

Appendix 1

Terms of Reference (ToR)

Project	Design, supply, installation, testing commissioning and user training of Solar System
Location	National Polio Laboratory, University College Hospital, Ibadan - NIGERIA

This TOR sets the requirements for the supply, installation, commissioning, and after-sales services for Solar PV National Polio Laboratory, University College Hospital, Ibadan

Current Situation/Findings

1. Total estimated load on critical equipment that needs to be powered daily are rated 29,136Watts. (Approximately 30kW)
2. The premise has an existing 150kVA generator for use.
3. The proposed area for the solar panels is an outside car park area. The solar panels would be mounted on a yet to be constructed car-port. Dimensions of available space: 21m x 13m (Length x breadth). T
4. The proposed location for the Solar Room (Inverter/Batteries) has a dimension of 6m length and 3.5m breadth with an open roof and untidy, not yet floored area.
5. The distance from the proposed solar car port to the propose solar room location is 30m.
6. The distance from the proposed solar room to the power house is 15m.

Technical Scope: Based on report on Site Survey

- Determining the critical loads to be powered
- Checking a suitable location for the Indoor Equipment – Batteries, Inverters etc
- To determine the type of inverter to be use for the building.
- Checking a suitable location for the solar panels
- To determine the length of cables (PV, DC and AC)
- System Design and Equipment Selection
- Develop the bill of Materials for the solar system.

Electrical Network Overview:

The center is a two-storey building that is currently powered by Utility from the Grid and a 150kVA generator. Each floor is equipped with 2 Nos of three phase Distribution board (D.B) each. There are total of 6 nos of DBs.

Cables, Wiring and Electrical Connectors

All external wiring, cabling, insulation material, junction boxes and combiner boxes must be UV-resistant, and terminals should be protected against dust and moisture. The wiring installation shall be both physically robust against bumping and tugging, and electrically robust. All wiring and connectors should have a design lifetime of 20 years.

Junction Boxes and External Enclosures

All junction boxes shall be rated as specified. Any junction boxes used externally shall have bottom entry glands, and with drip loop installed externally. They shall be located to facilitate inspections with sufficiently long wiring loops internally.

Electrical Connectors and Cable-Ends

All wiring must be neatly done and secured by means of appropriate fasteners at regular intervals. Wiring lengths shall be sufficiently looped to allow ease of connection and disconnection in the case of component replacement, and for maintenance. Any wiring connections whether internal, external, high voltage or low voltage shall be inside accessible junction boxes. No visible connections. Conductor lugs should be used to terminate all DC wiring. Lugs and connectors should be crimped or soldered, and mechanically and electrically sound. All DC electrical connections shall be treated with corrosion inhibiting paste.

External wiring

All external wiring and cabling shall be straight and aligned vertically or horizontally, and cables firmly attached to the walls or cable trays at least every 500mm. Cable entries into buildings shall be made good, and with drip loops as necessary.

Earthing

The bonding of equipment should prevent dangerous voltage differentials arising between metallic equipment during fault conditions and provide alternative conduction paths to power cables should ground surges from nearby lightning strikes arise. The main earth point for the system shall be a systems earth electrode. It shall be located directly below each array structure.

The earth electrode shall be the common point for the casings of all balance of system components, and the array structure. The risk of lightning strikes varies according to location. However, for this site location the basic guidelines shall apply, as the electrical distribution is contained within one building.

Earth Connections

16mm² bare copper straps shall be used as earth straps to bind components to the earth

electrode. Under no circumstances shall connection points, bolts, screws, etc. be used for bonding or earthing be utilized for any other purpose. It shall be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment that must be earthed where these are not provided.

PV Array Structure Earthing

Each array structure shall always be bonded directly to the earth electrode. If there is electrical discontinuity between module frames and the array structure, then 16mm² conductors shall be utilized for bonding the module frames to the structure. Since there are two PV arrays, it is recommended that a trench earth be used to bond the individual earth spikes together underground.

Equipment Earthing and Bonding

All metal other equipment and casings (as outlined below) shall be bonded together, as they are inter-connected by the power cables. The bonding shall be made using copper conductors of 10mm² minimum. A separate conductor shall be used specifically for that purpose.

- The array structure shall be bonded directly to the main earth electrode with a resistance of less than 1.7ohms.
- The inverter casings shall be bonded (directly or indirectly) to the main earth electrode with a resistance of less than 1.7ohms.
- The resistance between any enclosures in any one location, shall be less than 0.2ohms.
- The earth resistance of the earth electrode shall be less than 10 ohms.

Lightning and Surge Protection

Lightning protection is designed inherently into the system configurations, earthing, and some level of surge protection is built into the inverters themselves. For added protection, there is a need for additional protection or surge arrestors on the inverter DC inputs. This shall take the form of Class 2 protection on the DC cables in the Photovoltaics (PV) Array junction box or Enclosure.

To protect against surge overvoltage from the utility side, it is required to install an SPD (Surge Protective Device) as near to the inverter as possible. This equipment will leak the energy of the overvoltage to the ground. For this reason, it is essential that earth terminals be of a good quality and moreover, it is required that all of the earth terminals be properly connected so as to assure equipotentiality. The required SPD has to be able to discharge high currents caused by an induced overvoltage, for that reasons, it needs to be a type 2 according with IEC 61643 standard. To ensure safety of the equipment, it needs to be at least 40KA as maximum current (Imax). The inverter is a very sensitive equipment, the SPD needs to have been tested, in addition, as a type 3. The type 3 SPDs are specially designed to protect the most sensitive equipment's.

Labelling, Safety Signs and Notices

There shall be labelling and signage as appropriate. All notices, labels or signs shall be durable and not removable except by determined and deliberate action. The inscriptions shall be legible and indelible. Where possible, standard approved symbolic safety signage shall be used. All distribution board labels shall be professional quality signage.

Where compliance is required in terms of codes and regulations, which is not already covered elsewhere in the Specifications, variations required after contract award and site visits shall be covered by contract variation orders if any.

Electrical PV Acceptance and Commissioning Tests

The Acceptance Tests shall depend on the exact equipment supplied. Essentially, the Project Coordinator shall test the systems for electrical performance as specified. Quality of equipment and quality of installation inspections shall also be part of the Acceptance Tests.

Other Services

The Consultant shall develop a simplified training manual (with graphic illustrations) in basic solar PV system maintenance and security and shall conduct a one-day training in the maintenance and security of solar PV systems for selected representatives of the beneficiaries.

Certification

The Client shall certify completion and operational acceptance of the installation by issuance of completion and operational acceptance certificates respectively.

General information.

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Solar array will be roof mounted

The batteries, power electronics and ancillaries shall be in a technical cabinet and shall be pre-assembled and tested in a Factory/Lab environment before shipment.

Solar system will operate with batteries and must be designed with necessary features to supply directly the power generated by PV to the loads while simultaneously charging the batteries for later usage.

The equipment's manufacturer shall be a reputable entity and active in the solar sector for at least 5 years. It must have a quality (at least ISO 9001) and Environmental (at least ISO 14001) management system certification.

All equipment installed shall be labelled with the equipment's brand name, model and

other. The label should be highly discreet and unobtrusive, and readable only from very near distances of less than 1m.

The supplier shall carry out all civil and electrical works for solar solutions to be compatible with the existing electrical systems and distribution lines. They shall also ensure that each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors.

For the actual work to be carried out at the site bidder needs to execute the work in consultation with assigned WHO representative/Inspector.

The Supplier shall provide all necessary components except otherwise specified, and accessories as well as manpower, etc., at the Supplier's own expense to install complete operational units. The equipment shall conform in capability, strength, quality and workmanship to the accepted industry standards and relevant international quality standards. Any additional works not covered above, but necessary for the functioning of the system and required as per specification incorporated. The works of minor nature, which are not mentioned, shall be incorporated by the bidder.

The Supplier shall perform a detailed site assessment visit to the sites at own's cost and confirm the suitability of the solution. The supplier will also inspect the solution and/or components prior to the installation and prepare an installation plan to collate the amount of work to be done.

Erection and commissioning of the supplied system on the specified site and do any other work urgently required as per site conditions.

The Supplier should remove the waste of works undertaken including the trash and dirt resulting from the works and attend to any snags caused by workmanship. The site should be returned to its initial state of cleanliness.

Project Deliverables:

Deliverable 1:

1. Detailed Planned Schedule of works.
2. A Health, Safety and Environmental Management Plan.
3. A description of the proposed performance and acceptance testing procedure that will be undertaken during commissioning phase.
4. A letter certifying the compliance with requirements on warranties, spare parts and standards, etc.
5. In case the PV modules are roof-mounted, supplier will take responsibility for structural integrity of the roof.

Deliverable 2:

1. Pre-assembling and wiring: mounting of inverters, controllers and the likes done as much as possible in a factory/lab environment.
2. Supply and delivery of the equipment at supplier at the UCH, Ibadan with all components needed for project delivery and operation.

Deliverable 3:

1. Installation of complete Solar PV Plant with all components required for operation, and implementation of all related performance testing.
2. Submission of final Technical Report, inclusive of:
 - i. As-built drawings,
 - ii. Technical description of the final solution
3. Submission of photos, videos and visual material of the final system installed.
4. Training on Operation and Maintenance (O&M) of the installed equipment for the beneficiaries' representatives (end users and beneficiaries' staff maintenance crews) and provision of training materials and O&M manuals. Inclusive of:
 - i. Basics on the Solar PV system commissioned (components and operation)
 - ii. Basic shutting-down procedures (in case it is necessary)
 - iii. Operation and Maintenance of the solar PV system (for future hand-over after maintenance period)
 - iv. Integration with gensets (where applicable)
 - v. All basic issues that might occur and the relevant troubleshooting.
 - vi. A special focus should be on using the online monitoring system and troubleshooting of basic errors and problems that occur frequently.

Signaling labelling:

- i. All components shall be labelled in English.
- ii. Signs or labelling warning about safety hazards, e.g. smoking, water contact, etc.
- iii. Emergency shutdown procedures (visual information) shall be provided.
- iv. Panel with up keeping and operating instructions for the beneficiary shall be installed.

Deliverable 4:

1. System monitoring inclusive of reporting as part of the maintenance service.
2. Warranty for 12 months:
 - i. System Warranty: Required warranty period for all PV systems is 1 year from commissioning date. It should include monitoring, technical support and maintenance. This should be provided in the form of a warranty certificate/statement.

The below pictures are from the site.



Ground Floor D.B



First Floor D.B



General Power Room For The Premises.



Propose Area For Battery Bank & Inverter.



Propose Solar Car port Area



Both Incoming & Outgoing for the Inverter Pass



Building Structure



From the Solar Car-Port To The propose Power Bank & Inverter.



Propose AC Cable Laying Path



Propose AC Cable Laying Path



Picture of the Power Bank & Inverter.

