FIRE DETECTION SYSTEM

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1. GENERAL

The purpose of this specification is to serve as a guide to companies providing analogue fire detection alarm systems.

All details, dimensions and instructions shown on any drawings, diagrams, and specifications quoted herein, shall be taken as forming part of this specification.

If there is any discrepancy between drawings and specifications, the specification shall take precedence.

A Contractor supplying goods for the first time shall obtain approval from the Engineer of advance samples before proceeding with the bulk of the contract. The Contractor must be a member of the FDIA (Fire Detector Installer Association) and ASIB (where sprinkler installations are required).

2. SUPPLEMENTARY SPECS, REGULATIONS AND REQUIREMENTS

When a specification is quoted, the latest issue of that specification shall be followed, unless otherwise specified.

The alarm system shall comply with the relevant requirements of the following specifications as amended.

When a specification is quoted, the latest issue of that specification shall be followed, unless otherwise specified. The alarm system shall comply with the relevant requirements of the following specifications:

- SANS 10139: Fire detection and alarm systems - System design, installation and servicing.
- SANS 50054-1: Components of automatic fire detection systems Part 1: Introduction
- SANS 50054-2: Fire detection and alarm systems Part 2: Control and indicating equipment
- SANS 50054-3: Fire detection and alarm systems Part 3: Fire alarm devices - Sounders
- SANS 50054-4: Fire detection and alarm systems Part 4: Power supply equipment
- SANS 50054-5: Fire detection and alarm systems Part 5: Heat detectors - Point detectors
- SANS 50054-7: Fire detection and alarm systems Part 7: Smoke detectors - Point detectors using scattered light, transmitted light or ionization
- SANS 50054-11: Fire detection and alarm systems Part 11: Manual call points
- SANS 10142-1: The Wiring of Premises Part 1: Low Voltage Installations.

- SANS 1411-5: Materials of insulated electric cables and flexible cords Part 5: Halogen-free, flame-retardant materials
- SANS 60331-21: Tests for electric cables under fire conditions - Circuit integrity Part 21: Procedures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV
- SANS 1507: Polyvinyl Chloride (PVC) Insulated Electric Cables and Flexible Cords.
- SANS 950: Non-metallic Conduit and Fittings (for Electrical Wiring)
- SANS 1200LC: Standardized specification for civil engineering construction Section LC: Cable ducts

The Following Regulations Shall Also Apply:

- EN 54 : European Norm: Fire Detection Systems
- ACT 85 of 1993: Occupational Health & Safety Act.
- ACT 103 of 1977: National building regulations Act.

The system shall also comply with the relevant requirements of one or more of the following bodies provided there is no conflict with any other requirement of this specification or S.A. regulations.

- VDS (the German Underwriters Association)
- The Fire Officer's Committee of the United Kingdom.
- The Council of Fire Insurance Companies of South Africa

3. INSPECTION

The Engineer reserves the right to arrange for the inspection of all goods forming the subject of any contract or order, at any stage before final acceptance and by any means it may think fit, and when such inspection is to be carried out, the relevant contracts, orders and sub-orders shall be endorsed accordingly.

When inspection at the Contractor's works or warehouse is specified, the authorised person shall have free access to the premises of the Contractor at all times during working hours; shall have liberty to inspect work which is the subject of the contract or order, at any stage of manufacture. The Contractor shall make good any work found defective or in any way not conforming with the terms of the contract or order. The Contractor shall afford all reasonable facilities for such access and inspection.

The Contractor shall supply, without charge all tools, gauges, templates and other equipment which may be required for checking the accuracy of the work, provide the labour necessary for inspecting the work in accordance with requirements specified in the contract of order and shall render all reasonable assistance in carrying out this checking and inspection.

The Contractor shall, without charge, prepare and supply all test pieces, samples and specimens, provide all labour and apparatus for carrying out tests and analyses in

accordance with the terms of the contract or order and render all reasonable assistance in making such tests and analyses.

4. CERTIFICATE OF COMPLIANCE

The Contractor shall indicate, section by section, whether or not his equipment complies in every respect with this specification.

If alternative equipment is submitted, all deviations from this specification shall be clearly stated.

5. RIGHT OF RESERVATION

The Engineer reserves the right to accept certain parts of the self-addressable fire detection system only and not necessarily the complete system as a whole.

6. UNDERTAKING BY CONTRACTOR

The Contractor shall undertake to provide, as part of the following in respect of the equipment he has offered:

- All technical and other information, in English concerning the equipment.
- Proposals regarding the schematic lay-out of his equipment as part of the complete system in which it will function.
- The technical and other information on the drawings and in the technical manuals shall include:

  a) Electrical input and output requirements
  b) Installation instructions
  c) Operations instructions
  d) Circuit diagrams and component layouts
  e) Routine testing information and requirements
  f) System and equipment description

7. SAMPLES

A sample of the items covered by this specification shall be submitted, if called for. The sample will be regarded as being identical to the item which has been submitted.

8. SCOPE

The specification covers the requirements for the design, delivery to site, installation, testing, commissioning and handing over in a working condition of a fire detection and alarm system.

The Contractor shall submit with this offer a detailed list of additional requirements he considers necessary in order to ensure that the installed system shall:

- be fully operational
- comply with the specifications mentioned above
- any other improvement the supplier may offer that can be to the benefit of the user.

9. GENERAL DESCRIPTION

The fire detection system shall comprise a Central Station, connected to field devices, including fire detection devices, alarm devices and control devices, located throughout the protected building.

The central station shall continuously monitor the ambient status of all sensing devices, and initiate action when a fire or smoke condition is present.

The alarm management shall be field programmable to enable the system to be easily tailored to suit the protected building, and to permit future changes.

The system shall be fully modular in design to meet the user's requirements.

The central station shall have, visible on the front panel, zone LED's for "fire" and "fault" common LED's and controls, and a LCD display. The unit shall have facilities for interfacing with a micro-computer and desk printer.

The central station shall consist of a wall or rack mounted cabinet with key-lockable doors, glazed with clear Perspex. All lamps and controls shall be behind the Perspex.

10. FACILITIES

The transmission paths between the control unit and other external devices shall be a 2 wire circuit.

It shall be possible to couple the following devices/detectors to the control unit (Central Station).

- Automatic fire detectors
- Manual fire detectors
- Alarm devices (zoned)
- Remote signalling devices
- Control devices for automatic fire protection equipment e.g. FM200, Inergen or Argonite.

The central station shall accept the following types of fire sensing devices.

- Ionization smoke detectors
- Optical smoke detectors

- Heat detectors, fixed temperature, 58° C.
- Heat detectors, rate-of-rise, 58° C.
- Linear (beam type) smoke detectors.
- Manual "Break-Glass" units.

These circuits shall be continually and automatically monitored for open circuit, short circuit, earth leakage and detector removal. A single short circuit is to cause a maximum of 20 detectors in the system to be disabled, with the remaining detectors functioning normally. This is to be achieved by the use of line isolator units.

11. LINE ISOLATORS

Line isolators are to be located at intervals on the detector line. In the event of a line short circuit, the isolators on each side of the short must open and isolate the faulty section of wiring.

The isolators must be under software control. In the maintenance mode it must be possible to open or close isolators manually from the panel for test purposes.

A fault in any of the transmission paths shall cause a "Fault Alarm" to be indicated automatically in the central station.

Any change in the ambient condition of any receiver line shall automatically be updated and stored in the central station.

12. MONITORING OF ELEMENTS IN AN ALARM LINE

The alarm threshold of every detector shall also vary in accordance with its idle state. This change shall be stored and continually updated in the central station.

Each element of an alarm line shall be continually and automatically monitored, individually. Any change in the ambient value of the element shall be updated and stored in the central station. When the value of an element reaches a level at which it will no longer perform its function, a "Fault Alarm" must be automatically indicated in the central station.

Such a fault indication shall not prevent a fire alarm in the line being detected and indicated.

13. MONITORING OF ZONES

Each detection line shall be divisible into a maximum of 4 separate zones and a maximum of 20 devices per zone.

Each zone shall be clearly defined and indicated.

Each zone must have the facility to be monitored for a fire alarm condition from either manual or automatic detectors.

14. ALARM DETECTION LINES

Alarm/Detection lines may have a capacity of detectors or elements as decided upon by the manufacturer, but shall not have more than 127 detectors. These detectors/elements shall be freely distributed over any one of the individual alarm zones.

An alarm zone may only extend over a single fire zone and quick and precise identification of the seat of the fire must be possible.

An alarm line shall not extend beyond one floor except in the case of stairwells or lift shafts.

Each line shall be capable of monitoring functions.

An LCD display shall be provided for indicating the exact position of triggered detectors/elements in any line.

A triggered detector/element shall not cause any other detectors on the line to cease monitoring.

Each line must be capable of switching on/off air-conditioning plants, fans, etc. in case of an alarm, and cause plant facilities to be switched on/off via separate high or low voltage relays, or via a switching matrix.

In the specific zone where a fire has been detected it shall be possible to control equipment plant, fire dampers, etc. pertinent to that particular zone only.

Any detector, when triggered, shall be capable of causing a specific control function.

Every line shall have a "double-knock" function built-in, providing a specific control function capability whenever two detectors on the line are triggered.

Any individual zone or detector in an alarm line shall be capable of being isolated without affecting the operation of the remaining zones or detectors in the line and without raising a fire alarm. However, during this condition an isolation indication per zone, shall be displayed in the central station.

15. SIGNALLING AND ANNUNCIATION

15.1 General

Fire and fault signals shall be indicated visually and audibly in the central station. The indications shall be such that fire alarms and fault warnings can be clearly distinguished visually and audibly.

The internal audible signal device may be the same for both fire alarms and fault warnings.

All zone visual indicators shall be dual LED's - i.e. one LED per zone for fire and one LED per zone for fault. Common LED's for "fire" and "fault" conditions shall be provided. No incandescent lamps shall be used.

A LCD display shall be provided which shall indicate specific information about the status of the system. In an alarm condition it must show details of the first received alarm, and if more than one detector is in alarm, it may be possible to call each piece of information to the display.

Similarly, the LCD display must show relevant information regarding faults or isolated devices.

A facility shall be provided for calling-up information to the display, such as maintenance functions or isolating detectors and zones.

An LED test button for testing the function of all LED's on the front panel.

An "Alarm-Accept" button for silencing the local panel buzzer.

A "Reset" button for restoring the system to normal.

15.2 Remote Annunciation

Facilities must be provided for remote indication and control of all functions.

The system must be able to interface with wall mounted mimic panels, as well as desk mounted micro-computers and printers. Block plans must be mounted on each floor of the installation.

15.3 Normal Condition

When the central station is in the normal operating condition without any alarms or faults being displayed, a green LED shall indicate visually that the power is turned on.

15.4 Fire Alarm Condition

A fire alarm shall be indicated in the central station as follows:

- An intermittent audible indication
- A flashing "Alarm" indication on a central panel common to all zones.
- The LCD display must indicate the details of the first received alarm, indicating line, zone and detector number.

The audible signal shall be capable of being switched off from outside the central station. However, the visual alarm shall only be accessible after the front panel of the central station or central panel has been unlocked.

After the alarm has been accepted, by operation of a switch, the central "Alarm" visual indicator shall cease flashing and become steady. The zone visual indicator shall continue to flash until the alarm is reset.

When a new alarm is received by the central station the common alarm indicator on the central panel must revert from a steady indication to a "Flashing" indication. The new alarm zone LED's shall also flash. No limitation shall exist for receiving a new alarm from another zone.

The control unit must have facilities for two independent Remote Signalling circuits. These circuits shall be suitable for potentially free or 24 Volt signalling and shall be monitored for short circuit, open circuit and earth leakage. They must be suitable for operating external alarm devices such as bells, hooters and visual flashing lamps.

A fire alarm shall be indicated outside the central station as follows:

Audible and optical alarm devices located as required throughout the building are triggered automatically and can only be switched off, after opening the central station.

15.5 Fault condition

Any fault warning shall be indicated in the central station as follows:

- A steady audible indication
- A steady "Fault" indicator on a central panel in the central station, common to all zones.
- One steady AMBER LED indicating the effected zones.
- A LCD display indicating the line number and detector number prior to where the fault occurs or the last functioning detector in the line. The audible signal shall be capable of being switched off from outside the central station. However, the visual alarm shall remain until the fault has been repaired.

- When a new fault condition is received by the central station, the audible alarm shall re-start automatically.
- An earth leakage indication shall be provided for the entire system.

15.6 Power failure

In the event of mains failure for a period in excess of 50 seconds, a power supply fault shall be indicated, audibly and visually, in the central station. The visual display shall be a separate AMBER LED. Any mains outages of less than 50 seconds shall automatically switch the load to the stand-by battery, but without an indication.

In the event of a fault occurring on the standby battery, even though it is not on load, a power supply fault shall be indicated, audibly and visually, in the central station. The visual indication shall consist of an AMBER LED.

16. SYSTEM MAINTENANCE

16.1 General

The system shall be, as far as possible, self testing and maintenance free.

The control unit shall continually update the idle state of each detector, and indicate a "Maintenance Required" signal in the event that a detector sensitivity is too high or too low.

A log book must be supplied to log events and maintenance of the system.

16.2 Control Unit Test

The control unit shall have a test facility for the following:

- Simulation of short circuit, open circuit and fire alarm for each zone
- Individually.
- General simulation of earth leakage.
- LED test for all panel and zone LED's.

The control until shall have the facility for printing out, upon demand, the idle status of each detector on a line.

16.3 Field Tests

16.3.1 Detector Tests

The control unit shall allow for detector test and inspection by a single person.

The test alarms triggered on each detector by the inspecting person shall be indicated on the detector by a RED LED, and shall be automatically reset by the control unit. Alerting shall not take place.

Zones which are not switched to "inspection" mode shall remain ready for normal alarm procedure.

When testing lines equipped with only manual push button alarm boxes, it shall be possible for a single person to check each manual box individually for correct operation without disabling the function of the other alarm boxes in the line. An "Alarm Received" indication shall be transmitted by the central station to the push button under test, where it shall be indicated by a RED LED.

16.3.2 Alarm Tests

The control unit shall allow for the testing of all audible and visual alarm devices and control relays, to check correct functioning of these devices.

17. ACCEPTANCE TESTS

The acceptance tests as stipulated in the "Acceptance Procedure for Fire detection Systems installed in Equipment Buildings" shall be strictly adhered to.

Where the system is installed elsewhere (non-technical buildings), the onus shall be on the Engineer/Contractor to stipulate the acceptance procedures. These procedures shall be for the user's approval.

18. SYSTEM POWER SUPPLY

The output of the power supply shall be capable of sustaining an alarm from all the connected alarm lines simultaneously.

The power supply shall be an integral part of the control unit.

In the event of a failure of the 24V dc supply there shall be an automatic switch over to the stand-by battery supply without an interruption of the load and without activating a fire alarm.

The power supply unit shall be dimensioned in such a way, that it maintains the battery at fully charged state or is capable of re-charging the battery, discharged to cut-off voltage at the rated discharged current, to 80% of the achievable rated battery capacity within a period of 24h, besides supplying the power requirements of the alarm system in the idle condition.

The central control unit shall be protected against reverse polarity on the voltage supply side.

The unit shall be suitable for the use with a positively earthed dc power supply system.

19. STAND-BY BATTERY

The stand-by battery must be capable of supplying the system in idle condition for the stated period of 24h plus an hour in alarm condition after the stated period.

The standby battery must be a maintenance free lead acid type.

20. ALARM INPUTS FROM OTHER SOURCES

Alarm inputs from fire detectors and alarm initiating devices, which are provided by others, shall be incorporated by the Contractor to the central fire alarm monitoring system, provided by him.

21. INTERFACE WITH BUILDING MANAGEMENT SYSTEM

The fire detection system shall be required to interface with the building management system. The protocol shall be specified in the detailed technical specification.

22. GUARANTEE

The contractor shall guarantee all equipment fitted for a period of 12 months. The guarantee shall include latent defects.

TECHNICAL SPECIFICATION FOR METAL DETECTOR

CLAUSE	DESCRIPTION	STATE DETAILS OF OFFER
3.1	**GENERAL**	
3.1.1	In addition to complying with the specification, the metal detector shall meet the requirements of the S.A. Police Security Advisory Board, Pretoria (Liaison officer: Dir. B Barnard Tel.: 082 778 9254. Name and tel. no. of the tenderer's contact person to make arrangements with: Name: _____ Tel. No.: _____	_____
3.1.2	The metal detector shall consist of a free standing walk-through frame with an integral control unit, and shall be suitable to detect metallic objects on a person by means of the magnetic field principle.	_____
3.1.3	The metal detector shall be suitable to detect ferrous and non-ferrous metals.	_____
3.1.4	The metal detector shall be equipped to eliminate false alarms.	_____
3.1.5	The metal detector shall scan the entire area of the walk through area and detect metal objects on a person passing through to the levels as specified.	_____
3.1.6	The metal detector shall incorporate self test button to confirm that the system is operating correctly.	_____
3.1.7	The metal detector shall be completely tamper proof.	_____
3.1.8	The programme and sensitivity push buttons shall be so arranged that tampering by unauthorised persons is entirely eliminated.	_____
3.1.9	The metal detector shall not be adversely affected by stationary metal bars or structures in the vicinity of the unit or moving metal near the archway.	_____
3.1.10	The metal detector shall be capable of operating adjacent to an X-Ray inspection unit.	_____
3.1.11	The detector is intended for indoor use at an altitude of up to 1800m above sea level.	_____
3.1.12	The detector shall be capable of operating in the following conditions:	
3.1.12.1	Min. temperature: 0°C	_____

3.1.12.2	Max. temperature: 40°C	_____
3.1.12.3	Max. relative humidity:80%	_____
3.1.13	The operation of the metal detector shall not be adversely affected by repositioning of the frame within certain limits of its original adjusted position.	_____
3.1.14	The metal detector shall have multi-zone vertical detection zones for the full height of a person. Each zone shall have a display bar with proportional indication on the vertical sides of the metal detector.	
3.2	**CONSTRUCTION**	
3.2.1	The metal detector shall comprise a free standing walk-through frame containing the detector coils and the control unit, complete with a 5m length of flexible cable and 16A 3-pin plug top. The cord and plug top shall comply with the relevant SABS specifications.	_____
3.2.2	The frame and the control unit shall be of robust construction and the base of the frame shall be designed to ensure rigidity.	_____
3.2.3	The unit shall be able to execute a full body scan and detect metal objects down to the lower feet level within the settings specified.	_____
3.2.4	The finish shall be durable and maintenance free.	_____
3.2.5	The type of material used for the construction of the frame and control unit must be stated by tenderers.	_____
3.2.6	The colour range in which the metal detectors are available must be stated by tenderers. The Department will select a colour finish to suit the environment.	_____
3.2.7	All material consisting of metal shall be treated against corrosion.	_____
3.2.8	The approximate internal dimensions of the frame shall be as follows:	
3.2.8.1	Walk-through height : 2m	_____
3.2.8.2	The walk through width: 720mm.	_____
3.3	**CONTROL SYSTEM**	
3.3.1	The system shall operate by means of automatic level control adjustable to environmental changes, Without the need to reset.	_____
3.3.2	The control unit shall be equipped with the following:	
3.3.2.1	"ON-OFF" main switch and "MAINS ON" indicator light.	_____

3.3.2.2	Selector switch with at least ten sensitivity settings, with a maximum sensitivity to consistently detect metal at least the size of a R5,00 coin.	_____
	The sensitivity settings shall be consistent at average walking speed.	_____
3.3.2.3	Visual indication in the form of vertical display bars shall give an indication of the volume of metal on a person in accordance with the sensitivity settings. When the "ALARM" zone is activated it shall simultaneously activate an audible alarm having a continuous tone and adjustable volume. The alarm system will automatically reset after the metal has passed through the frame.	_____
3.3.2.4	The system shall be modular to facilitate maintenance and repairs.	_____
3.4	**SAFETY FEATURES**	
3.4.1	All electronic and electrical components shall be protected by lockable panels.	_____
3.4.2	The detectors shall not have any effect on heart pacemakers.	_____
3.4.3	The detector shall not affect magnetic storage media or camera film.	_____
3.5	**ELECTRICAL SUPPLY SYSTEM**	
3.5.1	The detectors shall be designed for connection to a 230V +/-5%, 50Hz, single phase, three wire (phase, neutral and earth) power supply.	_____
3.5.2	The existing connection points on site comprises standard 16A, 3-pin, socket outlets.	_____
3.5.3	A suitable and efficient battery back-up system to facilitate power failures of up to 45 minutes must be incorporated in the detectors.	_____
3.6	**THROUGHPUT**	
	The system shall accept a passage of at least 50 persons per minute without functional overload.	_____
3.7	**PLACING IN POSITION AND TESTING**	
3.7.1	The detector shall be placed in position, tested, commissioned and adjusted to the user Department's requirements by the successful tenderer. NOTE: The final positioning will be determined on site.	_____
3.7.2	The system must be arranged so that the traffic-flow is channelled through the metal detector.	_____

3.8 BROCHURES

3.8.1 Brochures furnishing descriptions and technical specifications, etc., of the unit offered shall be submitted with the tender. _____

3.8.2 The following information is also required:

Manufacturer _____

Year of manufacture _____

Country of origin _____

Model number _____

3.9 MAINTENANCE

3.9.1 The unit must be relatively maintenance-free and with minimum future service. A statement confirming this is required from the tenderer. _____

3.9.2 Electronic modules must be easily exchangeable. _____

3.9.3 Spare parts must be locally stocked and availability guaranteed for a ten year period starting from date Of delivery. _____

3.10 GUARANTEE AND SERVICE

3.10.1 The successful tenderer shall guarantee and service the complete unit for a period of twelve (12) months from date of delivery of every unit to site. _____

3.10.2 During the period of guarantee the successful tenderer shall at his own expense, carry out all necessary repair work including material and labour (excluding work required due to damage by others) in order to maintain the unit in a working condition. _____

3.10.3 The successful tenderer shall, during the period of guarantee, repair the unit to the satisfaction of the Department within 24 hours after he has been notified that the unit is not operating. _____

3.10.4 After the lapse of the initial twelve-month period of servicing under the guarantee, the successful tenderer may be required to enter into a service agreement with the Department. _____

3.11 TRAINING

The successful tenderer shall thoroughly train and instruct operators designated by the user Department in the operation of the unit. _____

3.12 MANUALS

Two complete sets of manuals, each with the following information shall be handed over to the Department when the unit is delivered to site:

(a) Operating instructions

(b) Technical description with diagrams and Instructions for maintenance and repairs.

TECHNICAL SPECIFICATION FOR X-RAY INSPECTION UNITS

CLAUSE	DESCRIPTION	STATE DETAILS OF OFFER
1.1	**GENERAL**	
1.1.1	A licence for the X-ray machine, issued in terms of the Hazardous Substances Act (Act 15 of 1973), must be submitted with the tender, failing which the tender will not be considered. Plus the ID No's and SABS BIN No. of the service technicians registered to carry out the servicing of the X-ray machines in accordance with the requirements of the SABS.	_____
	In addition to complying with the specification the X-ray inspection unit shall meet the requirements of the SA Police Security Advisory Board, Pretoria. Liaison Officer: Dir. B Barnard Tel.: 082 778 9254	_____
	Name and tel. No. of the tenderer's contact person to make arrangements with: Name: _____ Tel. No. _____	
1.1.2	The X-ray inspection unit shall complete with:	
	- Dual Energy Detector system (Multi Energy Imaging) - Colour monitor (remotely operated) - Conveyor belt - Screening for full profile of inspection tunnel - Discharge roller table - UPS	_____ _____ _____ _____
1.2	**GENERAL SPECIFICATION**	
1.2.1	**Construction Details**	
1.2.1.1	The unit must incorporate a facility to be controlled either from the right or the left-hand side.	_____
1.2.1.2	In addition a facility must be incorporated so that, the operating keyboard and monitor can be operated remotely, at least 5m from the unit.	_____
1.2.1.3	Maximum height including the tunnel shall not exceed 1400mm from the floor level.	_____
1.2.1.4	The unit must be quiet when in operation.	_____
1.2.1.5	X-ray high voltage generator, shall be rated at 160kV and operate at 140kV	_____
1.2.1.6	Ambient conditions, under which the unit must operate: -0°C to 40°C -relative humidity 95%, non-condensing	_____ _____

1.2.1.7 Control elements (pushbuttons, switches, etc.) are to be of sturdy design, selected for severe operating conditions. _____

1.2.1.8 The unit must be of steel base construction on roller castors and not exceeding 700kg in total weight. _____

1.2.1.9 Discharge rollers to be included with the unit. The discharge roller platform shall be long enough to prevent articles being X-rayed from falling off before it is recovered by the owner. _____

1.2.1.10 The conveyor belt must be designed for 24 hour, heavy-duty operation. _____

1.2.1.11 The unit shall not be longer than 900mm wide and 2600mm in overall length, including the conveyor belt platform. _____

1.2.2 **Power ratings**

1.2.2.1 The unit has to operate from 230V ±5%, 50 Hz, single phase power supply. _____

1.2.2.2 The maximum running current shall be less than 5A. _____

1.2.2.3 A suitable power point will be provided on the site by others. _____

1.2.3 **Image presentation**

1.2.3.1 Objects of the following dimensions must be able to be passed through the tunnel without any obstruction:

- Height: at least 400mm _____
- Width: at least 600mm _____
- Length: unlimited _____

Monitor display shall cover not less than 500mm of the object length. _____

Full scan volume must be seen on the screen, without any corner cut-off. This is a firm requirement. _____

1.2.3.2 Imaging scale of all objects should be constant with the minimum distortion. _____

1.2.3.3 A zoom facility is essential. The optimum requirement is for the push-button selection of at least 9, independent zoom sectors. The selected sector must be identified by light frame before zoom is activated. _____

1.2.3.4 A colour monitor (non-interlaced), screen size of at least 34cm, is required. Parallel operation of additional monitors, without modification to the unit, must be available. _____

1.2.3.5 The image on the monitor screen must be flicker free. _____

1.2.3.6 Control of brightness and of contrast must be provided on the front panel of the monitor. _____

1.2.3.7	Possibility of switching over from "POSITIVE" to "NEGATIVE" image should be available as an option.	_____
1.2.3.8	A digital memory is essential.	_____
1.2.3.9	The capacity of the digital memory must exceed 1Mbyte.	_____
1.2.3.10	The number of solid state detectors shall be not less than 1152.	_____
1.2.3.11	Dual (Multi) energy colour system with a four (4) colour (Industry Standard) is a firm requirement.	_____
1.2.3.12	Organic/Inorganic colour stripping.	_____
1.2.3.13	High and low penetration.	_____
1.2.3.14	Variable colour stripping and variable gamma edge enhancement.	_____
1.2.3.15	Automatic density (variable) threat alert.	_____
1.2.3.16	Automatic organic material threat alert.	_____
1.2.3.17	Operator log-in identification facility.	_____
1.2.3.18	Video output capabilities for recording of images shall be included.	_____
1.2.3.19	Voltage stabiliser must be included.	_____
1.2.3.20	UPS shall be included to provide 10 – 15 minutes back-up.	_____
1.2.4	**Resolution and penetration**	
1.2.4.1	A sample wire with diameter of 0.16mm (AWG 34) must be distinguished on a monitor, and 30AWG wire must be visible behind 21mm of aluminium.	_____
1.2.4.2	The image quality on the monitor must be uniform, without distortion in the centre or the edges.	_____
1.2.4.3	Penetration of 25mm steel minimum must be guaranteed.	_____
1.2.4.4	A pre-selectable density threat level must be a feature of the equipment, with a visual and/or audible alarm if any item being screened exceeds that pre-selected density.	
1.3	**CONTROL OPERATION – MINIMUM REQUIREMENTS**	
1.3.1	**Controls**	
1.3.1.1	A mains key switch for 230V main power supply is required.	_____
1.3.1.2	Push button – power "ON".	_____
1.3.1.3	3 Push buttons for conveyor control, "GO", "STOP" & "REVERSE".	_____
1.3.1.4	As a minimum, 9 push button keyboard for zoom sector selection and a separate push button for zoom activation is required.	_____

1.3.1.5	A robust, RED, emergency stop push button, fitted in a prominent position on the keyboard, as well as on the X-ray unit.	_____
1.3.1.6	Light symbols indicating "X-ray on".	_____
1.3.1.7	X-ray warning signs, in accordance with the requirements of the SA Radiation Board, must be attached to each end of the tunnel in a visible position.	_____
1.3.1.8	Easy operation of the unit is essential.	_____
1.3.2	**Passage of luggage through X-ray unit**	
1.3.2.1	Objects must be able to be conveyed through the unit in any orientation.	_____
1.3.2.2	All objects, also those which are only partially lying flat on the conveyor belt (e.g. guitars, etc.) must be fully screened.	_____
1.3.3	**Object representation**	
1.3.3.1	The conveyor belt speed should be such that each point of an object, when passing through the unit, will be visible for at least 5 seconds	_____
1.4	**CONVEYOR BELT**	
1.4.1	**Loading**	
1.4.1.1	At least 75kg overall weight	_____
1.4.1.2	The conveyor belt must be driven by an almost noiseless drum-motor.	_____
1.4.2	**Dimensions**	
1.4.2.1	Belt length: < 2100mm	_____
1.4.2.2	The height of the top of the conveyor belt above floor level shall be not less than 600mm, but shall not exceed 800mm	_____
1.4.3	**Speed and duty cycle**	
1.4.3.1	Conveyor belt speed: approximately 0.2 m/sec.	_____
1.4.3.2	Up to 2400 objects must be screened per hour.	_____
1.4.4	**Operation**	
1.4.4.1	Normal: Continuous operation in forward direction.	_____
1.4.4.2	Stop:	_____
1.4.4.3	Reverse: Intermitted operation by pressing the reverse button.	_____
1.4.4.4	Duty cycle: no warm-up period will be accepted.	_____
1.5	**SAFETY**	

1.5.1 **X-ray dose: Screened object**

1.5.1.1 Standard –0.1 mR per inspection. Lower dose units may be offered as an alternative. _____

1.5.2 **Radiation leakage to surrounding**

1.5.2.1 Less than 0.5 millirems/h at any point on the surface, 5cm from the surface _____

1.5.2.2 The unit must comply with all ruling international safety regulations such as the German TUV, Swiss SEV, UK NRPB or USA FDA. _____

1.5.3 **Conveyor belt**

1.5.3.1 The feed and discharge ends of the conveyor belt are to be of such design that fingers, etc. cannot be caught during normal operation. _____

1.5.4 **Operation under fault conditions**

1.5.4.1 The X-ray tube shall be automatically de –energised when conveyor belt is stopped. _____

1.5.4.2 X-ray radiation shall only be switched on with the moving conveyor belt, before the object passes through the unit. _____

1.5.4.3 X-ray radiation shall be automatically switched off if the radiation shielding covers are removed. _____

1.5.5 **Film safety**

1.5.5.1 Tenderers must guarantee the unconditional safety of photographic material of professional quality. _____

1.5.5.2 Typical standards must allow for highly sensitive films of 1000 ASA to be irradiated at least 30 times without damage. _____

1.6 **PLACING IN POSITION AND ASSEMBLING**

1.6.1 The unit shall be placed in position and assembled on site by the successful tenderer.
NOTE: The final placing will be determined on site. _____

1.7 **BROCHURES**

1.7.1 Brochures, furnishing description and technical specification, etc. of the unit offered, shall be submitted with the tender. If the brochures have information, which does not comply with the specification, the tenderer must submit a covering letter listing all brochure items, which do not comply and confirm that the equipment offered will comply with the specification, referring to these items. _____

1.7.2 The following information is also required:

Manufacturer: _____

ISO Rating: _____

Country of origin: _____

Model number of the unit offered _____

Date of manufacture _____

1.8 **MAINTENANCE, SERVICE AND REPAIR**

1.8.1 The unit design must be of the low maintenance type and with minimum future service. **A statement confirming this is required from the tenderer, together with a copy of the service/maintenance schedule.** _____

1.8.2 An overall design of modular type is preferred. _____

1.8.3 Electronic modules must be easily exchanged. _____

1.8.4 All sub-assemblies in the unit must be of such a design that, maintenance and repair can be carried out by a single person, including removal and exchange of the X-ray generator tanks. _____

1.8.5 Spare parts must be locally stocked and availability guaranteed for a ten-year period, starting from the date of delivery. _____

1.9 **GUARANTEE AND SERVICE**

1.9.1 The successful tenderer shall guarantee and service the complete unit for a period of twelve (12) months from the date of delivery to site, and successful commissioning of the unit. _____

1.9.2 During the period of guarantee, the successful tenderer shall, at his own expense, carry out all necessary repair work, including material and labour, (excluding work required due to damage by others) in order to maintain the unit in a working condition. _____

1.9.3 The successful tenderer shall, during the period of guarantee, repair the unit to the satisfaction of the Department, within 24 hours after he has been notified that the unit is not operating. _____

1.10 **TRAINING**

1.10.1 The successful tenderer shall thoroughly train and instruct all the operators and supervisors, designated by the User Department in the operation of the unit. _____

1.11 **ONBOARD COMPUTER**

1.11.1 Video Memory: at least 16MB

1.11.2 Processor Speed: at least 333MHz

1.11.3 Storage Capacity: At least 1 000 MB

1.11.4 A two part training programme must be incorporated in the system.

1.11.4.1 Part 1 – Initial training

Pre-loaded images must be recalled by the computer, some without and some with threats. The operator must detect the threats and his progress is logged.

1.11.4.2 Part 2 – Ongoing training
The system must merge fake threat images into real time images and the performance of the operator must be logged.

1.12 **MANUALS**

Three complete sets of manuals, each with the following information shall be handed over to the Department when the unit is delivered to site:

(a) Operating instructions _____

(b) Technical description with diagrams and instructions for maintenance and repairs. _____

1.13 **DEVIATIONS FROM SPECIFICATION AS ALTERNATIVE (STATE BRIEFLY)**

_____

_____

_____

_____

2. **TECHNICAL INFORMATION**

State the following information of the unit offered:

2.1	Total height above floor level	_____
2.2	Maximum X-ray voltage	_____
2.3	Dimensions of the unit	
	Height	_____
	Width	_____
	Length (including conveyor belt)	_____
2.4	Total running current	_____
2.5	Maximum dimensions of objects:	
	Height	_____
	Width	_____
	Length	_____
2.6	Number of detectors	_____
2.7	Capacity of digital memory	_____
2.8	Number of shades of grey	_____
2.9	Maximum over-all loading on conveyor belt	_____
2.10	Conveyor belt speed	_____
2.11	X-ray dose per inspection	_____
2.12	Radiation leakage at any point, 5cm away from surface	_____
2.13	Multi-Energy mode – State colours for material discrimination	_____

STANDARD SPECIFICATION FOR AN UNINTERRUPTABLE POWER SUPPLY

STANDARD SPECIFICATION FOR AN UNINTERRUPTABLE POWER SUPPLY

1. GENERAL DESCRIPTION

The uninterruptible power supply (UPS) system will consist of the following :

1.1 Rectifier/charger

1.2 Static inverter - 3 phase or single phase as required

1.3 Associated control logic

1.4 Transformers, protective devices

1.5 Storage battery.

The equipment may be arranged into two separate housings, i.e. the UPS module consisting of items 1.1 to 1.4 and the battery or alternatively, for smaller units, all equipment and battery may be housed together in a tower case. The equipment shall comply with Telkom RFI Regulations with regard to Noise Suppression (EM/RFI) and to SANS 1474.

2. OPERATION

2.1 Primary AC power is converted by the solid state rectifier/charger to DC which is used both to charge the battery and to provide input power to the inverter. The inverter converts the DC power to AC for use by the critical load. (Double conversion true on-line UPS).

2.2 Upon failure of the primary AC power, the inverter draws power directly from the battery bank to continue to supply AC power to the critical load without interruption.

2.3 Upon reinstatement of primary AC power, the battery is recharged while AC output power continues to be supplied to the critical load without interruption.

3. RECTIFIER CHARGER

3.1 For UPS units above 15kVA, the rectifier/charger is to consist of a 3 phase (in the case of a 3 phase UPS), controlled SCR bridge and LC filter, supplying the DC bus. The bridge must control both the output voltage and current. For smaller

units the rectifier assembly may consist of a bridge rectifier feeding a charger that will regulate the voltage and current.

3.2 The rectifier must be able to operate at full capacity at nominal input AC mains voltage plus/minus 10% and nominal frequency plus/ minus 5%.

3.3 When mains is restored after an outage, the power drawn from the mains must be phased in from 0% to 100% over a period of 15 seconds - termed the "power walk-in" period.

3.4 The rectifier/charger must have sufficient capacity to supply the maximum output power of the UPS as well as recharging the battery from a fully discharged condition to 95% charge within ten times the discharge period. After the battery is recharged the rectifier/ charger must maintain the battery at full charge.

4. INVERTER

4.1 The inverter is to consist of solid state switching devices (GBT's or SCR's, dependent upon the output power).

These devices are to produce pulse width modulated waveforms, which are to be passed through a matching transformer and filter network to produce a smooth and uniform sine wave.

4.2 All power semi-conductor devices must be protected against over- current and transient over-voltage.

4.3 The incoming supply neutral and outgoing supply neutrals may be commoned. Should total galvanic isolation be required, such as for hospitals or where earthing could be unreliable, then a double wound isolation transformer should be provided.

4.4 The inverter must prevent the batteries discharging below 1,67 V/ cell and must switch off when this condition is reached.

4.5 The control electronics shall keep the output of the inverter in sync with the utility and during utility outages the inverter shall operate on an internal oscillator which shall keep the inverter within the specified tolerance for frequency.

4.6 The system is to be equipped with a static by-pass switch operating in parallel with a mechanical by-pass switch. Should the UPS system malfunction, the static switch is to achieve an uninterrupted transfer of the output from the inverter directly to the AC incoming mains. The mechanical switch must then be able to manually take over from the static switch.

5. CONTROLS, PROTECTION AND CONSTRUCTION

5.1 The UPS unit must incorporate a rectifier breaker, reserve breaker and battery isolator as well as a maintenance by-pass switch.

5.2 The UPS system is to be protected against over and under voltage mains power surges and transients and voltage surges introduced at the output terminals.

5.3 All three phase output UPS units are to be provided with a single line mimic diagram which is to be indelibly drawn on the fascia of the UPS. LED's on this diagram are to indicate the status of the various sections of the circuit.

Single line diagrams without incorporating LED displays will be required on single phase output units.

5.4 Voltage free contacts are to be available for remote indication of the status of the major components of the system.

5.5 All materials and components used in the UPS are to be new, of high quality and of current manufacture. All relays are to be in dust tight enclosures.

5.6 Terminals are to be provided for making all external cable connections. These terminals are to be of the clamp type and not of the pinch screw type.

5.7 All electronic control boards are to employ plug-in connectors to facilitate maintenance.

5.8 The UPS must be housed in a substantial enclosure constructed from sheet metal, treated and powder epoxy coated. All doors or panels are to be provided with panel key latches or have hinged doors with lockable catches.

5.9 Adequate ventilation must be provided to ensure that a safe internal temperature is maintained. Either forced or natural ventilation is to be employed, depending on the power rating of the UPS. The cooling air is to enter the cabinet via a grille. Serviceable filters which are to keep the ingress of dust and dirt to a minimum shall be provided in polluted areas.

5.10 The heat sinks for the power semi-conductors must be fitted with heat sensors which are to initiate a shut-down if the safe working temperature is exceeded.

6. STORAGE BATTERY

The storage battery shall be of the lead-acid maintenance free type.

Battery cells shall be contained in a well ventilated enclosure with a corrosion-resistant drip tray.

The anticipated life of the battery cells shall be 3 to 5 years or longer.

7. SYSTEM STATUS PANEL (SPP)

The SPP shall provide an electrical flow diagram on the front which shall mimic the current operating status of the UPS. It shall provide the following controls, indicators and meters :-

7.1 Indicators

a) Single or Three Phases of Input Voltage.

b) Single or Three Phases of Bypass Voltage.

c) Single or Three Phases of Maintenance Bypass Voltage.

7.2 LED Indicators For :-

a) Inverter ON

b) Utility ON

c) Rectifier ON

d) Inverter OFF

e) Battery Charging

f) Battery Discharging.

g) Low Battery.

h) ON Maintenance Bypass.

i) ON Automatic Operation.

j) Battery Circuit Beaker Open.

k) Battery Circuit Breaker Closed

7.3 Analog Meters For :-

a) Input Voltage.

b) Output Voltage (Inverter)

c) Output Voltage (Bypass)

d) Output Current.

e) DC Bus Voltage.

f) DC Bus Current (Inverter)

7.4 Control Switches For :-

a) Input Voltage.

b) Output Voltage Inverter.

c) Output Voltage Bypass.

d) Output Current.

e) Emergency Power Off Guarded Push-button.

HYBRID BACKUP SYSTEM WITH GRID TIE SOLAR INVERTERS AND SOLAR CHARGING

HYBRID BACKUP SYSTEM WITH GRID TIE SOLAR INVERTERS AND SOLAR CHARGING

1. INTRODUCTION

The backup system with solar charging herein specified is to be installed at the Sundumbili magistrates court in Kwazulu-Natal.

The system shall generally comprise of inverter-chargers, lithium-ion batteries, charge-controllers, solar modules, isolating and protection equipment, associated cabling, monitoring systems and a load control system. The system shall operate on a priority basis as detailed under the design criteria

The tenderer must sign and return the compliance document. Failure to do so will automatically lead to disqualification of the tenderer and his/her tender will not be considered regardless of tendered value.

2. SCOPE OF WORK

The contract comprises of the design, installation, testing, commissioning and hand-over of the complete system. This includes the items below and details further mentioned:

a) Inverter-chargers
b) Lithium-ion batteries
c) Solar inverters with optimizers
d) Charge-controllers
e) Solar modules complete with mounting structure
f) DC cabling complete with protection for parallel arrays
g) DC isolation complete with surge protection
h) AC input isolation c/w surge protection
i) AC output isolation c/w residual current protection and surge protection
j) AC cabling
k) Feeder circuit breaker in DB
l) Manual by-pass switch
m) Electrical earthing and bonding to closest earth point
n) Inverter-charger monitoring system
o) Power usage monitoring system
p) Load control system
q) Interface with generator controller
r) Labelling

s) Drawings (for approval prior to construction) must include
   a. Solar panel layout
   b. DC cabling
   c. System wiring
   d. AC tie-in
t) Equipment list that includes all equipment
u) Design (signed by ECSA registered Pr Eng or Pr Tech Eng)
v) Delivery, off-loading and installation
w) Site acceptance testing and commissioning
x) Hand-over to and training of client
y) Quality, compliance and operating and maintenance documents
z) Health and safety

3. SITE SPECIFIC SUPPLY

The supply to which the system is to be connected is 3-phase, 4-wire, 400/230 V with a frequency of 50 Hz.

4. INVERTER-CHARGERS

Single phase inverter-charger's must be connected in parallel and connected to create a three-phase network and must comply to the following:

Individual inverter size	:	12kW / 15kVA
Number of units parallel)	:	12 (three phase configuration, four in
System size	:	144kW / 180kVA
Inverter inputs auto transfer	:	Two independent with integrated
Inverter outputs switched	:	Two outputs, one permanent and one
Parallel operation	:	Possibly up to 6 units per phase
Power control	:	Yes
Power assist	:	Yes
Remote monitoring	:	Yes
Remote control	:	Yes
Remote configuration levels)	:	Yes (with configurable access
Integrated transfer switch	:	Yes, rated at 100A
AC Input voltage range	:	187V to 265V
AC Input frequency	:	45Hz to 65Hz
DC Input voltage range	:	38V to 66V
AC Output voltage	:	230V, +/- 2%
AC Output frequency	:	50Hz, +/- 0.1%
DC Charge current	:	200A

Programmable output relays	:	3
Battery connection	:	4 x M8 bolts
AC connection	:	M6 bolts
Safety standard	:	EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1
Crest factor	:	3:1
Lifetime free online monitoring	:	Yes
Efficiency	:	96 %
IP rating	:	21
Anti-islanding	:	Yes, NRS and SANS compliant

5. LITHIUM IRON PHOSPHATE BATTERY

Only lithium iron phosphate batteries will be considered. As charging and discharging voltages and currents are critical to batteries these must be considered in the selection of the battery. The battery back-up time shall be sized to meeting design criteria.

The battery shall comply to the following:

Number of batteries	:	2
kWh rating	:	500kWh
Usable kWh	:	400kWh
Current capacity (Ah)	:	10 000Ah per battery
Nominal voltage	:	52V (to suit 48V inverters)
Minimum voltage	:	47V
Maximum voltage	:	56V
Charge / Discharge current	:	2800A per battery
Cooing fan	:	No
Enclosure	:	3mm aluminium, powder coated white
External interface	:	DB15 (various signals), 2 x RJ45 (CAN Bus)
Protection	:	Circuit breaker with shunt
Remote tripping over CAN Bus	:	Yes
Manual reset	:	Yes
Cell under- & over voltage protection	:	Yes
Built-in temperature protection	:	Yes
Minimum SOC control	:	Yes
Human machine interface indication	:	Yes, with 0-100% state of charge
Wi-Fi remote monitoring	:	Yes
Warranty	:	10 years / 4000 cycles
Service life	:	>16 years at 70% DoD
Mounting	:	Floor standing only (no cabinet mounting)

6. SOLAR INVERTERS AND OPTIMIZERS

The solar inverters complete with optimizers shall be installed on the load side of the inverter-chargers and shall comply with the following:

Individual inverter size	:	27.6kW
Number of inverters	:	4
Total inverter capacity	:	110.4kW
Configurable power factor	:	Yes
Maximum continuous output current	:	40A per inverter
T4 DC input pairs	:	3
Built-in module level monitoring	:	Yes
Transformer less topology	:	Yes
Adjustable grid code selection	:	Yes, in field
Lifetime free online monitoring	:	Yes
Max DC input power	:	37250kW
Max DC input voltage	:	900 V
Nominal DC input voltage	:	750V
Reverse polarity protection	:	Yes
Ground fault isolation detection	:	Yes
AC connection type	:	Three phase 4-wire + protective earth
Grid voltage	:	400 V
Rated frequency	:	50/60 Hz
AC connection type	:	2.5mm2 – 10mm2
Anti-islanding protection	:	Yes
Efficiency	:	98.3 %
Night consumption	:	< 4 W
Wireless remote monitoring	:	Yes
User interface	:	Yes, screen
Ambient temperature range	:	-20 to +60 degrees Celsius
IP rating	:	65
Cooling	:	Forced air with fan, field replaceable
Isolation	:	Transformer-less
Photovoltaic array isolation control	:	as per IEC 62109
Safety standard	:	IEC 62109-1 & 2

Optimizer configuration	:	Dual
Optimizer rating	:	950W
Number of optimizers	:	134
Efficiency	:	99.5%
Maximum DC input voltage	:	125V
Operating DC voltage range	:	12.5 to 105V
Overvoltage category	:	II
Safety output voltage per optimizer	:	1Vdc

Safety standard	:	IEC 62109-1 & 2
Fire safety standard	:	VDE-AR-E 2100-712:2013-05
Relative humidity	:	0-100 %
Type	:	To match inverter model and specification

7. CHARGER-CONTROLLERS

Charge-controllers will be installed for solar charging of the battery. It is imperative that the design consider the maximum charge current of the battery, charging current of charge controllers, cable ratings and fuse ratings. The total solar module capacity connected to the charge controllers shall be adequately designed considering DC losses.

The following items shall form part of the charge controller design:

a. Maximum DC input voltage (PV input)
b. Maximum input current per termination point (T4 connector rating)
c. PV fuse protection per parallel array at charge controller (no field fuses)
d. DC input shall have DC isolator (PV rated)
e. DC input shall have Type 2 40kA PV rated surge protection
f. DC output fuse protection
g. DC output isolation

Charge-controllers shall also comply to the following:

Number of charge controllers	:	3
Maximum open circuit voltage	:	250V
Charge current	:	100A
Battery voltage	:	48V
Built-in MPPT	:	Yes (PWM chargers not permitted)
Cooling fan	:	No
Protection	:	Over-temp, PV reverse polarity & current
Remote monitoring	:	Yes
Remote control	:	Yes
Programmable relay	:	1
Safety standard	:	EN-IEC 62109-1
Efficiency	:	99%
Consumption	:	20mA
Charge algorithm	:	multi-stage adaptive
IP rating	:	22

8. SOLAR MODULES AND INSTALLATION

Solar modules must be the poly-crystalline type and comply with the following:

Number of solar modules	:	268
Solar module rating	:	410W
Maximum system voltage	:	1000 V
Operating voltage (Vmp)	:	39.1V
Operating current (Imp)	:	10.49A
Efficiency	:	18.6% minimum
Fire performance	:	Class C as per IEC 61730
Tier rating	:	1
Application class	:	C
Power tolerance	:	+/- 10 W
Cell arrangement	:	144
Front cover	:	3.2 mm tempered glass
Frame	:	Anodized aluminium alloy, crossbar enhanced
Junction box	:	IP68, 3 bypass diodes
Cable	:	4 or 6 mm^2
Connector	:	T4 series
Temperature Co-efficient	:	-0.36 % (P_{max}), -0.28 % (V_{OC}) and 0.05 % (I_{SC})
Operating temperature	:	-40 to +85 degrees Celsius

The solar modules shall be installed on a suitable mounting system. The mounting system shall be certified and have appropriate installation instructions. Weather conditions must be considered when the mounting system is designed to match the installation site's weather conditions.

Solar modules must be installed in neatly arranged rows with consideration for cleaning, servicing and maintenance. For this reason, access paths must be included in the design. A maximum linear string must have an access path every 50m. The design must be submitted for approval to the engineer prior to ordering and installation of any equipment.

Where appropriate, permanent safety lines or anchors for temporary safety line must be included in the design and the tender offer.

The Employer shall provide the successful tenderer with confirmation that the roof is capable of carrying the weight of the intended solar PV installation. Tenderers shall provide the weight of all equipment in their data sheets as part of the tender submission.

The Employer shall be responsible for the installation of water points for cleaning purposed.

Permanent or temporary access **post** hand-over (via mobile ladders, permanent cat ladders or access equipment) shall the Employer's responsibility.

9. DC CABLING AND INSTALLATION

DC cabling and installation shall comply with the following:

DC cable standard	:	IEC 62930
Installation standard	:	IEC 60364-4
DC voltage rating	:	1000 V
Cable size	:	6 mm^2
Connectors	:	T4
Junction boxes	:	IP65, UV and weather proof
Cable installation: on roof	:	Below solar modules allowed
Cable installation: solar modules to DC isolators	:	Galvanized conduit
Cable installation	:	Earth- and short-circuit proof
Cable installation	:	UV and weatherproof
Parallel strings	:	Fused on positive and negative poles with PV rated DC fuses
Field array enclosures	:	Must include surge protection and fuse protection of strings
Earthing	:	Galvanized conduits to be bonded with earth strapping
Earthing	:	All solar modules to have individual earth wires to structure
Earthing	:	Mounting structure to be earthed with minimum 16 mm^2 wire

All connections and extensions to be done with T4 connectors. No joining or extending of solar cable to be done with terminals or strip connectors.

10. SOLAR INVERTER AND CHARGE CONTROLLER DC ISOLATION AND SURGE PROTECTION

DC isolation shall be provided. The DC isolation enclosure(s) shall be double insulated and mounted on an external wall of the building to provide easy isolation for emergency services. Alternatively, a remote emergency stop shall be installed that isolates the DC supply from the solar modules. A fail-safe design for this type of installation shall be used.

The enclosure shall be weatherproof and include individual surge protection per incoming string. The DC isolators and surge protection shall be PV rated. Clearly

visible labelling shall be installed for emergency personnel.

11. INVERTER-CHARGER AC INPUT ISOLATION

Each inverter-charger's AC input shall be fitted with an AC isolator. The AC isolator shall be fitted with a circuit breaker with isolation behaviour. The AC isolator shall be 25% larger than the maximum current of the inverter-charger
Included in the AC input isolator enclosures will be Type 2 40kA surge arrestors complete with fuse protection to surge protection arrestors manufacturer's requirements
Also included in the AC input isolator enclosures will be by-pass switches that allow for easy by-pass of the inverter-charger system for maintenance or failures

12. INVERTER-CHARGER AND SOLAR INVERTER AC OUTPUT ISOLATION

Each inverter-charger 's AC output shall be fitted with an AC isolator. The AC isolator shall be fitted with a circuit breaker with isolation behaviour. The AC isolator shall be 25% larger than the maximum output current of the inverter
Included in the AC output isolator enclosures will be Type 2 40kA surge arrestors complete with fuse protection to surge protection arrestors manufacturer's requirements
The by-pass unit fitted in the AC input isolator enclosure will be wired to this enclosure for by-pass requirements

As most inverter-chargers are transformer-less and not galvanically isolated, the output AC isolator shall be fitted with Type B residual current protection. The AC isolator shall be IP65 rated and mounted within 1.5 m of the inverter(s).

13. AC CABLING

All AC cabling shall be neatly installed on a suitable cable support system. Saddles shall not be permitted to support AC cabling. AC cabling shall be PVC/SWA/PVC four core cabling with external insulated earth. The cabling sizing shall consider fault level, voltage drop at full load as well as the current carrying capacity after deratings

The cable support system shall be galvanized. All joints and bends shall be done with suitable equipment as supplied by the cable support system suppliers. No custom-made joints and bends will be permitted. Bonding of the cable support system is considered to be an integral part of the installation.

Suitable glands shall be used for all cables entering and exiting electrical equipment and enclosures. Should BW glands be used they will be fitted with suitable rubber

shrouds.

14. INVERTER-CHARGER CIRCUIT BREAKER IN DISTRIBUTION BOARD

The installation of the inverter infeed circuit breaker is part of this contract

The circuit breaker shall be clearly labelled, have isolation behaviour and be correctly rated for voltage, current and fault level at the point of installation. Cascading shall not be permitted

The circuit breaker shall be installed by an experienced electrical panel builder that must issue a routine test report. The panel builder shall be liable for the alteration to the DB and take full responsibility and liability for the work done. Busbar or cabling used shall be matched to the current rating of the circuit breaker

15. DESIGN AND SYSTEM CRITERIA

The system design must comply with the following criteria:

a. 12 x 12kW (15kVA) single phase inverters in three phase configuration with 4 in parallel
b. kWh meter fed back to solar inverter for monitoring platform
c. 20% oversizing of solar modules on solar inverters and charge controllers
d. DC cable sizing to avoid DC ripple
e. DC busbars to suite battery and inverter-charger supplier's requirements
f. DC fuses between charge controllers and battery
g. DC fuses between inverter-charger and battery
h. Surge protection as indicated in this document and drawings
i. Back up time: 6 hours at full load (144kW)
j. The system shall be programmed to meet output demand and the balance of the capacity of the system shall be fed back into the local electrical network up to the full rating of the system. This will be applicable from 09:00 to 15:00
k. The control and load control (see below) systems shall use the following priorities
    a. Grid tied solar first priority of power source
    b. Charge controller solar modules power over battery charging to meet demand
    c. If the grid tied solar and charge controller power can't meet demand utilize battery power until battery reaches 20% SOC (state of charge)
    d. Once the battery reaches 20% SOC the utility power shall be used to meet demand. If the demand is above the utility limit of 200kVA the generator shall be started until the demand is below 200kVA or / if conditions a. and b. above can provide enough power to meet demand
    e. The generator shall automatically start upon power failures or if the

demand is above the hybrid system capacity (180kVA / 144kW)

l. Battery re-charge time: 10 hours @ 800A per battery from 20:00 to 06:00
m. AC cabling sizing to consider deratings, voltage drop and short-circuit rating
n. Generator control and programming for low battery level and power assist (configurable)
o. Generator supplier liaison

16. INVERTER-CHARGER MONITORING SYSTEM

The backup system shall have a monitoring system. The monitoring system will monitor the inverter-chargers, charge controllers and lithium iron phosphate battery. The monitoring system will be connected to a local area network or local Wi-Fi network and must be accessible via the internet and a dedicated smart phone application

The monitoring system shall monitor and include the following as minimum:

a. Remote control and configuration of system
b. Inverter-charger values i.e. voltage, current, power and load
c. Inverter-charger statuses i.e. healthy input and output, alarms and protections
d. Charge controller values i.e. voltage, current and power
e. Charge controller statuses i.e. alarms and protections
f. Battery information i.e. DoD, SOC, temperatures, cell voltages and charging status
g. kWh from and to grid

17. POWER USAGE MONITORING SYSTEM

As part of the solar installation contract a permanent power usage monitoring system shall be installed. The information shall be locally stored in the data concentrator and shall be accessible via the built-in webserver.

The power usage monitoring system shall include the following:

- Installation of kWh meters in the main distribution boards on the following circuits:
  - Incomers: Transformer, Generator and Solar PV
  - HVAC feeder(s)
  - Feeds to sub distribution board(s)
- Installation of a data concentrator with built-in webserver (see specification below)
- Communication cabling between kWh meters and data concentrator
- Setup, commissioning and hand-over

- Training of the Employer on access to and use of the monitoring system

The kWh meters for the power usage monitoring system shall measure the following:

- Voltage, current, power factor
- Active power (kW) – 4 quadrant metering
- Apparent power (kVA)
- Reactive power (kVAr)

The kWh meters shall comply with the following:

Values	:	Voltage, current, kW, kVA, kVAr and PF Meter type : Active, reactive, apparent (signed, four quadrant)
Accuracy class	:	Class 1 to IEC 62053-21 and IEC 61557-12
Rated voltage	:	100 to 277 Vac and 173 to 480 Vac
Network frequency	:	50 Hz and 60 Hz
Technology type	:	Electronic
Display type	:	LCD
Sampling rate	:	32 samples / cycles
Tariff input	:	Tariff (4)
Communication protocol	:	Modbus RTU
Local signalling Green	:	Power ON, Yellow: Modbus comms active
Digital inputs	:	1
Digital outputs	:	1
Over voltage category	:	III
Pollution degree	:	2

The data concentrator shall comply with the following:

Component type	;	Energy server
Power supply	:	24V dc
Power consumption	:	26 W for 24V dc and 15 W for PoE
Communication	:	RS485 to meters and Ethernet for network
Digital inputs	:	6
Analog inputs	:	2
Analog input types	:	PT100, 0-10 V & 4-20 mA
Memory capacity	:	128 MB RAM, 256 MB Flash and 4G SDRAM
Number of sub devices	:	32 serial devices (Modbus RS485)
Data storage duration	:	2 years
Built-in webserver	:	Yes
Real time data	:	Yes
Historical data	:	Bar graph and trending formats
Built-in data publisher	:	Yes
LED indication	:	Power supply, status, communication & IO's

3G Modem : Yes

The following items shall be trended:

- Voltages and currents – all meters
- Imported kW, kVA, kVAr – all meters
- Power factor – all meters
- Imported kWh – Incomers (Transformer, generator and solar PV)
- Exported kWh – Incomer (Transformer)

A monthly report, containing the trended information above, shall be automatically emailed from the data concentrator to email addresses that shall be provided by the client

18. LOAD CONTROL SYSTEM

A load control system will be installed as part of this contract. The load control system shall switch circuit breakers ON and OFF based on total facility load by measuring the current. The system will consist of a programmable logic controller (PLC), human machine interface (HMI) and other associated equipment. The associated equipment shall include the required power supply, relays, lights, push buttons, selector switches, wiring and terminals.
The power supply for the PLC and HMI shall be taken from the output isolator of the inverter-charger to guarantee continuous power supply to the system.
The load control system shall be installed in a dedicated enclosure.
All the cabling to and from the load control system to the inverter charger, generator and main DB shall be installed by the electrical contractor.

The following items shall be covered by the load control system:

- At an adjustable high current limit, selected circuit breakers shall be switched OFF
- At an adjustable low current limit, selected circuit breakers shall be switched ON
- All switching shall be time delay based
- Selectable circuit breakers, current limits and time delays shall be adjustable via a dedicated settings screen on the HMI
- Current values shall be determined by current transformers fitted on transformer incomer, generator incomer, inverter-charger output and solar incomer. The current values shall be converted with transducers from the current transformer 5A output to 4-20mA. The 4-20mA signals shall be wired into analogue inputs on the PLC. Each incomer shall have a current transformer per phase. The highest current of each incomer shall be used to determine when to switch by the PLC
- All inputs onto the PLC shall be fused

- All output on the PLC shall be wired to relays that will switch the required equipment
- In addition to the above circuit breaker switching the load control system shall switch change-over switches to control current flow from the transformer and generator supply during power failures or as needed to meet the total building demand
- The load control system shall be linked, via a multiport network switch, with Modbus TCP/IP to a transformer incomer power meter, generator controller and the inverter-charger system
- The following values shall be displayed on the HMI:
    - Transformer voltages: phase-to-phase and phase-to-neutral
    - Transformer load: total kVA, total kW and ampere per phase
    - Generator voltages: phase-to-phase and phase-to-neutral
    - Generator load: total kVA, total kW and ampere per phase
    - Generator fuel level
    - Inverter-charger system input and output voltages and currents per phase
    - Battery percentage
    - Solar inverters' kW production
    - Charge controller's kW production
    - All switched circuit breakers' statuses
- The HMI shall be a 12"touch screen with full colour display and communicate over TCP/IP to the PLC
- The PLC shall be a reputable brand well supported in the market

19. SITE ACCEPTANCE TEST (SAT)

The contractor will have a dedicated test sheet for testing the system that must be completed during the SAT. This test sheet shall include voltage measurements (AC and DC), current measurements (AC and DC) and frequency. The readings must be recorded and signed off by a trade-tested electrician

The SAT shall include a full battery test that include discharge and re-charge cycles as well as a full test of the load control system

Prior to the SAT all labelling will be fitted indicating the function and isolation points

20. DRAWNGS

Within one week of the receipt of order the successful tenderer shall submit the following drawings / information for approval prior to placing orders on suppliers / delivery to site:

a) Inverter-charger details

b) Battery details
c) Solar inverter with optimizers
d) Charge controller details
e) Solar panel details
f) Solar panel layout
g) Mounting system details
h) DC cabling details
i) DC isolator with surge protection details
j) AC input and output isolator details
k) AC tie-in
l) Manual by-pass switch
m) AC and DC wiring schematic
n) Equipment lists
o) Design details showing voltage and power calculations
p) Design confirmation using dedicated solar design software
q) Power usage monitoring system
r) Load control system
s) Recommended spare parts

21. OPERATING AND MAINTENANCE MANUALS

The contractor shall supply three complete, comprehensive sets of operating and maintenance manuals containing all design and drawing information as listed above.

The above manuals are to be handed to the Employer's authorised representative on completion of the site acceptance test

22. WARRANTY

General workmanship	:	12 months
Electrical equipment and material (AC and DC)	:	12 months
Solar modules	:	25 year product 10 year performance
Inverter-chargers and charge-controllers	:	10 years
Lithium iron phosphate battery	:	10 years / 4000 cycles

The tenderer shall provide the warranties above on the system for the indicated periods, starting from the date of hand-over. During the warranty periods, the tenderer shall repair any defective material, equipment or workmanship (excepting proven, wilful or accidental damage, or reasonable wear and tear). These shall be made good with all possible speed at the tenderer's expense and to the satisfaction of the Employer.

When called upon by the Employer, the tenderer shall make good on site and shall bear all expense incidental thereto, including making good of work by others, arising from the removal or reinstallation of equipment. All work arising from the implementation of the guarantee of equipment shall be carried out at times which will not result in any undue inconvenience to users of the equipment or occupants of premises.

If any defects are not remedied within a reasonable time, the Employer may proceed to do the work at the tenderer's risk and expense, but without prejudice to any other rights which the Employer may have against the tenderer.

The Employer reserves the right to demand replacement or making good by the tenderer at his own expense of any part of the tender which is shown to have any latent defects or not to have complied with the specification, notwithstanding that such work has been taken over or that the guarantee period has expired.

Should any specified materials or equipment in the tenderer's opinion be of inferior quality, or be unsuitably employed, rated or loaded, the tenderer shall prior to the submission of his tender advise the Employer accordingly. His failure to do so shall mean that he guarantees the work including all materials or equipment as specified.

23. RETURNABLE HYDRID BACKUP SYSTEM DATA SHEET

SCHEDULE OF INFORMATION / COMPLIANCE DOCUMENT (RETURNABLE DOCUMENT)

The tenderer must sign and return the compliance document. Failure to do so will automatically lead to disqualification of the tenderer and his/her tender will not be considered regardless of tendered value.

** Tenderer to indicate Yes or No to confirm compliance to specification **

Description	Yes / No	Make & model & size
Inverter-chargers		
Lithium iron phosphate batteries		
Solar inverters with optimizers		
Charge controllers		
Solar modules		
Mounting system		
DC cabling and installation		
DC isolation with surge protection		
AC input isolation with surge protection		
AC output isolation with surge protection		
AC output isolation with Type B RCD		
AC cabling and installation		
Feeder circuit breaker in DB		
By-pass switch included		
Electrical earthing and bonding allowed for		
Inverter-charger monitoring system		
Power usage monitoring system		
Load control system with PLC & HMI		
Generator control and programming for low battery etc		
Generator supplier integration and liaison		
Labelling		
Drawings, equipment lists & design requirements		
ECSA accredited (Pr Eng / Pr Tech Eng) sign off		
Health & Safety file allowed for		

Site acceptance testing allow for		
Customer hand-over and training allow for		
Anti-islanding NRS and SANS approved		
Guarantee		

Date

Tenderer authorised signature

Name and Surname

Position

BILLS OF QUANTITY PREAMBLES FOR THE ELECTRICAL INSTALLATIONS

GENERAL NOTES

1. The descriptions in these Bills of Quantities shall be read in conjunction with the specification.

2. The unit rate for each item in the Bills of Quantities 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.

3. The Bills of Quantities shall not be used for ordering purposes. The contractor will check dimensions on site before producing shop drawings and ordering any equipment from the approved drawings. An allowance for off-cuts shall be made in the unit rates.

4. The rates shall **EXCLUDE Value Added Tax** and the total carried over to the **FINAL SUMMARY SHEET.**

5. All material covered by this specification shall, wherever possible, be of South African manufacture.

6. Description in the Schedule of Quantities are abbreviated and may differ from those in the Standardised Specifications. No considerations will be given to any claim submitted on these bases. Should any requirements of the measurement and payment clause of the appropriate Standardised Specification(s) be contrary to the terms of the Schedule, the requirement of the appropriate Standardised, Project or Particular Specification as the case may be, shall prevail.

7. The amounts and rates to be inserted in the Schedule of Quantities shall be the full inclusive amounts to the Employer for the work described under the several items. Such amounts shall cover all the costs and expenses that may be required in and for the construction of the work described, and shall cover the costs of all general risks, profits, taxes (but excluding value-added tax), liabilities and obligations set forth or implied in the documents on which the Tender is based.

8. An amount or rate shall be entered against each item in the Schedule of Quantities, whether or not quantities are stated. An item against which no amount or rate is entered will be considered to be covered by the other amounts or rates in the Schedule and shall be deemed to be included.

9. The Tenderer shall enter a rate or lump sum for each item in the Schedule of Quantities in BLACK INK.

10. The quantities in this Bill are re-measurable. Payment shall be effected for quantities actually installed.