with 20 minute batteries	R
	<u>General items</u>	
2.	Installation of UPS machine	R
3.	Training	R
4.	Preparation of drawings and "As Built" drawings	R
5.	Commissioning of UPS machine	R
6.	Maintenance for twelve [12] months	R
7.	Guarantee	R
8.	Operating and Maintenance manuals	R
9.	Factory acceptance testing	R
10.	Sub-Total	R
11.	14% VAT	R
12.	Total carried forward to Form of Tender [including VAT]	R

Notes:

- The above shall exclude VAT
- Exchange rate used for the above pricing as specified above.
- Cost of imported content:
- Delivery period:
- The spot rates as quoted in the document shall be used in the pricing of the submissions.

4 SCHEDULE OF DRAWINGS

DRAWING NO.	DESCRIPTION OF DRAWING
Z0423-SC-01	Schematic Diagram of Building 46 - ML/LV

TENDERERS ARE TO ENSURE THAT THEY ARE IN POSSESSION OF THE ABOVE DRAWING.