PROJECT TECHNICAL SPECIFICATION

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1.1 GENERAL

The principal materials and equipment that the *Contractor* will be required to provide and install in compliance with this document and the drawings are covered in this section of the specification.

This section contains enough details to allow the tenderer to calculate an accurate price for the work. Tenderers shall allow for any items, whether or not specifically indicated in the tender documents, essential to execute the installation in a neat and workmanlike way that is according to standards detailed below is clause 1.2.

1.2 STANDARDS

The system shall be designed according to the below standards and limited to:

- IEC 62116, Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures;
- IEC 62446-2:2020 Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 2: Grid connected systems - Maintenance of PV systems;
- IEC 60068: Environmental Testing;
- SANS 60364-7-712/IEC 60364-7-712, Electrical installations of buildings – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems;
- SANS 61215/IEC 61215, Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval;
- IEC 62109: Safety of power converters for use in photovoltaic power systems: all Parts IEC 61727: Photovoltaic (PV) Systems - Characteristics of the Utility Interface;
- IEC 61683: Photovoltaic Systems - Power Conditioners - Procedure for Measuring Efficiency;
- IEC 62930: Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC (SANS 62930);
- IEC 62852 / SANS 62852: Connectors for DC-application in photovoltaic systems - Safety requirements and tests;
- SANS10142-1: The wiring of premises;
- OHS Act – Occupational Health and Safety Act and Regulations, Act 85 of 1993.
- NRS 097 Part 2: Small scale embedded generation (all part 2 series); and
- Grid connection code for renewable power Plants (RPPs) connected to the electricity Transmission system (TS) or the distribution System (DS) in South Africa (latest edition).

1.3 FIXED TILT PHOTOVOLTAIC (PV) SYSTEM

The *Contractor* shall design, build, install and commission the new PV systems that is inclusive of grid-tied carport systems that incorporates battery energy system for the Port of Ngqura. As well as to operate and maintain the PV systems for the period of seven (7) years. The *Contractor* shall ensure that the system is optimised to provide a high energy yield and minimise losses. The rooftop and onshore structure shall be designed and signed off by a professionally registered structural that is a senior engineer (or technologist) whereby the structure shall be designed to withstand the site environmental elements.

The PV system electrical design and the installed system shall be approved by a qualified Professional Engineer or technologist that is a senior engineer. The *Contractor* shall ensure that method statements are submitted for the all the components of the system as part of the health and safety file.

1.4 SIMULATIONS and PERFOMANCE ANALYSIS

The system shall be designed and simulated with the aid of a reputable industry simulation software. The complete design shall have a simulation that provides the following and not limited to:

- System size (DC side kWp and AC side kWp & kVA)
- System component parameters
- Complete simulation reports for energy yields
- Load Ratio
- kWh/kWp
- Performance Ratio
- System losses report e.g.: o Incidence angle (IAM) losses.
    - o Soiling losses
    - o Irradiance losses
    - o Thermal losses
    - o Light soaking effect
    - o Module quality losses
        - o Mismatch losses
        - o Module degradation loss
        - o Ohmic wiring losses
        - o Auxiliaries consumption
        - o Inverter Losses
        - o System Unavailability loss

1.5 PHOTOVOLTAIC MODULE

All PV Modules shall be transported, stored, handled, and installed in accordance with the manufacturer's standards, to ensure that the module manufacturer's warrantee is honoured. The PV Modules shall be from a tier 1 manufacturer (or tier 1 PV Module) and shall be of the Monocrystalline solar panel type. The panels shall carry a minimum 24-year linear power warrantee and a minimum 10 year material warrantee.

The PV Modules shall be compatible to the site environmental conditions related to weather and corrosion and all PV modules shall have anti-PID properties. All modules supplied shall be of the same type and from the same manufacturer. The *Contractor* shall ensure that PV modules are selected and arranged to minimise 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 Client.

The *Contractor* shall appoint a PV specialist to test the PV modules and attain baseline VI curves for the system. The tests method statements will be submitted to the Client (Transnet National Port Authority) for approval before the testing is carried out. This testing must be carried out at practical completion stage and must be done during the construction and after commissioning for the next five (5) years, on a yearly basis, to ensure that PV modules are still performing as per provide data sheets and to monitor unforeseen manufacturer defects. The *Contractor* and Transnet National Port Authority delegate shall attend, approve and monitor the PV specialist when conducting the testing session in the price schedule.

The final choice of PV module must be based on high quality, high efficiency, optimal performance, and long service life.

1.6 INVERTERS

All Inverters shall be transported, stored, handled, and installed in accordance with the manufacturer's standards, to ensure that the module manufacturer's warrantee is honoured. Inverters shall be string inverters and have a NRS 097-2-1 inverter compliance certificate from a third-party test institute. Approved inverter manufacturers are ABB/Fimer Spa, Huawei and SMA. The *Contractor* shall ensure that inverters are not exposed to direct sunlight.

To enable ease of maintenance, training and spare parts, the *Contractor* shall ensure that all inverters are of the same type and manufacturer. The inverters shall have communications control capabilities as indicated on the schematic drawing. The inverters shall be suitable for outdoor installation and for

coastal conditions with severely corrosive environment. The inverters shall carry a minimum 10-year warrantee on performance and build. The installation and wiring of inverters shall be strictly in accordance to manufacturers standards and must be suitable to site conditions. Areas allocated for inverter positions are indicated on the drawings. The inverter controls or the system control system shall meet the requirements of clause 1.7 below.

1.7 SYSTEM CONTROLLER

All parallel inverters shall operate as one system to meet the requirements as per the grid connection code for renewable power plants RPPS's.

The PV System shall be able to perform as per grid codes, with regards to:

- Normal operating conditions
- Abnormal operating conditions
- Frequency response
- Reactive power capabilities
- Reactive Power and Voltage Control Functions
- Power Quality
- Protection
- Active Power Constant Functions
- Control functions
- Availability, supervisory control and data acquisition
- Testing and Compliance

The system shall be equipped with a monitoring and signaling functions to send signals to the Clients through a SCADA System. This system shall be able to report the following to the Client's monitoring system:

- Inverter DC Voltage
- Inverter DC Current
- Inverter DC Power
- Inverter Condition (operating, faults, alarms and errors)
- AC Power output (kW, kVAr, kVA and power factor)
- AC Power direction
- AC Voltages
- AC Currents
- Module Temperature
- Global solar irradiation on plane of array (kWh/m²)
- Global solar irradiation on horizontal surface (kWh/m²)
- Any essential monitoring parameters essential for maintenance

The systems data manager shall be able to log the following data at averages of 15 minutes intervals, with sufficient storage for 1 year's data:

- Inverter DC Voltage
- Inverter DC Current
- Inverter DC Power
- Inverter Condition (operating, faults, alarms and errors)
- AC Power output (kW, kVAr, kVA and power factor)
- AC Power direction
- AC Voltages
- AC Currents
- Module Temperature
- Global solar irradiation on plane of array (kWh/m²)

1.8 DC SYSTEM

The PV System for each inverter must be equipped with string over current protection, over voltage protection and surge protection. All equipment used on the DC System must be rated to the highest operating DC Voltage and Current and should be able to handle the DC fault levels. The DC System to each inverter should be isolatable in accordance to SANS 10142-1.

Battery Energy storage System requirement must have a high energy density, high power, long life (charge-discharge cycles), high round-trip efficiency and safe. The system must be optimized to provide a high energy yield that will meet the required port demand with minimal losses.

1.9 PV MODULE MOUNTING SYSTEM

The PV system must be designed, constructed, tested and commissioned by a specialist *Contractor*. All materials used for the PV and Battery systems shall be suitable for **severely corrosive environment** and carry a minimum warrantee of 10 years. The system shall be designed and signed off by both a suitably qualified structural senior engineer and electrical senior engineer.

1.10 DRAWINGS AND DOCUMENTATION

The *Contractor* shall supply a full set of drawings for the Client's approval. These drawings shall indicate:

- Cable routes for AC and DC circuits
- Single line diagrams for DC system
- Single line diagram for AC system
- Equipment position layouts

- Distribution line diagrams
- General arrangements for Distribution Boards
- Control and monitoring system (including communication drawings)

Upon completion of the project the *Contractor* shall provide as built drawings and Operational and Maintenance documents for all system components. In addition, the *Contractor* shall supply a list of recommended spares.

1.11 MUNICIPAL REQUIREMENTS

The *Contractor* shall be responsible for the following:

- Registration of the system with the municipality and Eskom
- Grid-studies required by the municipality and Eskom
- Provision of all required documentation upon project completion (including test reports and commissioning data)
- Ensuring the system complies to municipal and Eskom by-laws

1.12 TESTING AND COMMISSIONING

Testing and commissioning shall be done in accordance with the relevant Clauses of the Technical Specification and requirements of the Grid connection/Grid code standard.

Prior to the first delivery inspection of the completed installation, the *Contractor* shall satisfy himself that the works are complete **in every respect** fully in accordance with this specification and accompanying drawings. Only then shall he arrange for the inspection and commissioning of the installation in the presence of the Engineer and the Client. The *Contractor* shall remove all his accumulated debris from the site.

The *Contractor* shall ensure that all test certificates and commissioning data is provided to the Client before the remainder of the retention is released.

Level 1 operator training shall be provided to all relevant client personnel.

- Normal operating conditions
- Abnormal operating conditions
- Frequency response
- Reactive power capabilities
- Reactive Power and Voltage Control Functions
- Power Quality
- Protection
- Active Power Constant Functions
- Control functions

- RPP availability, supervisory control and data acquisition
- Testing and Compliance
- Inverter DC Voltage
- Inverter DC Current
- Inverter DC Power
- Inverter Condition (operating, faults, alarms and errors)
- AC Power output (kW, kVAr, kVA and power factor)
- AC Power direction
- AC Voltages
- AC Currents
- Module Temperature
- Global solar irradiation on plane of array (kWh/m²)
- Any essential monitoring parameters essential for Maintenance.