public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

SPECIFICATION

FOR THE

SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

AT

BUILDING NAME

TOWN

QUANTITY SURVEYORS

NAME
ADDRESS
ADDRESS
ADDRESS
TEL NO
FAX NO
CONTACT PERSON: NAME
CELL NO

ARCHITECTS

NAME
ADDRESS
ADDRESS
ADDRESS
TEL NO
FAX NO
CONTACT PERSON: *NAME*
CELL NO

ELECTRICAL ENGINEER

NAME
ADDRESS
ADDRESS
ADDRESS
TEL NO
FAX NO
CONTACT PERSON: *NAME*
CELL NO

DEPARTMENT OF PUBLIC WORKS

Building
Street address
CITY
Postal Address
CITY , Code

DATE

TABLE OF CONTENTS

	PAGES
Specification for the UPS	
Section 1 – General	1.1 – 1.4
Section 2 – Equipment Requirements	2.1 – 2.11
Section 3 – Schedule of Technical Information	3.1 – 3.*
Section 4 – Schedules of Quantities	4.1 – 4.*
Annexure A – Schedule of Imported Materials and Equipment	A1

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 1 – GENERAL

TABLE OF CONTENTS

Clause		Page
1.	Intent of Specification……..	1.1
2.	Standards and Codes…….	1.1
3.	Scope of Work…….	1.1
4.	Ambient Operating conditions……...	1.1
5.	Site Information……	1.1
6.	Co-ordination……	1.1
7.	Test Certificates and Inspections……..	1.1
8.	Guarantee and Maintenance…….	1.2
9.	Materials and Workmanship……..	1.2
10.	Brochures……..	1.3
11.	Submittals……..	1.3

SECTION 1 – GENERAL

1. Intent of Document

The specification is intended to cover the complete installation of the uninterrupted power supply. The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation.

2. Standards and Codes

Refer to clause 1 of Section 2 of this document for the relevant standards and codes.

All equipment shall be Y2K compliant.

3. Scope of Work

Supply, delivery, installation and commissioning of the complete uninterrupted power supply specified in this document.

The plant room will be provided by other trades and the contractor shall ensure that the space allowed is sufficient for the installation of the UPS and that the ventilation of the plant room is adequate. If any changes to the design have to be made the contractor must inform the consulting engineer in writing.

Consultant to include Particulars of this contract

4. Ambient Operating Conditions

a) Ambient Temperature
b) Relative Humidity
c) Altitude
d) Dust
e) Corrosion

Consultant to include information a – e particular to this project

5. Site Information

Consultant to include Particulars of this contract

6. Co-ordination

Due to the nature of the installation, a fixed sequence of operation is required to properly install the complete uninterrupted power supply. The work shall be closely scheduled in order not to delay the entire project.

The contractor shall familiarise himself with the requirements of the other trades and shall examine the plant and specification covering each of these sections.

The space requirements shall be carefully checked with the other trades to ensure that he equipment can be installed in the proper sequence in the space allocated.

7. Test Certificates and Inspections

The following tests are to be carried out :

(a) After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected and

the contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

(b) The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion.

(c) Test reports of both tests as specified under (a) and (b) are to be submitted to the Department.

8. Guarantee and Maintenance

The Contractor shall guarantee the complete plant for a period of twelfth months after first delivery has taken place.

If during this period the plant is not in working order, or not working satisfactorily owing to faulty material, design or workmanship, the Contractor will be notified and immediate steps shall be taken by him to rectify the defects and/or replace the affected parts on site at his own expense.

The Contractor shall maintain the plant in good working condition for the full twelfth month period to the final delivery of the installation. However, should the Contractor fail to hand over the plant in good working order on the expiry of the specified twelfth months, the Contractor shall be responsible for further monthly maintenance until final delivery is taken.

During this period the contractor will undertake to arrange that the plant be inspected at regular intervals (whatever number of visits the contractor deems necessary to fully maintain the equipment) by a qualified member of his staff who shall: -

(a) Check the mechanical soundness of all parts

(b) Check and adjust all the output and control values of the system (voltage, frequency, control voltages, etc.)

(c) Take control measurements on the major system components and record these measurements.

(d) Replace all defective components.

(e) Service batteries.

(f) Check ventilation UPS equipment.

(g) Clean all equipment and/or rooms as required.

(h) Provide 24 hour standby maintenance and repair service at all times, including statutory holidays.

Note: At each visit, which shall be arranged in advance with the client's representative, a record of maintenance carried out shall be kept. The time and date of visits shall be entered in a logbook, which shall be kept in the plant room.

9. Materials and Workmanship

(a) The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative/Agent who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(b) All work shall be executed in a first-class manner by qualified tradesman.

(c) The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in the Contract Document.

(d) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.

(e) All components and their respective adjustment, which do not form part of the equipment installation work, but influence the optimum and safe operation of the equipment shall be considered to form part of, and shall be included in the Contractor's scope of works.

(f) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(g) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the installation and guarantee periods to ensure the safety of the public and the User Client.

(h) The Contractor is to include for all scaffolding required to complete the work required.

10. Brochures

Detailed brochures of all equipment offered shall be presented together with the tender documents.

11. Submittals

The following information must accompany the tender documents

(a) The information requested in the schedule of information.

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

(c) 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.

(d) Descriptive and illustrated brochures and other information pertaining to the inverter and ventilation equipment and switchgear.

(e) The proposed layout as stated.

(f) Arrangement of batteries.

(g) A sample test report as stated.

(h) The circuit diagram requested.

(i) The information requested.

(j) Tenderers shall submit a list of successful installations completed in the Republic of South Africa.

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 2 – EQUIPMENT REQUIREMENTS

TABLE OF CONTENTS

Clause		Page
1.	Quality, Standards and Regulations…….	2.1
2.	Uninterrupted Power Supply (UPS)……..	2.1
3.	Construction Of Cubicles And Switchboards……..	2.7
4.	Instrumentation And Controls……	2.8
5.	Alarms……...	2.8
6.	Ventilation…….	2.8
7.	Quality Assurance……...	2.9
8.	Drawings……...	2.9
9.	Instruction Of Operator And Manuals……..	2.9
10.	Tests……..	2.9
11.	Cabinet……..	2.11
12.	Schematic Diagram…….	2.11
13.	Auxiliary Equipment……	2.11
14.	Ups Power Plug Outlet……...	2.11
15.	Distribution Wiring……...	2.11

1. QUALITY, STANDARDS AND REGULATIONS

All material and equipment supplied for this contract shall be new and the best of their respective kind. All new materials and equipment supplied, shall comply fully with the requirements laid down in the specification. The whole of the works shall be executed in accordance with best practice and to approval of the engineer. The equipment shall comply with the latest issues of the following standard specifications:

1.1 South African Bureau of Standards

SABS 150	Insulated wire.
SANS 1091	Colour standards for paint.
SANS 0142	Wiring code of practice.
SANS 1474	UPS units.

1.2 Regulations and Rights of Engineer

Apart from any other authority, which the engineer may have in terms of the contract, he shall have the right to set the standard and to accept or reject part of the specified equipment depending on the quality of material and workmanship offered.

The contractor shall be notified if the quality of such materials and/or workmanship is not acceptable. In such an event, the contractor shall replace the specific part or repair it to the satisfaction of the engineer, all at the cost of the contractor. Such an instruction shall not exempt the contractor from any of his obligations in terms of the contract.

The installation shall be erected and carried out in accordance with:

a) The Basic Conditions of Employment Act and the Machinery and Occupational Safety Act of 1983, as amended.

b) The local Municipality by-laws and Regulations as well as the regulations of the local Supply Authority.

c) The local Fire regulations.

d) The Regulations of the Department of Posts and Telecommunications.

e) The Standard Regulations of any Government Department or public service company where applicable.

In addition the contractor shall at his cost issue all notices in respect of the installation to the local authorities, and shall exempt the client from all losses, costs or expenditures which may arise as a result of the contractor's failure to comply with the requirements of the regulations enumerated above.

It shall be assumed that the contractor is conversant with the above-mentioned requirements. Should any requirements, by-law or regulation, which contradicts the requirements of this document, apply or become applicable during erection of the installation, the contractor shall immediately inform the engineer of such a contradiction. Under no circumstances shall the contractor carry out variations to the installation in terms of such contradictions without obtaining the written permission to do so from the engineer.

2. UNINTERRUPTED POWER SUPPLY (UPS)

2.1 Definitions

(a) **UPS** shall denote the complete UPS unit with associated controls, remote alarm panel and batteries and any accessories required by the system for its successful operation.

(b) **Power Converter Module** shall denote a rectifier, battery charger, inverter, electromechanical by-pass switch and manually operated by-pass switch.

(c) **Rectifier** shall denote that portion of the converter module containing the equipment and controls to convert the incoming AC power to regulated DC power required by the inverter.

(d) **Inverter** shall denote that part that converts the DC supplied by the rectifier to AC satisfying the load requirements.

(e) **Electro-mechanical** by-pass static switch shall denote a by-pass system provided break free switching from inverter to mains operation and vice versa.

(f) **Battery charger** shall denote that portion of the power converter module containing the equipment and controls to convert the incoming AC power to precisely regulated DC power required for battery charging.

(g) **Critical load** denotes the load as presented to the UPS by the computer or other load requiring constant supply and associated circuits and apparatus.

(h) **Mean-Time-Between-Failure (MTBF)** shall denote an overall MTBF of the UPS as a complete system.

(i) **A system failure** shall denote any interruption to, or degradation of the critical load bus voltage or frequency beyond the limits set forth herein.

(j) **Efficiency** shall denote the ratio of real output power (kW) to real input power (kW) with the UPS operating at a defined load power at the defined power factor, the battery fully charged and with nominal input voltage.

2.2 System Requirements (The Required Input and Output Voltages Are Detailed In Part 2 Of This Specification)

(A) Input to the UPS

(a) Input voltage : 400/231V ± 10% or 231V ± 5%

(b) Frequency : 50Hz ± 4%

(c) System : 1 phase 2 wire or 3 phase 4 wire with operative earth conductor, supplied from utility network or standby generator set. Refer to detail specification.

(d) Power factor Not less than 0,8 lagging.

(e) Max starting current: 10 times full load current for not more than ½ a cycle with rectifier soft starting facility.

(B) **Output to Load**

(a) Rating : Refer to detail specification.

(b) Output voltage : Refer to detail specification.

(c) Frequency : 50 Hz ± 0,5 Hz.

(d) System : 1 phase 2 wire or 3 phase 4 wire with operative earth conductor. Refer to detail specification.

(e) Voltage regulator : ± 10% maximum deviation of steady state voltage recovering to within 5% in less than 50 ms and to within 1% less in that 100 ms.

(f) Frequency stability : Normally automatically synchronised to mains frequency if the latter is within 50 Hz ± 2% (adjustable window) Runs free at 50 Hz ± 0,5 Hz at any load when mains is out of limits.

(g) Harmonic content : Less than 4% total distortion.

(h) Amplitude modulation : Less than 2%

(C) Overall Performance

Efficiency (overall) : 80 - 85%

(D) Ambient Operating Conditions

Refer to Section 1, General – Clause 5

(E) System Description

The system shall consist of a static UPS complete with the following components :

(a) Rectifier/charger.

(b) Inverter.

(c) Battery.

(d) Automatic electronic no-break bypass circuit and switch.

(e) Separate manual bypass switch.

(f) Protective devices and measuring equipment.

(g) The required controls and necessary equipment.

(h) A self monitoring system with digital readout by means of which all critical functions can be checked.
Note: Requirement (h) Is Only For Ups Systems Above 200 kVA

The system shall be capable of providing an uninterrupted supply to the load with the output characteristics as specified for a minimum period of **30 minutes** during a total mains failure (i.e. normal mains and standby generator supply failure). The batteries shall be rated at an AC load power factor of 0,8 lagging.

The complete system, including all controls shall be designed in such a way that the failure of any one vital central component will **NOT** cause a complete system failure. If necessary such a failure must be avoided by connecting the load directly to the mains by means of the bypass switch.

The UPS shall operate satisfactorily synchronous with the mains supply even under severe conditions of up to 100% unbalanced load.

The UPS shall be amply rated to carry the stated full load current. The UPS shall furthermore be capable of withstanding the following overloads.

Static Overloads: 100% of full load continuously.
125% of full load for 5 minutes.
150% of full load for 2 minutes.
165% of full load for 1 second with inductive decay after initial equipment switch on surge current.

Dynamic Overload : 300% for less than 5 msec.
1000% for less than 1 msec.

All component parts, cables and other connections shall be amply rated to withstand the overloads stated and maintain the input voltage **at the load** within the tolerances stated.

The equipment shall be designed for the maximum operating efficiency. The efficiency shall be determined when the system is delivering full load at 0,8 power factor with the batteries fully charged. The load required by the auxiliary equipment (controls, alarms, etc). electronic switches and cabinet fan shall be included in he determination of overall efficiency. A typical test report clearly showing how the efficiencies are calculated, shall be submitted with the tender.

It shall be the responsibility of the successful tenderer to ensure satisfactory operation of the complete system for the load to be supplied. It is, therefore, essential that the tenderer acquaint himself fully with typical load conditions before the tender closing date.

All cabinets containing thyristors shall be adequately screened and earthed to prevent direct radio frequency radiation.

Tenderers shall submit with their tenders a schematic diagram showing :

Input circuit breakers.
System busbars.
Rectifiers.
Batteries.
Inverters.
Electronic switches.
Bypass circuit.
Detour circuit.
Fuse protection.
Output circuit breakers.
Oscillator.
Power supply circuits to oscillator, alarms, controls, etc.
Battery isolator.

The diagram shall also show the relative phase displacement of the rectifier transformers.
NOTE: This Is Not Applicable To Systems Below 200kVA.

(F) Inverter Oscillator

The inverter shall contain an oscillator capable of operating and maintaining the inverter output frequency as specified. The inverter oscillator shall be capable of frequency synchronisation and phase locking to the mains (or standby generator) power source frequency. When operating as a slave to the mains or standby power and a failure occurs in the slaving signal, the invertor oscillator shall automatically revert to a free running state and maintain the specified limits. All changes in output frequency to free run or synchronise shall be gradual to suit the load requirements.

(G) Rectifier

The UPS shall have its own rectifier and rectifier transformer which shall operate satisfactorily from the mains or standby supply.

The rectifier shall be of the solid state type providing full wave rectification of the input voltage suitably regulated to suit the input requirements of the inverter. Where necessary, a high grade DC filter shall be utilised to limit the output ripple to within acceptable levels for the inverter input. Current limiting features shall be provided to protect the rectifier. The current limiting settings shall be variable for final adjustment on site.

Voltage free contacts shall be provided for the malfunction alarms of the rectifier.

An input monitoring circuit shall be provided for the rectifier. This circuit shall switch off the rectifier when the r.m.s. value or frequency of the input voltage falls below present values.

The necessary protection circuitry shall be provided to switch off the rectifier if any one of the rectifier phases should fail, thus presenting an unbalanced load to the incoming supply.

The output of the rectifier shall be connected in parallel to the battery and inverter.

The rectifier shall have over temperature protection. Temperature sensing probes shall be placed on the thyristor housing, thyristor mounting, or on the heat sink close to the thyristor. The sensing of the off coming air temperature alone is not acceptable.

Tenderers shall take into account the possible effects of harmonics that may be present on the input supply due to non-sinusoidal waveforms at the rectifier input, phase commutation, the effect of reactance during phase commutation etc. 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.

For three phase units each of the three rectifier transformers shall have a different primary to secondary phase displacement in order to minimise the harmonics generated by the rectifiers.
NOTE: This Is Not Applicable For Systems Below 200 kVA

(H) Inverter

The inverter shall be adequately protected against any excessive overload or short circuits that occur in the load. Reactive current limiting or other methods shall be employed to render the thyristors short circuit proof. The successful tenderer shall replace any thyristors or any inverter components at his own expense if these should be damaged.

The necessary feedback and control circuits shall be incorporated to ensure satisfactory operation separately or in synchronisation with the mains supply under all conditions of dynamic load variations, stated overloads, severe unbalanced conditions and high operating temperatures. The thyristor bridge shall contain the necessary auxiliary circuitry to ensure satisfactory operation.

The output of the inverter shall be connected in parallel with the thyristor switch output.

Each inverter shall have over temperature protection similar to the over temperature protection for the rectifier.

A discharge device shall be provided across the D.C. input to the inverter, which will discharge any capacitors in the inverter module when it is switched off.

(I) Battery charger

The battery charger shall be a solid state, constant voltage type providing full wave rectification of the input voltage with the output regulated to an accuracy as specified. A high grade D.C. filter shall be utilised to limit the output ripple to the stated tolerance. Current limiting features shall be provided. The value of the current limit setting, shall be in accordance with the maximum allowable charging current that the batteries can withstand.

The maintained voltage on float charge shall be such as to give maximum life to the batteries whilst maintaining the maximum charge conservation and minimising gas formation and water loss. The optimum float charge voltage shall be specified by the battery manufacturer but is expected to be approximately 2,23 volts per cell. The voltage shall be kept within ± 0,5% of the nominal value for all loads from no load to the full rated battery charger current when supplying the full output with batteries discharged.

(J) Computer rooms/office UPS installation

The rectifier shall be equipped with **2 independent** over voltage shutdown contacts for maximum charger security.

The battery charger shall be designed to charge the batteries to 90% of its fully charged capacity within 14 hours and to 100% capacity within 20 hours.

The battery charger shall be capable of boost charging the batteries to 2,6 volt per cell. The boost facility shall be manually operated.

The battery charger shall be provided with a current limiting circuit.

The current limit setting shall be variable for easy adjustment on site.

The necessary voltage free contacts for the alarms and battery charger failures shall be allowed for in the tender price.

The battery charger shall have over temperature protection similar to the protection specified for the rectifier.

The battery charger shall have circuitry to inhibit the charging of batteries from the standby generator. This circuitry shall be activated by normally open contacts on the generator control panel. The interconnecting cables will be supplied and installed as part of this contract.
NOTE: This requirement is only applicable for UPS systems above 200kvA

(K) Battery

The battery capacity shall be sufficient to provide full load for the specified time. The capacity shall be rated at a maximum specific gravity of 1,245 at 25 C and correctly filled.

Tenderers shall state the discharge capacity of the battery after 10 hours of charge and the battery voltage at its terminals under various conditions. The inverter shall switch off on low battery voltage.

The battery cells shall be of the maintenance free type.

The batteries shall give satisfactory service for a minimum period of **3 years**. Tenderers shall state the maximum expected lifetime of the batteries and motivate their statement, and provide a statement by the battery manufacturer supporting this and stating that the charger offered is suitable for the battery.

The cells must be mounted in a matching steel cabinet or in the same cabinet as the control equipment. The vented type cells should be mounted on a wooden stand, consecutively, numbered with positive and negative terminals clearly marked in a ventilated battery room.

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.

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

All connections to cells must consist of flexible cable to avoid mechanical stress at the cell terminals.

The tenderer shall describe the method of removal and replacement of a faulty cell.

The battery shall be complete with a battery fuse isolator capable of breaking the full load current drawn by the inverter. These battery fuse isolators shall be installed in the inverter unit room or cabinet.

Terminal posts should be effective for the expected lifetime of the battery and should be effective even if the cell is overfilled.

The battery may be resistance grounded through 5000 ohm to 10000 ohm for the purpose of ground fault.

Tenderers shall submit full details with dimensioned drawings of the batteries offered.

Tenderers shall submit the calculations and motivations complete with curves supporting the selection of a specific battery cell.

All cabling for the battery shall be installed on PVC cable trays and fitted to the satisfaction of the engineer.

(L) Automatic by-pass switch

An integral automatic bypass switch shall be provided to transfer the critical load without break to the mains should the UPS unit fail. The latter unit shall simultaneously be disconnected from the critical load bus. This transfer shall, however, be inhibited if the mains is out of synchronism with the UPS output. Retransfer to the UPS output shall be on a manual or automatic command. This switch must have a cover fitted screwed to the panel so as to make the operating of this switch impossible without having first removed the cover. This switch cover must also have the following words etched in white with a red background mounted on or adjacent the cover: **CAUTION : BYPASS SWITCH ONLY : ONLY TO BE OPERATED BY QUALIFIED PERSONNEL**

The static switch should prevent "hunting" and after trying unsuccessfully to switch a maximum of **three** times the static switch should be inhibited from further switching.

3. CONSTRUCTION OF CUBICLES AND SWITCHBOARDS

All the converter equipment shall be housed in totally enclosed, free standing, floor mounted cubicles, designed top provide adequate ventilation for the equipment.

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

All cubicles shall be vermin proof.

All equipment 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 power bridges, filters and other major components both in the inverter and rectifier, shall be completely withdrawable to facilitate rapid repair and/or replacement. The method of withdrawal shall be such that a complete module can be extracted in the operating condition so that checks and measurements may be made while in operation and access to all components facilitated.

All electronic printed circuit cards shall be of a good quality and shall be easy and simple to interchange.

All auxiliary power supplies shall be duplicated and shall be connected so as to operate in parallel redundancy. At least two primary sources of power shall be provided for each of the power supplies in the system.

Flexible wires shall not be soldered directly onto terminals but shall have a crimped tab, which is soldered onto a terminal or post. The wire wrapping technique shall be employed for electronic circuits where possible.

The front panel alarms shall be clearly and adequately marked in both official languages. 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.

All input and output power cables shall be terminated using approved cable glands, onto a cable gland support bracket. The cable conductors shall terminate at the connecting busbars or shall be connected directly to the appropriate switchgear. All power cables

shall be properly numbered with wrap around cable markers with punched figures to identify cables at each termination point.

4. INSTRUMENTATION AND CONTROLS

All the required instrumentation as indicated on the drawings shall be provided.

Supply and install all the necessary controls for the operation of the system. Facilities shall be provided for controlling the rectifier, switching the inverter on, switching the inverter output to the synchronous motor/alternator and controlling the bypass thyristor switch circuit.

All control switching of the rectifier and inverter as well as the bypass operation shall be pushbutton initiated.

Standard electronic equipment from overseas manufactures shall **not be accepted** if not duly protected with transsorbs and metal oxide varistors in power supplies and external communication lines. Standard electronic equipment not internally protected with transsorbs or MOV's may be protected externally by means of transsorbs and MOV's mounted on klippon type terminals. All external communication and remote power supply lines shall be protected by means of transsorbs and MOV's of sufficient rating mounted on klippon type terminals.

5. ALARMS

All alarms shall be of the tell tale type with memory features e.g. a flashing light indicates a fault coupled with an audible alarm. The pressing of the appropriate button shall cancel the audible alarm and allow the alarm lamp to burn continuously until the fault is removed.

The following minimum alarm conditions shall be monitored on the equipment:

(1) Normal
(2) Mains failure
(3) Inverter failure
(4) Shutdown imminent
(5) Load on mains
(6) Overload
(7) Charger fails

Where required a remote panel must be supplied and installed. The alarms indicated must duplicate all the alarms indicated on the UPS control panel. In addition a buzzer must be provided. Any alarm occurring must sound the buzzer to draw attention. An alarm accept pushbutton to silence the buzzer must be provided.

Provision shall be made on all the alarms mentioned above to be remotely monitored. Normally open contacts shall be supplied at the converter for each alarm for this purpose. The contacts shall close under an alarm condition.

6. VENTILATION

All equipment racks shall be positioned in logical fashion on the floor in a configuration, which will ensure proper ventilation

Each cubicle containing heat-generating equipment (thyristors, transformers electronic circuitry, filters, etc) shall, where necessary, have extraction ventilation fans mounted on the top of the cubicle to assist air circulation. These fans shall be fed from the output distribution panel of the uninterrupted power supply.

7. QUALITY ASSURANCE

The manufacturer shall be responsible for the performance as specified herein and to prove such performances to the satisfaction of the engineer. Except as otherwise specified, the supplier must utilise facilities acceptable to the engineer.

8. DRAWINGS

As soon as possible after the awarding of the contract, the successful tenderer shall at his expense submit to the engineer for approval, three prints of:

(1) All general arrangement drawings.

(2) Detailed dimensioned drawings of all plant and equipment.

(3) 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 successful tenderer of his liability to carry out work in accordance with the terms of the contract.

On completion of the contract, a complete set of transparencies of all drawings of a quality acceptable to the engineer shall be handed to the engineer at the expense of the successful tenderer. These final drawings shall include:

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

(2) A schematic diagram clearly showing functions and component values. A material list showing make, model and characteristics of all components of the control equipment and switchgear is to be included.

(3) Fully dimensioned as-made physical layout drawing of the equipment, batteries and ventilation equipment.

(4) A detailed **schedule** of all wiring.

The contract shall be deemed incomplete until all drawings have been received by the client.

9. INSTRUCTION OF OPERATOR AND MANUALS

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

Three (3) copies of maintenance, fault-localising and operating manuals together with the drawings required shall be handed over to the engineer.

10. TESTS

The complete testing including the provision of test facilities, instruments, dummy loads and switchgear at the manufacturer's premises in the Republic of South Africa shall form part of this contract. If the factory tests cannot be performed in the RSA, the client may, at his discretion and own cost, decide to attend tests at the supplier's overseas factory. Tenderers shall not allow for this.

For the test in the manufacture's premises the client shall be notified four weeks in advance in order that a representative can be sent to witness these tests.

10.1 Battery tests

(1) The output voltage of the battery unit (i.e. all the cells making up one battery) shall be tested with the incoming supply removed.

(2) The full rated load for the battery shall then be connected to it. The voltage shall be measured at 5 minute intervals for the duration discharge period.

(3) The batteries shall be left to recharge. The voltage shall be checked after 14 hours with the load and incoming supply removed as well as with the load connected but incoming supply removed.

(4) When fully recharged, the voltage and specific gravity of every cell shall be measured with the incoming supply removed.

(5) The circulating A.C. current through and the A.C. voltage across the batteries shall be measured when the rectifiers are on with the battery discharged and fully charged.

10.2 Oscillator tests

(1) Frequency within tolerances at all loads.

(2) Parallel redundancy.

(3) Auto automatic synchronisation for connection of the synchronous motor/alternator to mains via the thyristor switch.

An electronic frequency counter shall be used to measure the frequency.

10.3 Rectifier tests

(1) Output voltage of rectifiers at no load and full load with batteries charged and not charged.

(2) Current limit, both for mains failure and return to mains.

(3) Switch off value mains input monitor.

(4) Sequential switch on for return to mains.

(5) Soft start circuits.

10.4 General

Ammeters will not be acceptable to prove the above items. A wave analyser and a recording oscilloscope will be required. Photographs shall be taken of the oscillograms by the contractor in the presence of the engineer.

The overall efficiency of the complete uninterrupted power supply shall be proved to be within the specified limit at full load and at no load.

The overcurrent protection mechanisms of the A.C.B. shall be proved by current injection (either primary or secondary)

The bypass and detour circuits shall be proved.

All alarms, indications and control functions shall be proved.

The test instruments provided shall in all cases be of high quality and suitable to be able to adequately assess the quantities being measured and the equipment being tested. All instruments shall be calibrated by a testing laboratory approved by the National Calibration Service of the CSIR. The test equipment remains the property of the successful tenderer.

At the completion of the tests, a full test report shall be submitted by the contractor to the engineer in triplicate.

Continuously adjustable dummy loads of a rating suitable to comprehensively test the UPS shall be provided by the contractor as well as any temporary cables required for the connection of the dummy load to the UPS on site.

11. CABINET

The contractor shall supply and install a metal cabinet with lockable doors of sufficient size to house all operating and maintenance instructions, drawings, spares, tools, etc.

12. SCHEMATIC DIAGRAM

A schematic diagram of the complete system shall be mounted in a suitable place and shall be resin encapsulated.

13. AUXILIARY EQUIPMENT

Tenderers shall make all allowances for plant required (i.e. hoists, cranes, trolleys, etc.) ensuring positioning of the equipment in the UPS room.

14. UPS POWER PLUG OUTLET

All UPS power plug outlets must be of the red non-standard 3-pin type with the earth pin not earthed to the plug baseplate to facilitate the installation of a single earth connection earthing system. Each socket outlet must be provided with a red plug top.

Each socket outlet must be labelled with an engraved label indicating the power circuit number to which it is connected.

15. DISTRIBUTION WIRING

All sub-distribution wiring circuits must be wired as follows:

15.1 Mains power plug circuits

4 mm^2 PVC/copper in red and black conductors and a 2,5mm^2 bare copper earth.

15.2 UPS power plug circuit

4 mm^2 PVC/copper in blue and black and a green PVC insulated 2,5mm^2 earth wire.

The black neutral conductors must be clearly labelled at each end as follows: "UPS" or "OKT"

15.3 UPS Earthing

The main earth bar must be connected to the insulated earth bar of the UPS via a removable copper link bar.

All UPS boards must have insulated earth bars, separately earthed to a clean 1,2m earth spike be means of 70mm^2 insulated earth to obtain at least one ohm at the UPS board.

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

TABLE OF CONTENTS

Clause		Page
1.	System Parameters…….	3.1
2.	Battery Charger……	3.4
3.	Oscillator……...	3.5
4.	Inverter……..	3.5
5.	Static Switch…….	3.6
6.	Batteries……	3.6
7.	Systems Above 200kVA……	3.7
8.	Details Of Manufacture Of UPS……..…….	3.8

SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

1. SYSTEM PARAMETERS

1.	Net output power of inverter system	kVA
2.	Power factor for which the system is rated	Lagging
3.	Nominal input voltage	Volts
4.	Maximum input voltage tolerated	Volts
5.	Minimum input voltage tolerated	Volts
6.	Maximum input frequency deviation tolerated	Hz
7.	Maximum and minimum input power factor at rated KVA	kVA
8	Maximum harmonic input tolerated for successful operation	%
9	Nominal output voltage	Volts
10	Steady state output voltage regulation	Volts
11	Dynamic output voltage regulation:	
(a)	Step load of 25% between 10% and 100% of full load	%
(b)	150% overload for 1 sec	%
(c)	Input voltage step variation of ± 15%	%
12	Time for voltage recovery to steady state:	
(a)	25% step load	ms
(b)	100% step load	ms
(c)	150% step load for 1 sec and then returned to 100%	ms

13.	Relative output phase angles at 100% unbalanced load (in degrees)	Degrees
14.	Maximum harmonic content of output voltage	%
15.	Overload capacity	
(a)	One hour	%
(b)	One minute	%
(c)	Ten seconds	%
(d)	One second	%
(e)	Five msec	%
(f)	One msec	%
16.	Total input required with batteries charged for rated full load	KVA
17.	Total input required at full load and and battery discharged	KVA
18.	Allowable temperature rise across equipment at input air temperature of:	
(a)	25 °C	°C
(b)	30 °C	°C
(c)	32 °C	°C
(d)	35 °C	°C
(e)	40 °C	°C
19.	Heat dissipation under normal full load Running conditions:	
(a)	Converter	KW

(b)	Battery		KW
20.	Efficiency of the complete UPS system	**1,0p.f.**	**0.8p.f**
(a)	Full load	%	%
(b)	80% load	%	%
(c)	75% load	%	%
(d)	65% load	%	%
(e)	50% load	%	%
(f)	40% load	%	%
21.	R.M.S. value of the A.C. **current** component through the batteries for:		
(a)	Discharged battery		Amp
(b)	Charged battery		Amp
22.	R.M.S. value of the A.C. **voltage** component through the batteries for:		
(a)	Discharged battery		Volts
(b)	Charged battery		Volts
23.	Total number of cubicles		
24.	Total floor space required		m^2
25.	Dimensions of cubicle in mm		W
			H
			L

2. BATTERY CHARGER

1.	Type	
2.	Output voltage for trickle charge	Volts
3.	Steady state regulation of output voltage trickle to full load	± %
4.	Output voltage for input voltage fluctuation	
(a)	± 10%	%
(b)	± 15%	%
5.	Ripple content (%)	%
6.	Current limit value	Amp
7.	Input voltage at which battery charger switches off	
(a)	Maximum	Volts
(b)	Minimum	Volts
8.	Maximum switch on inrush current	Ampere
9.	Battery charger overload protection (type)	
10.	Efficiency	%
11.	How is the effect of harmonics on input voltage minimised ?	

3. OSCILLATOR

1.	Type of oscillator (RC, crystal, etc.)	
2.	Stability:	
(a)	With oscillator supply fluctuation	± %
(b)	Temperature variation	± °C
(c)	Number of power supplies in parallel redundancy	
3.	Number of batteries from which oscillator is fed	
4.	Minimum time synchronise to mains frequency	sec

4. INVERTER

1.	Maximum continuous power output (kVA)	KVA
2.	Nominal output voltage	Volts
3.	Maximum harmonic content	%
4.	Nominal input voltage:	
(a)	Maximum	Volts
(b)	Nominal	Volts
(c)	Minimum	Volts
5.	Input current at full load	Ampere
6.	Input power factor at full load	Lagging
7.	Efficiency at full load	%
8.	Overload protection	

5. STATIC SWITCH

	Does switch comply to clause 3.2.2.12	
1.	Describe electronic switch	
2.	Minimum power factor at which switches will operate satisfactorily	
3.	How does switch derive operating signal ?	
4.	Maximum break time for switchover	ms

6. BATTERIES

1.	Manufacturer	
2.	Country of origin	
3.	Type	
4.	Type No	
5.	Total number of cells	
6.	Number of cells per inverter	
7.	Battery voltage (float conditions)	Volts
8.	Battery voltage (Boost charge)	Volts
9.	Capacity (rated for time required)	Ah at
		Hrs
10.	Battery time offered under load conditions specified in Clause 2.17 Part 2) and (Clause 3.2.2.5 (Part 3)	Minutes
11.	Maximum output current	Ampere

12.	Cell voltage under float conditions	Volts
13.	Cell conditions under boost conditions	Volts
14.	Cell voltage at start of discharge and full inverter load	Volts
15.	Cell voltage at end of discharge period	Volts
16.	Expected lifetime of batteries	Years
17.	Time to charge to 90% capacity	Hrs
18.	Total time to charge to 100% capacity	Hrs
19.	Material of supporting framework	
20.	Finish of framework	
21.	Dimensions of each cell	W
		H
		L
22.	Design of positive plate of cell	
23.	Rating of fused isolator	Ampere
24.	Cell configuration	

7. SYSTEMS ABOVE 200kVA

1.	No of shelves	
2.	No of rows/shelves	
3.	No of tiers/shelves	
4.	Shelf length	
5.	Shelf height (incl. Batteries)	

NOTE : ALL BATTERY CALCULATIONS INCLUDING CURVES SHALL BE INCLUDED IN THE TENDER

8. DETAILS OF MANUFACTURE OF UPS

1.	Manufacturer	
2.	Address	
3.	Country of origin	
4.	Make or trade name of equipment	
5.	Manufacture's type no.	
6.	Is tenderer an accredited agent ?	YES/NO
7.	Furnish details of maintenance and repair service facilities which can be rendered.	

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY
SECTION 4 – PRICE SCHEDULES

TABLE OF CONTENTS

Clause		Page
1.	General……	4.1
2.	Schedule..……	4.1
3.	Summary of Schedule of Quantities……	4.2

SECTION 4 – PRICE SCHEDULES

1. General

1.1 The conditions of contract and the application of the Contract Price Adjustment Provisions shall be as set out in Part A: Section 1: Preliminaries.

1.2 The descriptions in this Price Schedule shall be read in conjunction with the specification.

1.3 The unit rate for each item in the Price Schedules shall include for all materials, labour, profit, transport, etc., everything necessary for the execution and complete installation of the work in accordance with the description.

1.4 The Price Schedules shall not be used for ordering purposes. The Contractor shall check the lengths of cables and overhead conductors on site before ordering any of the cables. Any allowance for off-cuts shall be made in the unit rates.

1.5 The rates shall exclude Value Added Tax and the total carried over to the final summary in PART A.

1.6 All material covered by this **Specification** shall, wherever possible, be of South African manufacture.

2. Schedule

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT	
					R	c
1.1	Delivery, installation and commissioning of the UPS, complete with all equipment as specified:					
	a) … kVA					
	Supply	No	1			
	Installation	No	1			
	b) …kVA					
	Supply	No	1			
	Installation	No	1			
1.2	Battery as specified:					
	a) … kVA					
	Supply	No	1			
	Installation	No	1			
	b) …kVA					
	Supply	No	1			
	Installation	No	1			
1.3	Three Copies of Operation and Maintenance Manuals:					
	a) … kVA	No	1			
	b) …kVA	No	1			
	Total Carried to Summary			R		

3. Summary of Schedules of Quantities

Schedule		Page No	Amount R	c
1.	……	4.1		
Total Tender Price (Excluding VAT) for the Supply, Delivery, Installation And Commissioning Of Uninterrupted Power Supply to be Carried Forward to Part A			R	

ANNEXURE A WCS_____

SCHEDULE OF IMPORTED MATERIALS AND EQUIPMENT TO BE COMPLETED BY TENDERER

Items	Material / Equipment	Rand (R) (Excluding VAT)
1		
2		
3		
4		
5		
6		

The Contractor shall list imported items, materials and/or equipment which shall be excluded from the Contact Price Adjustment Provisions (if applicable) and shall be adjusted in terms of currency fluctuations only. Copies of the supplier's quotations for the items, materials or equipment (not higher than the Contract rate as listed below) should be lodged with the Representative/Agent of the Department of Public works within 60 (sixty) days from the date of acceptance of the tenders. No adjustment of the contractor's profit, local VAT amount, discount, mark-up, handling costs, etc. shall be allowed.

The net amounts will be adjusted as follows

FORMULA:

The net amount to be added to or deducted from the contract sum:

$$A = V\left(\frac{Z}{Y} - 1\right)$$

A = the amount (R) of adjustment

V = the net amount (R) (Supplier's Quotation) of the imported item (Material or Equipment)

Y = exchange rate at the closing date of tender submission

Z = exchange rate on the date of payment

CONTRACTOR

_____

SIGNED _____

DATE _____