

SCOPE OF WORK

SENTECH'S GOODS INFORMATION

GOODS INFORMATION

1. TECHNICAL REQUIREMENTS

1.1. Glossary of Terms

SYMBOLS AND ABBREVIATIONS

Throughout the documentation units of measurement are referred to by symbols: Abbreviations used:

Alternating Current	: AC
British Standard	: BS
Certificate of Compliance	: COC
Contract Price Adjustment	: CPA
Control and Management System	: CMS
Direct Current	: DC
Distribution Board	: DB
Environmental Impact Assessment	: EIA
International Electro-Technical Commission	: IEC
Ingress Protection	: IP
Kilo Volt-Ampere	: kVA
Low Voltage	: LV
Miniature Circuit Breaker	: MCB
Medium Voltage	: MV
New Registration System	: NRS
Point of Connection	: POC
PolyVinyl Chloride	: PVC
South African National Standards	: SANS
Steel Wire armoured	: SWA
Damp Proof Membrane	: DPM
The Main Contractor on Site	: Main Contractor
The contractor responsible for the electrical installation on site	: Electrical contractor

2. SCOPE OF WORKS

The scope of this project is for the appointment of a service provider to design, supply, install and commission a functional rooftop Photovoltaic system at Vryburg Operation Centre. The identified site is to have a 30kWp solar power without losses.

The project entails the following works:

- A recommendation as to the best location and orientation for the PV array, must be included in the submission. The reasoning behind these recommendations must be included.
- Pricing for a rooftop tilted, [with two panel portrait per structure], must be provided for.
- Calculation of power saving annually.
- Calculation of annual payback based on current tariffs and proposed 10% increases for 2025, 2026, 2027, and 12% thereafter.
- Calculation of payback period based on the tariff sheet.
- SMA hybrid inverters or approved similar to be used.

Rooftop installations

The array shall be installed on structures suitably sized for the array output required and the given area available. The structures must be designed and orientated as to achieve the maximum yield which will in turn provide the client with the quickest payback period. Any additional civil costs required due to a lack of research on the roof conditions shall be for the contractors account. Ballasted solutions will be the very last option to be considered. The installation must be secure.

A drawn design of the fixing detail of the structure to shall accompany this RFP.

Array

The system's photovoltaic array shall provide a peak (DC) power at Standard Test Conditions. The array by a combination of modular panels shall produce electrical power to supply the buildings during peak sun hours. Peak sun hours are the equivalent number of hours per day when solar irradiance averages 1 kW/m².

The array is to be optimally orientated and sized to achieve an average of five and a half (6.3) peak sun hours per day averaged over the year. Array efficiency is of paramount importance - inefficient array layouts that do not maximise solar exposure, [are subject to shading and less than 6.3 peak sun hours per day over the year], will not be considered.

Sufficient space must be allocated for the cleaning and servicing of the panels and thus adequate walkways and circulation space must be included in the submission. A description as to how the panels will be cleaned needs to be submitted.

The system needs to be sized to **30kWp power give or take 1kWp and 28,5kVA AC power**. The way to achieve this is left up to the discretion of the contractor preparing the solution. Panel performance depreciation over time also needs to be considered in the proposed solution. Drawings will be supplied to the contractor in order to prepare a panel layout. Co-ordinates will be provided to all bidders who attended the site briefing.

The proposed panel needs to be able to withstand normal weather conditions such as UV radiation, temperature, humidity, hail, snow and wind pressure. Testing details of the panel under various weather conditions need to be provided in accordance with IEC 61646. The proposed panel needs to be able to withstand a minimum hail diameter of 25mm, (7.53 g), but preferably 45 mm, (43.9 g)

Irrespective the type of installation, roof or ground, the support structures shall be light-weight in materials and design; evidence of this must be supplied. The PV array shall be installed to allow proper run off and drainage and avoid dirt accumulation. The abovementioned support structure will have to be approved by the appointed Structural Engineer.

The system is to include electrical terminal and combiner boxes, quick-connect electrical connectors, DC wiring, DC disconnects, hybrid inverters, AC disconnect and a corresponding Supervisory Control and Data Acquisition (SCADA) system. The inverters shall be wired to the electrical system through a suitable circuit breaker compliant to NRS 097-2-1 NS protection. The inverters shall be guaranteed for a minimum of five [5] years, but offers to extend it to 10 and 15 years must be provided. The Solar contractor shall endeavour throughout the project to ensure safety and appropriate compliances.

PV Modules

PV Modules shall be tier 1 and shall provide the maximum power production per meter squared (m²).

The Contractor shall supply and install the PV modules to achieve the specified levels of performance for the required design life of 25 years under the prevailing site environmental conditions, which shall be determined by the Contractor.

Modules to be used shall be reliable modules with a proven track record in performance, operation and obtaining long-term debt (project finance). The Contractor shall ensure that PV modules are sourced from a Tier 1 manufacturer.

All modules supplied shall be of the same type and from a single manufacturer.

The quality of equipment supplied shall be generally controlled to meet the guidelines for the design included in the standards and codes listed.

All transportation, storage, handling and installation of the modules shall be in accordance with the specifications from the manufacturer to ensure that the module manufacturer's warranty is honoured.

The module rated peak power shall be used to determine the peak power of the PV Plant. The peak power shall be the sum of the manufacturer's name plate data sheets for each individual module.

The Contractor shall be responsible to decide the module arrangements to minimise the losses due to mismatching. Where the manufacturer's module flasher data show an IMPP deviation of more than 3%, PV modules shall be sorted into three groups to meet a set tolerance. Only modules from the same set shall be used in the same string. All records of the testing and grouping of Modules must be kept and presented to the Clients.

Inverters

Inverters shall be hybrid inverters and have a NRS 097-2-1 (2017) inverter compliance certificate from a third-party test institute.

The Contractor shall provide inverter arrangement for the PV Plant that is selected to give overall optimal energy yield from the PV Plant over the life of the Contract Period, taking into account the site conditions, the proposed module layouts, shading and orientations.

The inverters shall be installed in a manner that it is not exposed to direct sunlight.

Inverters shall meet the following general requirements:

Due to maintenance reasons and a conservative spare-part approach, inverters of the same type and size from the same manufacturer shall be deployed.

Inverters shall be equipped with communication capabilities as required by the Control and Monitoring System (CMS); all inverters shall be able to be controlled / supervised by the same software or CMS system.

Software must be paid for or free access for the Client for the lifetime of the plant.

Inverter specifications shall be selected with respect to the local climatic and environmental conditions. The inverters shall be suitable for inland installation and operation in conditions such as extreme heat and dust.

Inverters to be used shall be reliable inverters with a proven track record in performance, operation and obtaining long-term debt (project finance). The manufacturer shall be established in the market.

Inverters must comply with applicable norms and standards including but not limited to NRS-097-2-1:2017.

The test result and certification must be attached to Returnable Technical Schedule,

Inverters shall comply with South Africa Grid Code requirements for renewables.

The Contractor shall submit calculations for ensuring electrical compatibility between the inverters and the modules selected including, selection of appropriate inverter dimensioning factor and ensuring system voltages lie within acceptable MPPT ranges across the range of operating conditions for the Site.

The quality of equipment supplied shall be generally controlled to meet the guidelines for the design included in the standards and codes listed.

All transportation, storage, handling and installation of the inverters shall be in accordance with the specifications from the manufacturer to ensure that the manufacturer's warranty is honoured.

The Contractor will be required to confirm the inverter manufacturer's warranties for the given environment and installation type. The Contractor shall also mention if the inverter warranties can be extended.

The Contractor is required to install a motorised circuit breaker.

The motorised circuit breaker shall have the following features:

- over and under voltage;
- over and under frequency;
- voltage vector shift; and
- rate of change of frequency (ROCOF).

The protection relays used shall comply with the relevant sections of the international standard for protection relays IEC60255.

The inverters to be used shall be SMA hybrid inverters or approved similar.

Circuit Breakers

The Contractor shall supply Circuit Breakers that are SABS approved. The tie-in circuit breaker shall be a motorized and be the same make as the circuit breakers in the Main distribution board.

Earthing

The Contractor shall design, supply and install an earthing system for the PV Plant that eliminates the risk to personnel of electric shock under normal operating conditions as well as fault conditions. Furthermore, the earthing system shall ensure the functionality of electrical protection equipment during electrical faults.

The Contractor shall design the earthing system in accordance with Solar PV industry best practice and in compliance with SANS Codes.

The bidder shall provide an earthing proposal including but not limited to:

- A project specific earthing system diagram;
- Data sheets of main products used;
- Proposed test procedure.

- The Contractor shall conduct tests on the earthing system to fully verify and certify the safety of the site.

The AC Distribution Board shall be bonded to the earthing system with a bare Cu earth conductor.

Protective earthing or bonding conductors connected to the main earthing system shall be provided for the array frames.

Surge and lightning protection

The Contractor shall carry out a risk assessment for lightning and install adequate lightning protection systems. The Contractor shall design the lightning protection system in accordance with the latest edition of the SANS/IEC standards.

The lightning protection system shall protect the plant, inverters, control and monitoring systems and any other electrical and mechanical equipment against damage caused by lightning strikes.

The proposals to the Client must provide for adequate design against lightning induced overvoltage risk.

Overvoltage protection shall be installed at DC side as well as AC side of the inverter and within the PV arrays. In general, the design of the DC system must ensure that cables are kept in parallel and as short as possible, while cable loops are also avoided or restricted.

Protection against direct strikes (direct strike lightning protection) shall be installed and coupling because of strikes elsewhere in the grid (indirect strike lightning protection) shall be taken into consideration and designed out of the system.

The lightning and surge protection shall meet the following criteria:

Lightning protection level (LPL 1 or 2)

Type 1:

Type: Modular, 1+2 Combined Lightning & Surge Arrester

Rating: $I_{total} = 100\text{kA}$ (10/350 μs), $U_p \leq 1.5\text{kV}$

Fuse: (Internal/Integrated) or external

Configuration: 3-phase = 3+1 configuration, or 1-phase = 1+1 configuration

Indication: Remote Signalling & Flag indication between (L-N, N-PE)

Technology: Spark-gap or equivalent

Follow current extinguishing capability [L-N]/[N-PE] (Ifi): 50 kA rms/100 A rms

Compliance : SANS/IEC 61643-11

Proven energy coordination with downstream arresters and terminal equipment

Lightning protection level (LPL 3 or 4)

Type 1:

Type: 1+2 Combined Lightning & Surge Arrester

Rating: $I_{total} = 50\text{kA}$ (10/350 μs), $U_p \leq 1.5\text{kV}$

Fuse: (Internal/Integrated) or external

Configuration: 3-phase = 3+1 configuration, or 1-phase = 1+1 configuration

Indication: Remote Signalling & Flag indication between (L-N, N-PE)

Technology: Spark-gap or equivalent

Follow current extinguishing capability [L-N]/[N-PE] (Ifi): 25 kA rms/100 A rms

Compliance : SANS/IEC 61643-11

Proven energy coordination with downstream arresters and terminal equipment

Sub AC distribution board

Type 2:

Type: Modular Type 2, Surge Arrester

Rating: $I_n = 20\text{kA}$ (8/20s), $U_p \leq 1.5\text{kV}$

Lightning impulse current (10/350 μs) [N-PE] (Iimp): 12 kA

Fuse: 125A gL/gG (External)

Configuration: 3-phase = 3+1 configuration, or 1-phase = 1+1 configuration

Indication: Remote Signalling & Flag (L-N, N-PE)

Technology: Spark-gap or equivalent

Short-circuit withstand capability for max. mains-side overcurrent protection (ISCCR): 50 kA rms

Compliance : SANS/IEC 61643-11

Energy coordination with upstream and downstream arresters and terminal equipment

DC SPD

Type:1

1+2 Combined Lightning & Surge Arrester

Total discharge current (10/350 μs) [DC+/DC- -> PE] (I_{total}): 12.5 kA

Voltage protection level [(DC+/DC-) -> PE] (UP): 2.5 kV (1000V DC)

Voltage protection level [DC+ -> DC-] (UP): 4.75 kV (1000V DC)

Short-circuit current rating (ISCPV):	1000 A
Indication:	Remote Signalling & Flag indication
Compliance :	EN 50539-11
Technology:	Y - configuration combined disconnection and
short-circuiting device with safe electrical isolation	
Energy coordination with terminal equipment (≤ 10 m)	
Type:2	Modular, 2 Surge Arrester
Total discharge current (8/20 μ s) [DC+/DC- -> PE] (Itotal):	40 kA
Voltage protection level (UP):	≤ 4 kV (1000V DC)
Voltage protection level [DC+ -> DC-] (UP):	≤ 3.5 kV (1000V DC)
Short-circuit current rating (ISCPV):	10 KA
Indication:	Remote Signalling & Flag indication
Compliance :	EN 50539-11
Technology:	Y - configuration combined disconnection and
short-circuiting device with safe electrical isolation	
Energy coordination with terminal equipment (≤ 10 m).....	

Control and Monitoring System (CMS)

The following technical parameters are required to measure and monitor the plants:

- AC energy output at the point of supply (kWh);
- AC energy output from each inverter (kWh);
- Ambient air temperature ($^{\circ}$ C);
- Module temperature ($^{\circ}$ C);
- Global solar irradiation on plane of array (kWh/m²);
- Global solar irradiation on horizontal surface (kWh/m²).
- Wind speed (km/h)

A 24/7 metering and monitoring system are required, including the following:

- Web display with a content and functionality, similar or equally approved to SMA's "Webconnect";
- Weather station equipped with a pyranometer integrated with the web portal, similar or equally approved to SMA's "Meteo Station";

The display shall include the following minimum items:

- Current power in kW;
- Inverter comparison status;
- Energy for the current day and running total for the plant;
- Reimbursement;
- CO2 avoided;
- Plant information, i.e. plant accumulated kWh to date and commissioning date;
- Current weather report;
- Graph with day, month, year and total options depicting the time and power (kW)
- Theoretical Maximum kWh production vs Actual Maximum kWh production.

Generator integration

The site is fully backed up by a generator in the event of a power failure. When a power failure occurs the PV system shall run in parallel with the generator in order to save diesel. The generator shall not run at less than 50% to 60% of its full load capacity in order to prevent carbonization. The PV system will need to be throttled accordingly in order to accomplish this.

General

The presence of voltage levels in the range of 300-600 V DC and beyond requires a very careful assessment of the protection and isolating devices.

The following forms of protection are to be taken into consideration during the design.

- Over current protection.
- Isolating devices on each string to allow this latter to be inspected or serviced without having to shut down other parts of the system.
- The exposed conductive parts of all the equipment must be earthed through the protection conductor with the aim to protect persons from indirect contacts.

- String protection against reverse currents.
- Earth fault protection.
- Grounding of the array.

Explanation as to how the above will be achieved will be by means of a protection philosophy schematic which must be included in the schematic.

A single-line electrical schematic is to be provided with the submission illustrating the system interconnections. This will illustrate the PV cell interconnections and how the PV array ties back into the domestic grid.

Detailed sizing calculations are to be included in the design submission. Design parameters and assumptions made are to be listed.

The Solar contractor will also train staff in the routine operation, maintenance and safety of the PV system, as well as the SCADA system.

The PV System is to be installed in a location that is not permanently manned. As a result theft is an issue at these remote sites. The contractor needs to allow for anti-theft means of fastening the panels to the structures as well as fastening the inverters to the structures

All cables (AC and DC) are to be buried and or enclosed as to prevent the cables from being stolen. ECC cables are to be used and they are to be accompanied by a separate insulated black earth cable.

Provision needs to be made to prevent veld fires from damaging the panels. Not only does the contractor need to clear and make provision under the panels, but the contractor also needs to clear/ make 5m provision around the installation. 19mm crushed stone needs to be allowed for under the installation.

A clearvu fence or a similar fence to the same quality needs to be installed around the PV system. An electric fence with remote alarm notification needs to be installed on top of the clearvu fence.

Nominal system characteristics:

Voltage : 400V \pm 5%
Frequency : 50 Hz \pm 0.1 Hz

Technical information submission requirements:

Please refer to Returnables document

2.1. Information to Bidders

DRAWINGS/DOCUMENTS TO BE PROVIDED TO THE SUPPLIER

- Vryburg site Layout
- Vryburg tariff sheet
- Co-ordinates of Site
- Vryburg main breaker size at POC
- Vryburg Cable size at POC

*Please note, drawings will be issued on the day of briefing(On site).

PRICING SCHEDULE

***Refer to the attached pricing schedule. Attached as a separate document.**

Schedule of completed projects

Project description	Year	Client	Project Value	Professional fee	Completion month & year