# Technical Specifications Document

Appendix-01

# SPECIFICATIONS

## TECHNICAL INFORMATION AND SPECIFICATION FOR SOLAR POWER GENERATION SYSTEM TO BE REQUIRED

### 1.0 SITE THECHICAL INFORMATION

The necessary technical information about the project site is discussed below. However any query about site information would be available on request within bidding time.

### 1.1 Site Introduction:

The proposed Solar Photovoltaic (PV) Power Project shall be installed on the rooftops of Pakistan Institute of Development Economics (PIDE), located within the premises of Quaid-i-Azam University, Islamabad, Pakistan. The site is situated on the Potohar Plateau, adjacent to the Margalla Hills, providing favorable solar irradiation conditions.

### 1.2 Site Location:

Geographically PIDE is located at at Latitude 33°44'59.4"N and Longitude: 73°08'19.4"E and Elevation 1550m


### 1.3 Site Description:

PIDE intends to install a **grid-connected rooftop Solar PV system** on its Main and East/West Buildings located within the campus. The objective is to utilize available rooftop space for sustainable power generation and reduction of grid dependency.

The existing electrical infrastructure comprises **two independent transformers and corresponding Low Tension (LT) metering systems**, serving the respective buildings. This arrangement allows flexibility in system design, enabling either separate or integrated solar PV configurations, subject to detailed engineering and net-metering requirements.

**Metering Details:**

- Meter No. 1: Ref. 281 141351966600R (East/West Buildings)
- Meter No. 2: Ref. 281 141351966700R (Main Building)

Bidders shall consider the existing metering and transformer configuration while proposing system interconnection and protection schemes. **Pictorial views of the PIDE buildings are provided below** for reference to assist in understanding site conditions and layout.

The Pictorial views of PIDE building is as follows:-

Front view of the Project Site

### 1.3.1 Building Locations.

The buildings identified for installation of the proposed **~200 kW Solar PV system** are located within the PIDE premises. The geographical coordinates of the project site are provided below:

| Sr. No. | Building Name | Latitude | Longitude |
|---|---|---|---|
| 1 | PIDE Building | 33°44'59.4"N | 73°08'19.4"E |

The available rooftop areas of these buildings shall be utilized for installation of the solar PV modules, subject to detailed design and optimization by the bidder.

### 1.3.2 Power & Controll Room

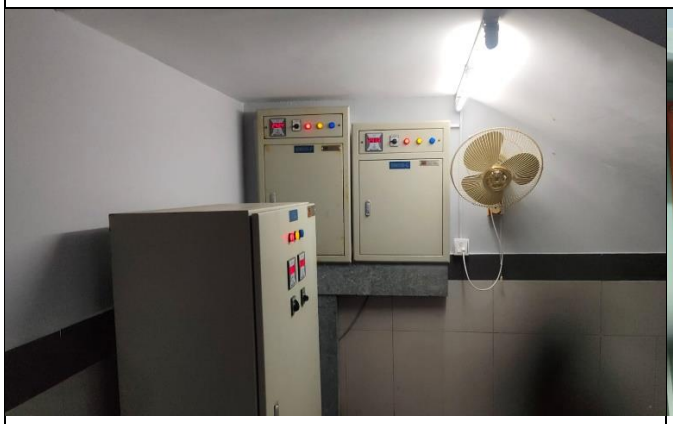
The existing power and control arrangements for the subject buildings are as follows:

- **East/West Buildings:** Ground floor (under staircase)

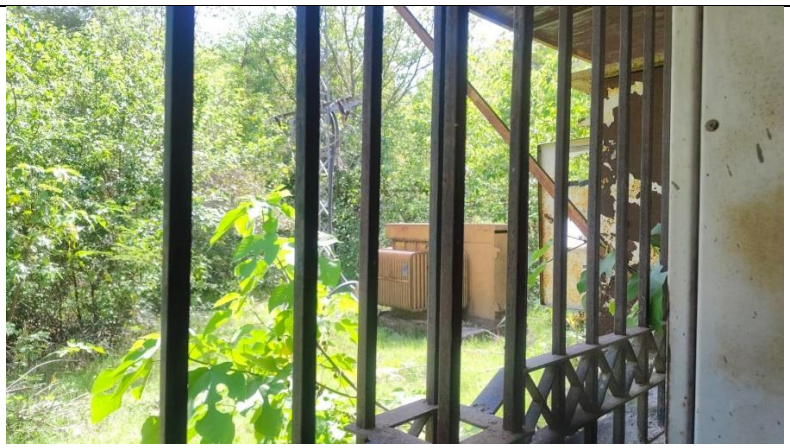
- **Main Building:** Outdoor installation at ground level
- **Proposed Solar Control Area:** Near the existing generator control DB, within an available compound area of approximately **5 ft × 140 ft**

The proposed location has been identified considering proximity to existing electrical infrastructure and ease of integration. However, the **final placement of inverters, LT panels, and associated equipment may be optimized by the bidder** based on detailed engineering design, safety requirements, and operational considerations.

Control Room for Main Building



Control Room for East/West Buildings



Transformer Room

## 1.4 Existing Power Supply Arrangements:

Load at PIDE Buildings is currently being powered through following supply sources:-

**a) Main Power Supply**

Electrical Power requirement for the Buildings is met from National Grid.

**Meter No. 1 (East/West Buildings)**

- IESCO- BARA KAHU Sub Division Bara kahu Rural
    - Reference No: 281 141351966600R
    - Feeder Name: University
    - Sanctioned Load: 48 KW
    - Tariff A-2c(06)T
    - Transformer Capacities: 200 kVA

**Meter No. 2 (Main Building)**

- IESCO- BARA KAHU Sub Division Bara kahu Rural
    - Reference No: 281 141351966700R
    - Feeder Name: University
    - Sanctioned Load: 120 KW
    - Tariff A-2c(06)T
    - Transformer Capacities: 200 kVA

**b) Emergency Power Supply**

Generators capacities have been installed for providing back up supply to critical load.

- Generators
    - 1x380 kVA
    - Fuel Diesel

DG Set with ATS

## 1.5 Site Area Availability for Solar PV Modules:

The available rooftop area for installation of Solar PV modules on the subject buildings has been assessed and is summarized below. The identified areas are suitable for accommodating the proposed solar PV system, subject to detailed design, layout optimization, and structural verification by the bidder.

The distribution of available area across the buildings is as follows:

| Sr. No | Blocks | Area for the installation of PV Solar Modules (meter sq.) |
|---|---|---|
| 1 | Main Building | 762 +76 |
| 2 | East/West Buildings | 76 + 76 |
| | Total | **990** |

Table: Available Rooftop Area for Solar PV Installation


Main Building


East/West Buildings

The **cumulative available rooftop area is approximately 990 m²**, which forms the basis for estimating the proposed system capacity. Bidders are encouraged to verify the usable area during site visits and optimize the module layout to maximize energy generation while considering spacing, access pathways, and structural constraints.

## 1.6 Cable Routing

The DC power generated from the rooftop PV arrays shall be transmitted to the inverter/control room through properly designed cable routing infrastructure.

The **approximate cable routing distance is 40 meters** from the farthest point of the PV array, particularly from the **eastern side of the building rooftop**, towards the inverter/control room located at the ground floor of the Main Building.

All DC cables shall be laid through **GI cable trays**, ensuring proper mechanical protection, organized routing, and compliance with safety standards. The routing shall be designed to minimize voltage drop, avoid sharp bends, and ensure ease of maintenance.

The final cable routing path, tray sizing, and cable selection shall be optimized by the bidder based on detailed site assessment, ensuring efficient, safe, and aesthetically acceptable installation.

Cable Routing Towards Main Building – Ground Floor

## 1.7 Project Overview

Based on the available rooftop area and preliminary assessment, a **Grid-Tied Solar PV System of approximately 200 kW capacity** is envisaged for installation at the subject site. This capacity has been estimated to achieve optimal utilization of the available space while meeting the building's energy requirements.

However, the indicated capacity is **tentative and indicative in nature**. Bidders are encouraged to carry out their own detailed **site assessment, shadow analysis, and energy yield simulations** using industry-standard tools. The final system capacity, configuration, and layout shall be optimized by the bidder to maximize energy generation, system efficiency, and overall performance, while ensuring compliance with applicable standards, structural limitations, and electrical integration requirements.

A **tentative layout drawing is provided below/attached** for reference; however, bidders may propose improved layouts based on their design optimization. Any deviation from the proposed capacity or layout shall be **properly justified with technical calculations and design rationale** as part of the bidder's proposal.

## 2.0 TECHNICAL REQUIREMENT

Based on the data presented, PIDE management is desired to Construct an expected/ estimated 200 KW Solar Based Power Plant with following deliverables on currently available Area:-

- Designing of Solar Based Power Plant
- Supply of Solar Based Power Plant
- Installation of Solar Based Power Plant
- Testing & Commissioning of Solar Based Power Plant
- Provisioning of Net-metering Services

### 2.1 Area Available for Solar PV Modules:

The area available and the expected/ estimated capacity of Solar PV modules for each building can be summarized as below: -

| Sr# | Description | Available Area | | Expected Solar Installed capacity (KW) |
|---|---|---|---|---|
| 1 | Main Building | *9020* | SFT | 172.64 |
| | | 838 | SM | |
| 2 | East/West Buildings | *1636* | SFT | 27.36 |
| | | 152 | SM | |
| | **Expected Capacity of Solar Based Power Plant** | **200 kW** | | |

Note: The Roof top drawings in this regards are enclosed in the Drawing section of the RFP document.

### 2.2 Strength/ Configuration of Roof:

It is important to note that the rooftops of the subject buildings are constructed with a **reinforced cement concrete (RCC) slab of approximately 6 inches thickness**, which forms the primary structural base for the proposed solar PV installation.

It is estimated that the installation of PV modules, mounting structures, and associated base works will impose an additional load of approximately **50 kg/m²** on the roof surface. Based on preliminary assessment, the existing structure is considered adequate to this additional load.

However, the above assumption is indicative only. The **bidder/designer shall be responsible for carrying out a detailed structural assessment** of the building prior to installation to verify load-bearing capacity and overall structural safety.

Fig: Roof Configuration

The successful bidder shall also be required to **submit detailed civil and structural design calculations**, including mounting arrangements and load distribution, for review and approval by the concerned authority (EXEN Building). Implementation of the project shall proceed only after obtaining necessary approvals, ensuring that the structural integrity of the building is not compromised.

## 2.3 Base Structure:

The base plates of the solar PV mounting structure shall be securely fixed to the existing RCC rooftop using **high-strength anchor bolts with chemical epoxy anchoring**. The epoxy resin shall provide enhanced bonding strength and shall also act as a **waterproofing agent to prevent any leakage** at the drilled anchoring points.

All anchor locations shall be executed through precise drilling, followed by proper cleaning and epoxy application to ensure long-term durability and structural reliability. After fixing the base plates, a **Plain Cement Concrete (PCC) block of appropriate dimensions** shall be cast over and around the base to provide additional dead weight, improve resistance against wind uplift, and ensure uniform load distribution.

The complete arrangement shall be designed to withstand wind speeds up to **140 km/h** and ensure safe, stable operation.

## 2.4 Mounting Structure:

The Solar PV modules shall be installed on a **fixed-tilt, customized mounting structure** designed with an inclination angle ranging between **10° to 15°**, optimized in accordance with site conditions and available rooftop space. The structure shall be configured such that it **starts at an approximate height of 5 feet and rises up to 16 feet**, ensuring the required tilt, adequate ventilation, and ease of maintenance.

The mounting structure shall be fabricated from **Hot-Dip Galvanized (HDG) steel** to ensure high corrosion resistance and long service life. Vertical posts shall be supported on concrete bases, maintaining sufficient clearance above the rooftop. The design shall ensure that **free physical movement and routine access on the rooftop remain unobstructed**, without compromising safety or maintenance activities.

The structure shall be securely fixed to the RCC roof slab using **wedge anchor bolts**, with proper **epoxy-based waterproofing treatment** at all anchoring points to prevent leakage. All nuts and bolts shall be of **Grade 304 Stainless Steel**.

Concrete blocks (minimum approximately **1 cubic foot**) shall be provided where required, and all civil works shall include proper waterproofing to ensure stability under wind speeds up to **140 km/h**.

A detailed layout of the mounting arrangement is provided in **Appendix-2.2**.

## 2.5 Placement of Power Inverter *and LT Panel:*

It is proposed to install the **inverters and LT panel adjacent to the ATS panel of the existing genset controller**, located at ground level outside the building within the available compound area of approximately **5 feet × 140 feet**. The selected location ensures proximity to the existing electrical infrastructure, facilitating efficient integration and ease of operation.

However, the project executer may review and optimize the **number, configuration, and placement of inverters** based on detailed design considerations, while maintaining the aesthetic integrity of the building and ensuring operational efficiency.

Since the installation is proposed in an open environment, the inverters and associated equipment shall be housed under a **proper protective shed (fiber or equivalent weather-resistant material)** to safeguard against direct rainfall and environmental exposure. The shed shall be designed to allow **adequate ventilation and heat dissipation**, ensuring safe and efficient performance of the equipment under all operating conditions.

## 2.6 Main Grid–Solar–Genset Synchronization Panel

A **combined Main Synchronization Panel** shall be provided to integrate and manage all power sources and loads within the system. The panel shall comprise **two (02) grid incomers (for separate meters), one (01) genset incomer (300 kVA), and two (02) solar incomers (100 kW each)**. It shall also include **two (02) independent outgoing feeders** for supplying the Main and East/West Buildings loads.

The panel shall incorporate a **common emergency bus**, complete **ATS and electrical/mechanical interlocking arrangements**, and **independent isolation for each grid and solar feeder**. It shall be equipped with comprehensive protection features including **reverse power protection for the genset**, over/under voltage, frequency protection, and surge protection devices.

The system shall provide **real-time solar curtailment and power management**, ensuring safe operation during both grid-connected and genset modes, while preventing reverse power flow towards the generator.

The panel shall be equipped with a **minimum 10-inch touch screen HMI** for local monitoring, control, and visualization of system parameters. It shall also support **online remote monitoring** through an integrated communication interface. A **manual override**

**facility** shall be provided to allow operator control during maintenance or emergency conditions.

## 2.7 Using of Cable Trays/ Tranches

All DC and AC cables shall be routed through properly installed **GI cable trays** to ensure safe, organized, and durable cable management across the building. The cable trays shall be of size **6" × 4" (Width × Depth)** with a minimum thickness of **16 AWG**, suitable for outdoor installation and mechanical protection.

Proper cable dressing shall be ensured throughout the routing, with adequate supports, fastening, and alignment to maintain neatness and ease of maintenance. Where required, trenching or alternative protective routing methods may be adopted in accordance with site conditions and approved design.

All cable tray installations shall comply with relevant standards and shall include necessary accessories such as bends, supports, and covers where applicable.

Further detailed requirements for execution of the project are described in the **Scope of Work** section below.

## 3.0 Scope of Work:

The scope of work comprises the **design, supply, installation, testing, commissioning, and performance verification** of an approximately **200 kW grid-interactive rooftop Solar Photovoltaic (PV) system** at PIDE Buildings, Islamabad. The project shall be executed on a **complete EPC (Engineering, Procurement, and Construction) basis**, including all associated works required for safe, reliable, and efficient operation.

The scope includes, but is not limited to, the following:

- **System Design & Engineering:**
  Detailed system design, layout preparation, shadow analysis, energy yield assessment, preparation of drawings, and submission of design documents for approval.
- **Supply of Equipment:**
  PV modules, Hot-Dip Galvanized (HDG) mounting structures, grid-tied inverters, DC and AC distribution boards with protection and indication, cables (AC/DC), earthing system, lightning protection system, communication and monitoring system, and all ancillary equipment required for complete system operation.
- **Installation & Integration:**
  Complete installation of the PV system including mounting structures, cable routing, inverter installation, and integration with existing electrical infrastructure.
- **Grid Interconnection & Net Metering:**
  Interconnection of the PV system with the utility grid, facilitation of net metering, and modification/replacement of energy meters as required, in accordance with applicable regulations.

- **Civil Works:**
  All civil works including base foundations, cable trenching (if required), waterproofing, and restoration of affected areas.
- **Testing & Commissioning:**
  Pre-commissioning checks, system testing, commissioning, and performance verification to ensure compliance with design and performance criteria.
- **Operation & Maintenance (O&M):**
  Provision of O&M services for the agreed warranty period, including routine inspection, maintenance, and performance monitoring.
- **Spare Parts & Documentation:**
  Supply of essential spare parts and submission of complete documentation including as-built drawings, manuals, test reports, and warranties.
- **Transportation & Insurance:**
  Responsibility for transportation, storage, handling, and comprehensive insurance of all equipment until final handover.
- **Health, Safety & Environment (HSE):**
  Compliance with applicable HSE standards (e.g., BS OHSAS / ISO 45001). Deployment of qualified HSE personnel to ensure safe execution of works.
- **Quality Assurance:**
  All equipment and works shall conform to relevant IEC standards and high standards of engineering, design, and workmanship suitable for commercial operation.
- **Completeness of Supply:**
  Any equipment, fittings, or accessories not explicitly mentioned but required for safe and efficient operation of the system shall be deemed included in the scope without additional cost.
- **Approvals & Compliance:**
  The contractor shall obtain all necessary approvals, submit design documents, and comply with guidelines issued by PIDE management and relevant authorities.
- **Employer's Rights:**
  PIDE management reserves the right to review, verify, and approve designs, materials, and workmanship, and to reject any work not in compliance with specifications.

### 3.1 Minimum Technical Specifications Requirement for Solar Panel and Allied Equipment.

**Note:-** The technical specifications of the Solar Panels & allied equipment must fulfill the standard requirements (PSS# IES) as per the import policy S.R.O 604 (I) /2019, Dated 28th May 2019. Verifiable Test Certifications for the required standards must be provided with the technical proposals. In case of discrepancy, the mentioned S.R.O shall prevail.

All equipment shall conform to applicable **IEC standards**. In case IEC standards are not available for specific components, other internationally recognized standards may be adopted with prior approval of the Project Director.

## A. Solar PV Panels

| S.No | Parameters | Min. Specifications required |
|---|---|---|
| 1 | Module Make | Tier 1, Brand should be verifiable for the procurement year |
| 2 | PV Module Capacity | 720 Watts (as per design) |
| 3 | PV Module Type | Mono PERC |
| 4 | Cell Quality | A Grade (verifiable) |
| 5 | Module Efficiency | 21% or higher |
| 6 | Power Tolerance | Must be + 3% or more |
| 7 | Operating cell Temperature | minus 40C to positive 85C |
| 8 | Temperature coefficient | minus 40 %/ C or less |
| 9 | bypass diode | AS per design |
| 10 | Bus bar | 4 or higher |
| 11 | Certification | IEC 61215, IEC 61730,IEC 61439,IEC 60947-3 as amended to date ,PID FREE |
| 12 | Frame | Must withstand 5400 PA impulse Load |
| 13 | Junction box | IP 67 or better |
| 14 | Cable | 4mm sq (IEC),1000mm or higher ( As per design) |
| 15 | Connectors | MC4 or comparable weather proof |
| 16 | Front cover | 3.2 thick prism type tempered glass or higher |
| 17 | Product Warranty and Guarantee | 10 years product replacement warranty power output within 10 years shall not fall below 90%Power output within 25 years shall not fall below 80% |
| | | 10 years full replacement of module, if the major components malfunctioning PV module performance guarantee 25 years or more Type of performance guarantee shall be final after 1st year |

## A. On-Grid Solar Smart Inverter

| S.No | Parameters | Min, Specification required |
|---|---|---|
| 1 | Inverter Make | 1 GW or above deployment in last two years. Renowned and verifiable brand having successful performance history in similar climatic conditions. |
| 2 | Inverter Type | Grid synchronized with generators on site |
| 3 | Output Voltage Range | 230VAC/400 VAC ±5% FOR String/micro inverters, for central inverters select as per design |
| 4 | IP Protection | IP 65 or better (IEC 60529)/outdoor use with natural heat sink |

| | | |
|---|---|---|
| 5 | Standby Power consumption | Max 3 watt |
| 6 | EU/CEC efficiency Euro-ETA | >= 97% or above |
| 7 | Protections | Short Circuiting, Surge Protection, PV reverse polarity protection, Anti-Islanding Protection, Leakage current protection, High Insulation Input, Over voltage (PV)(if built-in), Harmonics filters as per IEC standards Output, Over voltage (C) |
| 8 | Operating temperature For Ambient | minus 5C to minus 55C |
| 9 | Communication | With Remote Monitoring Feature, Mobile App, Web Server user Interface, Cloud Connected. Real time System Monitoring, Alerts, Faults and Warning data display, System Statistics, System Parameters, PV predicted values, Forecasted values, Load data, Energy Data, Net Metering Data Control. |
| 10 | Humidity | 10-90%R11 |
| 11 | THD | <=3% As per IEC 61000-3-2 (as amended to date) |
| 12 | Guarantee | 5 years Replacement Guarantee |
| 13 | Warranty | 10 Years or above transferable warranty from the original inverter manufacturer shall be provided or as defined in the RFP |
| 14 | Input Voltage Range | 150-950 V or above (depending upon the selected design) |
| 15 | Power Factor | 0.9 leading to 0.9 lagging(Grid Code Complaint) |
| 16 | Minimum Applicable Standards and Compliances | IEC:62109-1, IEC:62109-2, IEC 61683, IEC 62116, IEC 61727, UL:1741/IEEE:1547, 60068-2.(as amended to date) |

**Note: Bidder should justify the specs with appropriate lab test reports/certifications from the principle manufacturer**.

### B. Solar PV Panel Mounting Structure

| S. No | Descriptions | Requirements |
|---|---|---|
| Following are tentative out lines, actual design will be site dependent and may varies | | |
| 1 | Roof structure material | Hot dip galvanized (min 90 micron) or aluminum frame with more than 20 years of proven life with vertical posts supported by concrete foundations base 12 inches above roof top level. |
| 2 | Material | Mounting Structure should be Hot Dip Galvanized as per Drawing |
| 3 | Theft protection | The mounting structure must come with an anti-theft protection to impede demounting of modules |
| 4 | Material Gauge | SWG 14 or better /as per design. Fastener (nut, bolt, clamp) must be of stainless steel type (Grade 304 Stainless Steel). |

| | | |
|---|---|---|
| 5 | Material and wind loading | • Mounting structure to support the module must be made of durable material, resistant to sand storm, high wind speed upto 140km/h<br>• Corrosion (passing the salt spray test IEC 61701, among other verification), and UV induced degradation.<br>• The material must be compatible with the module frame material so as to avoid any adverse electrolytic/ galvanic effects |
| 6 | Civil work | • Structure should support the existing roof top/ground mounting the design shall be able to with stand the maximum wind loading requirements of 140km/h. Design shall be supported with proper calculations.<br>• The stability of the supporting structure after installation shall be guaranteed by the bidder.<br>• To avoid the drilling in the roof, use appropriate arrangements for leaking and strengthens the structure without damage the roofs.<br>• Pointed dead –loads on roof top surface must be avoided.<br>• Additional beams can be casted to avoid drilling of roofs.<br>• Water drainage must not be considered, separate WATER CHANNELS must be maintained for water drainage.<br>• The supporting structure must be grounded for short circuit and lightning protection through independent earthing.<br>• Each panel frame structure shall be so fabricated as to be grouted using wedge anchor bolts of appropriate gauge as per recommendation in cement concrete foundation with steel frame structure at the site |

**Note: Bidder should justify the specs with appropriate lab test reports/certifications from the principle manufacturer**.

### C. Wires & Cables

i) The cable shall be high standard grade, heavy duty, stranded copper conductor, with Cu/XLPE/PVC type.

ii) The cables shall, in general conform to IEC standards.

iii) The temperature resistance of all interconnecting wires and cables should be > 75° C. The minimum acceptable cross-section of the wire in each of the following sub-circuits is as in ISO and IEC prescription:

iv) Notwithstanding the ISO /IEC requirements, all wires must be sized accordingly to keep line voltage losses to less than 2% between PV Array and Inverter, Inverter to Main Power DB.

v) All wiring shall be color-coded and/ labeled.

vi) All connections should be properly terminated, soldered and/or sealed from outdoor and indoor elements. Relevant codes and operating manuals must be followed.

vii) The Cable fulfill all specifications of Cu/XLPE/PVC type manufactured by Fast/ Newage or equivalent.

| Sr. No. | Item | Requirement |
|---|---|---|
| **12** | Solar PV to inverter; | Voltage drop less than 2 % tin quoted (stranded and flexible) Cu/XLPE/PVC, 99.9% pure copper fire resistive insulation |
| **13** | Grid/LV Distribution Board to Inverter | Voltage drop less than 2%, 99.9% pure copper fire resistive insulation armored Cable. |

### D. DC Protection / String Interface Box (DCDB)

For the proposed system utilizing **string inverters**, individual PV strings shall be directly connected to the respective inverters. However, where required, **DC Protection / String Interface Boxes (DCDB)** shall be provided to ensure safe isolation, protection, and maintenance access.

The DCDB shall be designed to provide **string-level protection and disconnection**, without combining multiple strings. It shall facilitate safe operation, ease of maintenance, and protection of the inverter from electrical faults originating from the PV array.

**Technical Requirements**

| Sr. No. | Parameter | Description |
|---|---|---|
| **1** | Design | • Individual string isolation provision<br>• DC isolator switch for maintenance<br>• Proper termination and cable Management<br>• Provision for safe disconnection during operation |
| **2** | Maximum Input Voltage | ≥ 1500 VDC (IEC compliant) or higher as per design |
| **3** | Number of Inputs | As per string inverter configuration<br>• DC isolator switch<br>• Over-voltage protection (DC SPD, Type II) |
| **4** | Protections | • Reverse polarity protection (if not integrated in inverter)<br>• String fuses (if required as per design) |
| **5** | Enclosure Protection | IP65 or higher (suitable for outdoor installation) |
| **6** | Operating Conditions | Suitable for 10%–90% humidity (non-condensing) |

**Additional Requirement**

The DCDB shall be compatible with the selected string inverter system and shall be installed only where required as per design. In case the inverter includes **integrated DC protection**, separate DCDB may be minimized or omitted with proper justification.

### E. Main Grid–Genset–Solar Synchronization & Power Management Panel

The **Main Grid–Genset–Solar Synchronization & Power Management Panel** shall be a combined panel and shall include:

- Grid sensing and isolation arrangement for **Meter-1 and Meter-2**
- Genset incomer from existing **380 kVA genset**
- Common Emergency LT Bus
- Two independent outgoing load feeders:
  - Main Building load output
  - East/ West Building load output
- Interface with both 100 kW solar plants
- Solar curtailment / export control system
- Reverse power protection for genset
- Electrical and mechanical interlocking
- ATS interface
- Voltage, frequency and power monitoring
- Protection relays, MCCBs, SPDs and meters
- Communication gateway for inverter and genset monitoring

The two DISCO meters shall remain electrically independent during grid operation. During grid failure, both meters shall be isolated through interlocking/ATS arrangement, and the existing 380 kVA genset shall feed both buildings through the common emergency bus of the Main Synchronization Panel. The panel shall provide two separate protected outputs for the main Building and East/ West Buildings. Both solar plants shall be controlled in real time to prevent reverse power flow towards the genset.

### F. Lightning/air termination rod and Surge Protection devices;

| Sr. No. | Parameters | Min. Specifications Required |
|---|---|---|
| **1** | Air termination rod material | 99 % Pure Copper |
| **2** | Air termination rod Length | As per design |
| **3** | Earthing Pit | Less than 2 Ohm (NEC codes) 99% Pure Copper plate/rod. Size and weight of plate/rod varies from site to site as per PPIB Standards |
| **4** | Air termination rod diameter | As per design |
| **5** | Air termination rod | As per design |
| **6** | Cable for structure | 2.5 $mm^2$ or higher, 99.99% pure copper (strip or single conductor) |
| **7** | Cable for interconnecting/ Grounding metal structure (PV Plant Area) | Yellow Green Grounding Cable (10 $mm^2$) or higher, 99.99% pure copper |

| | | |
|---|---|---|
| **8** | Cable for interconnecting Inverter Grounding | Yellow Green Grounding Cable (25 $mm^2$) or higher, 99.99% pure copper |
| **9** | Cable for Thundering and Lightening Arrestors | Bare Conductor Grounding Cable (25 $mm^2$) or higher, 99.99% pure copper |
| **10** | Insulated Spacer | As per design |
| **11** | Cable Bracket | As per design |
| **12** | Stand- Fang Fix system | As per design |
| **13** | Recommended method for calculation | Rolling sphere method |
| **14** | Functional Compliance | IEC 62305-3 (EN62305-3)<br>IEC 62305-3 (EN62305-3) or equvilent |

### G. Surge Arrester (Complete Set)

| Sr. No. | Parameters | Min. Specifications Required |
|---|---|---|
| 1 | Applications | Both DC side & AC sides |
| 2 | Discharge current (I max) | Min. 20 kA (8/20 µ sec) |
| 3 | Impulse current (I imp) | Min. 25 kA (10/350 µ sec) |
| 4 | Response Time | ≤ 50 n sec |
| 5 | Leakage current | ≤ 1 mA |
| 6 | Die Electric strength | 2000 V AC @ 1 minute |
| 7 | Protection class | Class 2 (Type 2) minimum |
| 8 | Discharge Voltage | 600 V DC (Line to earth) or above (matching the sizer of inverter) |
| 9 | Ingress Protection | Minimum IP 20 (placed in IP 65 box along with other protections) |
| 10 | Short circuit with stand capacity | min. 30 kA |

**Note:** The external surge arrestors/ protection AC/DC must be added by the procuring department/ agency, if required according to the specific site requirement.

### H. Monitoring & Data Logging

A state of the art data monitoring/logging system, capable of local and remote monitoring so as to provide timely and accurate performance of the plant on continuous basis is designed and plan to place on site. All monitoring data will be transmitted to the designated PC or mobile App for logging and monitoring of the performance of inverter.

### I. Protections and Control

i. PV system software and control system should be equipped with islanding protection as described above. In addition to disconnection from the grid (islanding protection i.e. on no supply) , under and over voltage conditions , PV systems should be provided with adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC) side for overload and short circuit protection and disconnecting switches to isolate the DC and AC system for maintenance as needed.

Fuses of adequate rating should also be provided in each solar array module to protect them against short circuit.

ii. A manual disconnect switch beside automatic disconnection to grid should also be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch should be locked by the utility personal.

**J. Grid Location and Connection**

i. Synchronization : Available in the Inverter
ii. All Safeties : Available in the Inverter

**K. Meter Configuration Options**

The metering system for Billing should be of good quality and from WAPDA certified Companies.
The utility meter (Net-meter) has to be bi-directional meter to register both import grid electricity amount as well as export solar electricity amount.

**L. Miscellaneous Items for Installation**

**a) Wiring GI Channel Ducts**

A product of good quality standard material having 6”x4” (W*D) gauge 16 AWG size to be provided / used.

**b) Flexible PVC Pipe**

The flexible PVC pipe should be of good quality material with suitable size should be used.

**c) Boxes/ Panels**

Boxes/Panels should be manufactured through GI material with 100% copper strip in it for termination of PV Arrays.

**M. Cabling, Boxes and Earthing Services**

1. All exposed wiring (with the possible exception of the module interconnects) must be covered in conduits/duct. Wiring through roofing must form a waterproof seal (applicable for wiring only).
2. For conduit and duct flexible PVC material with suitable size must be use, so that ¾ spaces in a conduit should be empty.
3. Field installed wiring must be joined using terminal strips or screw connectors. Soldering or crimping in the field must be avoided if at all possible. Wire nuts are not allowed. The rated current carrying capacity of the joint must not be less the circuit current rating. All connections must be made in junction boxes. Fittings for lights, switches, and polarity sensitive socket outlets may be used as junction boxes where practical.
4. All wiring shall be color coded as per IEC standards and labeled at termination point.
5. No conduit or fitting shall be attached directly to thatch or any other non-supportive surface.
6. Especially avoid installing the conduit direct over the roof; there must be distance not less than 2 inches between the roof surface and conduit/duct.

7. Cables must be joined by the use of junction boxes, screw connectors, and block connectors, MC4 or Equivalent connectors must be used for PV joints.
8. All wires must be terminated with proper end sleeves and wire thimbles with different colors for positive and negative polarity
9. Size, voltage grade and manufacturer name should be printed on every cable
10. Cable Voltage drop specification are as followed that must be verified through software simulation/Calculations.
11. Earthing as per NEPRA net metering rules.

**N. Other Features:**

(i) The PV Module(s) should be warranted for a minimum period of 25 years from the date of supply and inverter should be warranted for a period of 05 year from the date of installation. The warranty card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

(ii) Adequate space should be provided behind the PV module/array for allowing unobstructed airflow for passive cooling.

(iii) Cable of appropriate size should be utilized to keep electrical losses to a bare minimum (e.g. length of the wire from module to combiner Box and Combiner Box to Hybrid Inverter should be as minimum as possible).

(iv) All wiring should be in proper conduit of capping casing. Wire should not be hanging loose.

(v) Instruction and O&M manuals

- ✓ Instruction and Operation and Maintenance Manual in English should be provided with the system.
- ✓ The manual shall be furnished at the time of dispatch of the equipment and shall include the following aspects:
  - a. Precautions during unpacking
  - b. Instructions for handling at site.
  - c. Erection drawings with written assembly instructions that would enable the Employer to carry out erection with his own personnel if opted by him.
  - d. Detailed instructions and procedures for the installation operation and maintenance.
  - e. Pre-commissioning tests.
  - f. About solar PV system – its components and expected performance.
  - g. Clear instructions about mounting of PV module (s)
  - h. About electronics
  - i. DO's and DONT's
  - j. Principle of Operation of various equipment
  - k. Safety and reliability aspects
  - l. Metering scheme
  - m. About power conditioning units software and controls
  - n. Clear instructions on regular maintenance and troubleshooting of solar power plant.
  - o. Name and address of the person or service center to be contacted in case of failure or complaint.

p. Outline dimension drawings showing relevant cross sectional views, earthing details, constructional features. Rated voltages and current etc.

**O. Harmonics Standard:**

As per the standard of IEEE 519, the permissible individual harmonics level shall be less than 3% (for both voltage and current harmonics) and Total Harmonics Distortion (THD) for both voltage and current harmonics of the system shall be less than 5%.

**P. Technical and interconnection requirements**

| **Overall conditions of service** | **State Distribution/Supply Code** | **State Distribution/Supply Code** |
|---|---|---|
| **Overall Grid Standards** | Central Electricity Authority (Grid Standard) Regulations 2010 | Central Electricity Authority (Grid Standard) Regulations 2010 |
| **Equipment** | BIS / IEC / IEEE | BIS / IEC / IEEE |
| **Meters** | Central Electricity authority (Installation & operation of meters) Regulation 2006 as amended time to time | Central Electricity authority (Installation & operation of meters) Regulation 2006 as amended time to time |
| **Safety and supply** | Central Electricity Authority(measures of safety and electricity supply) Regulations, 2010 | Central Electricity Authority(measures of safety and electricity supply) Regulations, 2010 |
| **Harmonic Requirements Harmonic Current** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 |
| **Synchronization** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | Photovoltaic system must be equipped with a grid frequency synchronization device. Every time the generating station is synchronized to the electricity system. It shall not cause voltage fluctuation greater than +/- 5% at point of connection. |
| **Voltage** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed | The voltage-operating window should minimize nuisance tripping and should be under operating |

| | | |
|---|---|---|
| | Generation Resources) Regulations 2013 | range of 80% to 110% of the nominal connected voltage. Beyond a clearing time of 2 second, the photovoltaic system must isolate itself from the grid. |
| **Flicker** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | Operation of Photovoltaic system should not cause |
| **Frequency** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | When the Distribution system frequency deviates outside the specified conditions (50.5 Hz on upper side and 47.5 Hz on lower side), There should be over and under frequency trip functions with a clearing time of 0.2 seconds. |
| **DC injection** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | Photovoltaic system should not inject DC power more than 0.5% of full rated output at the interconnection point or 1% of rated inverter output current into distribution system under any operating conditions. |
| **Power Factor** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | The photovoltaic system in the event of fault, voltage or frequency variations must island/disconnect itself within IEC standard on stipulated period. |
| **Overload and Overheat** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2013 | The inverter should have the facility to automatically switch off in case of overload or overheating and should restart when normal conditions are restored. |
| **Paralleling Device** | IEEE 519 CEA (Technical Standards for Connectivity of the Distributed | Paralleling device of photovoltaic system shall be capable of withstanding |

| | | |
|---|---|---|
| | Generation Resources) Regulations 2013 | 220% of the normal voltage at the interconnection point. |

Any minor equipment and material may not be specifically mentioned in this specifications but are required to make the system complete in a every respect in accordance with technical specification shall be deemed to have been covered under the scope of this specification and shall be provided by the tenderer/supplier within the quoted

**Q. Performance Monitoring:**

All grid solar PV power projects must install necessary equipment to continuously measure solar radiation, ambient temperature, wind speed and other weather parameters and simultaneously measure the generation of DC power as well as AC power generated from the plant. They will be required to submit this data to Procurer or any other designated agency on line and/or through a report on regular basis every month for the entire duration of CONTRACT. In this regard they shall mandatorily also grant access to Procurer or any other designated agency to the remote monitoring portal of the power plants on a 24X7 basis.

## 3.2 OPERATION AND MAINTENANCE

Compare to most other power generating technologies, PV Plant has much lower maintenance and servicing requirements. However, for optimum use of the system and maximizing life of the Plant following is planned:

### 3.2.1 The basic concept

- The project Client will be responsible for O&M by hiring right expertise at minimum scale of permanent staff.
- The supplier will conduct the training and capacity building of the O&M Staff.
- The supplier will be engaged for supervision of the scheduled maintenance during two years.
- Backup support / availability of spares / equipment same or matching specifications will be guaranteed by supplier.
- Down time will be minimized by continuous monitoring local / remote and not allowed beyond three hours except condition beyond human control.

### 3.2.2 Operation & Maintenance of Plant (O&M)

O&M will be carried out by Client. However, Supplier will be responsible to carry out the maintenance during warranty period. Maintenance is broken into:

***A-1 Scheduled maintenance:***

Scheduled maintenance will be carried out twice a year. For two Years, it will be the responsibility of supplier, using non-production time mostly. It will include:

- Module connection integrity
- Inspection / maintenance / repair of junction boxes
- Thermography test
- Inverter servicing
- Structural integrity
- Balance of plant inspections / maintenance / repairs
- iPV Tracker servicing

- Performance evaluation and optimization
- Spares & Reports

**A-2 Un-Scheduled**

Un-Scheduled maintenance will be carried out urgently in-response to failure and routine maintenance.

**A-3 Panel cleaning**

Fortnightly Panel cleaning will be the responsibility of the contractor during O&M period.

***3.2.3 Training of O&M Staffs***

- **At Service Provider:** Training to the Client personnel, 02 men per site for 02 weeks, for operation, trouble shooting and maintenance of the plant and its auxiliaries in manufacturer premises on site free of cost.
- **On Site:** Training for Client personnel of different expertise on-site during installation/commissioning for effectiveness.
- Details of training modules will cover following details to be finalized after final contract.

i. Training of electrical/mechanical staff - Installation
ii. Training of electrical/mechanical staff – Maintenance
iii. Training of operational staff

## 3.3 Performance Test

The performance test for at least 06 hours/day for one week (07 days) will be conducted right after the commissioning/grid connection. Since all the tests will be performed after mutual understanding between Client & Supplier/ Installer.

**Performance Optimization Strategy**

| | | |
|---|---|---|
| i. | Shading | : Nil all times |
| ii. | Incidence | : a. Anti-reflection coating<br>b. Texture glass<br>c. Tracking system |
| iii. | Low Irradiance | : Modules with good performance in low irradiance |
| iv. | Soiling | : Regular Module Cleaning |
| v. | Module Quality | : 100% Modules in + 0~3 % Range |
| vi. | Module Mismatch: | a. Similar Specs Modules in string<br>b. No String Shading<br>c. No variation in module tilt angles |
| vii. | DC Wiring | : Minimum length and appropriate dimensioned |
| viii. | Inverter Performance | : High Efficiency 98% and correctly sized, Max. MPPT |
| ix. | AC Losses | : a. Correctly dimensioned cable<br>b. Minimum Length<br>c. Efficient Transformer |

## 3.4 Installation / Commissioning of the Plant

- After receiving contract from client, Supplier will perform deliverables as per agreed terms and conditions. However the installation practices will be following the criteria as IEC62445.
- The commissioning will start immediately after installation.
- Supplier's full team of engineers will supervise.
- Test results will be recorded and signed-off.

- A full final acceptance test (FAT) requirement / procedure will be performed after mutual understanding between Supplier and Client. However the FAT must includes:

i. Pre-connection Test
ii. PR Ratio Measurement
iii. Open Circuit Voltage Test
iv. Short Circuit Current Test
v. Availability Test 6 Hrs / 7 Days (Average)

# Appendix-2

# Building Drawings

# Appendix-2.1
# Building Drawings

The offer layout for ***panel placement***


Figure:3-D view of Panel Placement

# Appendix-2.2

# PV Mounting Structure Drawings

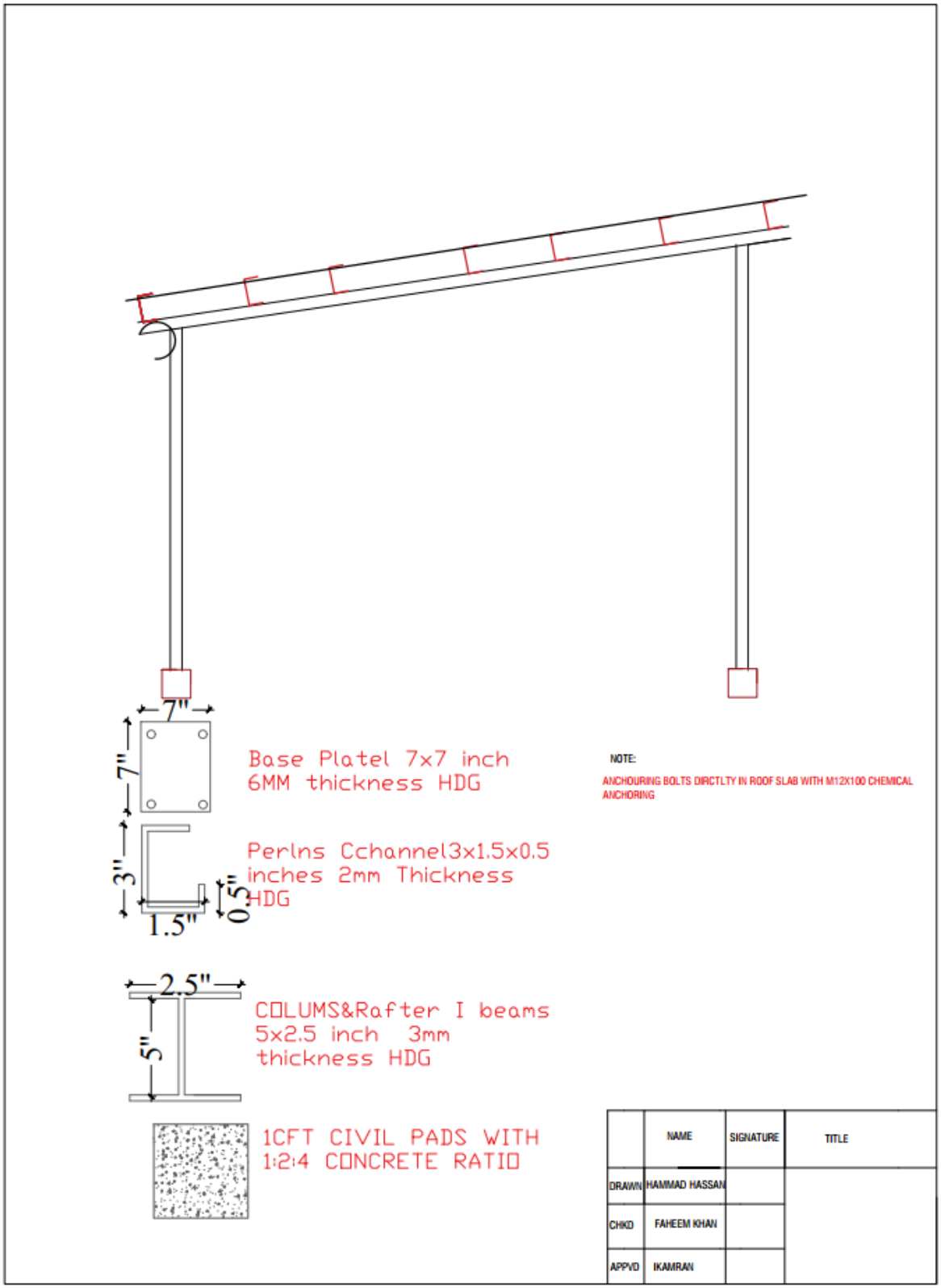



*Figure: Side View of Customized Structure*

# TECHNICAL PROPOSAL

APPENDICES TO CONTRACT

Appendix-03

# Project Conceptual Design, Design Criteria & Technical Details and Implementation Schedule

*[To be completed by the Bidder]*

Appendix-04

# Method of Performing the Work

*[To be completed by the Bidder]*

Appendix-05

# Project Management Facilities

*[To be completed by the Bidder]*

Appendix-06

# List of Proposed Contractors/Subcontractors

*[To be completed by the Bidder]*

Appendix-07

# Organization Chart for the Supervisory Staff & Labour

*[To be completed by the Bidder]*

Appendix-08

# Operation and Maintenance Methods

*[To be completed by the Bidder]*

Appendix-9

# Financial Arrangements/Audit Report

*[To be completed by the Bidder]*

# Appendix-10
# Financial Offer

*[To be completed by the Bidder]*

**Financial Offer**

## Price Evaluation Sheet (200 KW PV On-Grid System)

| S. No | Description | Unit Price | Qty | UoM | Total Price | Sub Total |
|---|---|---|---|---|---|---|
| **1.0** | **PV Modules & System** | | | | | |
| 1.1 | Solar Module (720 Wp) Jinko/Longi/Canadian or equivalent (Must be tier-1) | | 278 | Nos | - | |
| 1.2 | Inverter (Gried-Tied) 115 KW (Huawei or equivalent) | | 2 | Nos | - | |
| 1.3 | 4G Devices (Huawei or equivalent) | | 2 | Nos | - | |
| 1.4 | Backup Power infrastructure 10KW inverter (Inverex or equivalent) & Lithium Ion Battery (Dyness/Soluna or equivalent) for critical equipment | | 1 | Job | - | - |
| 1.5 | Cable for Interconnection (DC 4mm) | | 1 | Job | - | |
| 1.6 | DC Protection Arrangement (Integrated with Inverter / DCDB if required)-Chint or equivalent | | 2 | Job | - | |
| **2.0** | **AC Termination & Accessories** | | | | | |
| **2.1** | **Genset Controller Plus Solar Synchronization** | | | | | |
| 2.1.1 | **Main Grid–Solar–Genset Synchronization Panel (Syncgen Control System or equivalent)** Combined panel with 02 grid incomers, 01 genset incomer (380 kVA), and 02 solar incomers (100 kW each), along with 02 independent load outputs (Old & New Building). Panel shall include common emergency bus, ATS/interlocking, independent solar and grid isolation, genset reverse power protection, and real-time solar curtailment system. Complete with 10-inch touch screen HMI for local monitoring, online remote monitoring facility, and manual override control, including all protections, metering, | | 1 | **Nos** | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | communication and accessories required for safe and reliable operation. | | | | | |
| **2.2** | **LT Termination** | | | | | |
| 2.2.1 | **Low Voltage Panel**<br>Complete solar AC isolation/ protection for Building solar plant, with MCCB, SPD, meter, analyzer, relay, isolator and termination.<br>Local with Schneider protection) | | 2 | **Nos** | - | **-** |
| **3.0** | **Fabricated Items** | | | | | |
| 3.1 | Mounting Structure (Roof mounted, HDG 10 degree tilt, Panel clearance 35mm, 40 m/s wind speed<br>Mechanical Hammering). | | 1 | Job | - | **-** |
| 3.2 | Cable Tray (Galvanized 150x100 mm sq perforated | | 150 | Mtr | - | |
| **4.0** | **AC Cable & Accessories** | | | | | |
| 4.1 | AC Cables for Inverter Interconnection<br>3.5 core AC Cable 70 Sqmm 1kV/Cu/PVC/PVC rated temperature 70 degree<br>Brand : Fast /New Age or equivalent | | 50.00 | Meters | - | **-** |
| 4.2 | Control Cables | | 100.00 | Meters | - | **-** |
| **4.3** | **Installation Material** | | | | - | |
| 4.3.1 | Flexible pipe, Cable ties, nuts/bolts, screws,MC4 connectors nails, tape PVC, lugs , PVC cable duct 60*60 , rawal bolts , chemical for anchoring etc. | | 1 | Job | - | **-** |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4.3.2 | UPVC Pipe for DC Cable | | 100 | Meters | - | |
| 4.3.3 | Fire Extinguisher | | 2 | Nos | - | |
| 4.3.4 | Misc Installation Material (Signage) | | 1 | Lot | - | |
| 4.3.5 | Misc Installation Material (General) | | 1 | Lot | - | |
| **5.0** | **Earthing/ Grounding System** | | | | | |
| | | | | | - | |
| 5.1 | Grounding Pits | | 4 | Nos | - | |
| 5.2 | Yellow Green Grounding Cable (35mm sq.) for Inverter Grounding | | 50.00 | Meters | - | - |
| 5.3 | Yellow Green Grounding Cable (10mm sq.) for DC System | | 200.00 | Meters | - | |
| 5.4 | ESE Lightening Arrestors (Orbital) with 20 feet HDGI Pole with Civil Pad and all accessories | | 1.00 | Nos | - | |
| **6.0** | **Monitoring & Data Acquisition System** | | | | | |
| 6.1 | Video Monitoring System (40") | | 1 | Sets | - | |
| 6.2 | Meteorological Monitoring Devices | | 1 | Sets | - | - |
| 6.3 | Data Monitoring System | | 1 | Sets | - | |
| **7.0** | **Civil Work and cleaning network** | | | | | |
| 7.1 | Mounting Structure (Roof Preparation ) with inverter fabricated shed | | 1 | Job | - | |
| 7.2 | PV Module Cleaning Network (PVC Pipe Based) | | 1 | Job | - | - |
| **8.0** | **Services** | | | | | |
| 8.1 | Project Design & Execution | | 1 | Job | - | |
| 8.2 | Erecting of Mechanical Mounting Structure | | 1 | Job | - | |
| 8.3 | Installation, testing and Commissioning of Solar System | | 1 | Job | - | - |
| 8.4 | Net-Metering Process (Including Equipment, Fee, Approvals, License, Documentation, Inspection, ) complete job | | 1 | Job | - | |
| **9.0** | **Transportation** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9.1 | Charges | | 1 | Job | - | - |
| **Note: The detail specifications are mentioned in Technical Specifications Document** | | | | | | |
| **A** | **Total Project Cost Solar Based Power Solution** | **-** | | | | |
| | **Total Project Cost/Watt** | **-** | | | | |
| **B** | **GST @ 18% without PV Modules** | **-** | | | | |
| | **Total Project Cost with GST @18%** | **-** | | | | |
| | **Total Project Cost** | **30,000,000** | | | | |