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## **Bid Technical Data Sheet**

### **SPECEFIFIC TECHNICAL REQUIRMENTS**

**FOR TENDER OF SUPPLY, INSTALLATION, TESTING,**

**COMMISSIONING, AND OPERATION OF 120KW(AC)/170KWP SOLAR PV HYBRID  
SYSTEM WITH BATTERY ENERGY STORAGE BESS 372KWH/120KW(AC) IN FISH  
LANDING SITE (the 4th Mashroo) IN ALMUKALA**

### **1. Applicable standards**

The Contractor must ensure that the engineering, procurement, construction, testing, commissioning, operation and maintenance of the facility components, including all auxiliary facilities and systems, are according to internationally recognized standards and codes in their latest edition. It is the responsibility of the Contractor to check and comply with all regulations, which apply to any part of the contract.

The latest editions of the Standards, Codes and Recommendations issued by the following organizations must apply for the engineering, construction, testing and commissioning of the Facility.

International Standards (Highest precedence)

- EN European Standards.
- ISO International Standardization Organization.
- IEC International Electro Technical Commission

### **2. Quality of materials**

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All components, equipment and materials shall be new and shall comply with all relevant codes. The Contractor shall only supply and deliver equipment and materials that are suitable for the use in the applicable operational and weather conditions, as where such will be installed. All materials and equipment shall be of a robust design and of a proven technology, i.e. same type of equipment shall be in use successfully for more than one year at 3 different locations, without major breakdowns on similar duties and conditions. Unproven or prototype equipment or components are not acceptable.

### **3. Protection of Site, materials and works**

All materials and equipment shall be stored and protected in such a manner as to prevent any damage or deterioration from any cause whatsoever until such time as they are incorporated in the works. The Contractor shall be ready to advise the (EXPERTISE FRANCE GROUPE

AFD) Engineer of the location and condition of the materials at any time including materials shipped by sea.

The Contractor shall provide adequate security staff and lighting as required to safeguard the works from damage and theft and shall take all reasonable precautions to prevent unauthorized access.

The Contractor shall take care to prevent disruption to existing operations in the facility and surrounding establishment.

#### **1.5 Final documents**

The Contractor shall supply comprehensive shop-drawings before installation, in addition to the final documentation, which shall include as built drawings, calculations, operation manuals and maintenance manuals in the English language.

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Three draft copies of the final documentation shall be submitted for comment at least one week before completion date

Following the approval process, the contractor shall submit the final as-built drawings, operating manuals and maintenance manuals within one week after (EXPERTISE FRANCE GROUPE AFD) approval.

#### **4. Warranty:**

The contractor should warrant the complete system as per applicable standards of quality for minimum 1 years. Anything to be furnished should be new, free from all defects and faults in material and workmanship. The system should be in accordance with the specified technical parameters and should be of the highest grade and consistent with established and generally accepted standards for material. It should be in full conformity with the drawing or samples if any and should operate properly.

Main components must be warranted as following:

- PV Modules: must be warranted for minimum period of 25 years from the date of supply. (Output wattage should not be less than 90% at the end of 10 years and 80% at the end of 25 years).
- Hybrid inverters: must be warranted for minimum period of 5 years from the date of operate.

Battery Energy Storage BESS: must be warranted for minimum period of 10 years or 6000 cycles to 80% of initial capacity.

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- The mechanical structures, electrical components including, circuit breakers, switches, boxes, panels... etc. : must be warranted for minimum period of 5 years from the date of operate
  - Necessary maintenance spare parts for five years trouble free operation must also be supplied with the system.

All these items must be conformed to IEC /EN (or equivalent) specifications and standards.

The bidder must make arrangement to maintain a sufficient stock of essential spares and consumable spare parts to ensure proper maintenance of the system promptly.

More details of specific components warranty at listed on part (2) technical requirements.

## **5. Contractor's general obligations**

The Contractor will have sole responsibility to ensure that all aspects of the contract shall be undertaken within the current laws of the Republic of Yemen if the current laws allow for the need of certain permits, licenses, guarantees or special documentation with the granting of approvals by the port authorities, Regional Authority or other bodies.

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## **Section 2 Specific Technical Requirements**

**The contractors must read these instructions alongside the electrical drawings and specific technical requirements for each item, in addition to these general conditions.**

### **2.1 General Instructions to Bidders:**

**1. The contractors must follow all technical detailed listed in both Bill of Quantities Table BoQs alongside (Specific technical requirements) listed in this section.**

.2.The contractor should consider the site's condition in terms of obstacles.

3. The contractor must Supply of all components, sub components, spares and tools etc. necessary to make the system complete shall be the responsibility of successful bidder.

3. All supplied equipment must be manufactured by renowned global manufacturers, of high quality, meeting first-class standards, and accompanied by third-party independent testing certificates.

4. All materials and equipment must be supported by complete technical details and data. The contractor should provide samples for approval by the consultant, and any materials not previously approved will not be accepted.

5. . The contractor must submit a list of the work crew present on site, provided that the crew includes the project manager, an electrical engineer, with practical experience in projects of not less than 10 years in the field. At least one qualified electrical engineer must on site during the period of contract.

6. The contractors must follow The contractor must submit a timetable for implementing the works, provided that the time limit for implementation does not exceed 3 months from the date of signing the contract.

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7. The contractor must submit a weekly progress report to complete the project within stipulated time. The reports include: progress achieved, number of men employed during the week, and expected dates for completion of work.

## **2.2 Photovoltaic Modules**

### **2.2.1 General Conditions:**

Each PV Module shall be provided a bar code, which is embedded inside the module lamination and must be able to withstand harsh environmental conditions. The bar code data base shall contain the following information. Bar code scanner and database of all the modules containing the following information shall also be provided.

- Name of the manufacturer of PV Module
- Name of the Manufacturer of Solar cells
- Month and year of the manufacture (separately for solar cells and module)
- Country of origin (separately for solar cells and module)
- I-V curve for the module
- Peak Wattage,  $I_m$ ,  $V_m$  and FF for the module
- Unique Serial No. and Model No. of the module.
- Date and year of obtaining IEC PV module qualification certificate
- Name of the test lab issuing IEC certificate
- Other relevant information on traceability of solar cells and modules as per ISO 9000 series.

### 2.2.2 Standards and Codes

Photovoltaic Modules shall comply with the specified edition of the following standards and codes.

Standard	Description
<b>IEC 61215-1:2016 Ed.1</b>	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules Terrestrial photovoltaic (PV) modules - Design qualification and type approval
<b>IEC 61730-1:2016 Ed.2</b>	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction Photovoltaic (PV) module safety
<b>IEC 61730-2:2016 Ed.2</b>	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
<b>IEC 61701:2011 Ed.2</b>	Salt mist corrosion testing of photovoltaic (PV) modules (Applicable for coastal and marine environment)
<b>IEC 62716:2013 Ed.1</b>	Photovoltaic (PV) modules - Ammonia corrosion testing (if applicable)
<b>IEC TS 62804-1:2015 Ed.1</b>	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon (under conditions of 85°C/85% RH for minimum 192 hours)

### 2.2.3 Technical Requirements

Parameter	Specification
Module Efficiency	≥22%
Type of Cell	Monocrystalline
Minimum Manufacturer Warranty for Generation Capacity	10 years (≥90%) 25 years (≥80%)
Minimum manufacturer's workmanship warranty	12 years
Max system voltage	1500vdc IEC
Max series fuse rating	≥2 Isc
Power Out Tolerance	Positive
Minimum permissible wind load rating	2.4 kPa
Minimum permissible snow/mechanical load	5.4 kPa
Temp Coefficient of Plax	Not less than - 0.29
Operation Temp	-40 C- +85C
Application Class as per IEC 61730	Class A
Fire rating	IEC CLASS C or equivalent
Module glass	3.2mm coated tempered
Module frame	anodized aluminum
Junction box	IP68, Thermo-plastic, UV resistant

## 2.3 PV DC cables

- **Solar cable must be Copper/ XLPO DC/1.5 kV DC as IEC 62930/ EN 50618 (rated voltage 1.5kv DC).**
- Solar cable outer sheath shall be flame retardant, UV resistant and black in color. Solar cable with positive polarity should have marking of red line on black outer sheath.
- DC cables shall be single core, armored, Flame Retardant Low smoke (FRLS), PVC outer sheath conforming to IS 7098-I /IS 7098-II. DC cable with positive polarity should have marking of red line on black outer sheath.
- In addition to manufacturer's identification on cables as per relevant standard, following marking shall also be provided over outer sheath.

Cables must be sized based on the following considerations:

- i.  $1.56 \times$  Short Circuit current  $I_{sc}$  of the modules
  - ii. **. The average voltage drop in the cables (from PV Modules to PCU) shall be limited to 1.5 % of the rated voltage**
  - iii. Short circuit withstand capability.
- De-rating factors according to laying pattern and voltage grade.
  - Sequential marking of length of the cable in meters at every meter.
  - All cables must be placed on cable shall be laid in Class 'B' GI pipes at all entry to buildings. Whenever cable passes through GI pipes embedded across the wall in a building, both the ends of the pipe shall be suitably seal.
  - All cables From PV modules to combiner boxes and from combiner boxes to control room must be place on the cable tray / trunk on the walls.
  - Cable must be tied together and Label indicators are necessary to be placed on each cable to ease troubleshooting and maintenance.
  - Excavations of trenches must be carried out for all cables laid on the ground . The width of the trench at the bottom shall be 0.4 M for one cable. In case the total number of cables laid in trenches is more than one, then the width shall be such that the spacing between the cables is maintained as in the standard. Before the cable is laid in the trench the bottom of the trench shall be cleared from stones and other sharp materials and filled with sand layer of 150mm.
  - All PV cable termination materials such as MC4 connectors, cable glands, cable lugs, insulation tapes etc. shall be of approved makes.

- MC4 Cable terminations only allowable method of PV cables termination and must be done using suitable double compression gland, crimping with copper lugs.

## 2.4 **PV Combiner Boxes:**

- All Combiner boxes enclosure must be WSPN IP67 PV made of anti-corrosion metal or UV resistant, fire retardant, thermoplastic material with Minimum 3 inputs and 3 outputs.
- All Combiner boxes must be minimum included :
  1. 3\* 32A 1000V DC MCB IEC60947-3
  2. 3\* 3p 1500V/40kv SPD EN61643-3,
  3. 12\*MC4 and glands,
  4. DIN rail
  5. Earth busbar .
- All string must be connected with separate cable from PV modules to Inverter inputs. No strings connected in parallel to a single input of Box
- . One spare input terminal along with connector shall be provided for each boxes.
- Type-II surge protective device (SPD) conforming to IEC 6164311/IEC 61643-31/EN 50539-11 shall be connected between positive/negative bus and earth.
- MC4 connector conforming to IEC 62852 or EN 50521 shall be provided at each input. Cable gland (double compression metallic) of suitable size for DC cables shall be provided at output.
- UV resistant printed cable ferrules for solar cables & communication cables and punched/ embossed aluminum tags for DC cables shall be provided at cable termination points for identification.
- Standards and Codes shall be met as per table below:

Standard	Code Description
IEC 60529	Enclosure Ingress Protection
IEC 62262	Enclosure Impact Protection
IEC 61643-11	Surge Protection Device
IEC 62852 or EN 50521	Solar cable connector
IEC 60695-2-11	Fire hazard testing

## 2.5 Hybrid Inverter

Multimode inverter shall be used, having built-in MPPT solar tracker and feature of converting PV DC energy into AC and directly feeding to the load.

Technical required specifications are as follows:

Parameter	Description
Inverter Rated Output Power	$\geq 120\text{KW}$
Wave form	Pure-Sine Wave
Grid and generator input	3P+N+E 380/ 400 PN 220/230V +-15%
AC Voltage regulation (Battery Mode)	3P+N+E 380/ 400 PN 220/230V +-15%
Operating frequency	50hz +-2%
AC Input Power	$\geq 200\text{KW}$
Backup Overload capability	$\geq 132\text{kW}$ 10 min $\geq 180\text{kW}$ 10 sec
Pass through power	200kW
Generator Input ATS Support	Yes 120kW
Smart Load Support	Yes 120kW
AC coupling Support	Yes 120kW
PV Inverter algorithm	MPPT
No of MPPT	$\geq 12$
PV power input	$\geq 200\text{kwp}$
MPPT efficiency	$\geq 99\%$
Conversion EURO Efficiency	$\geq 97.5\%$
Max PV input voltage	$\geq 1100\text{vdc}$
Max PV input Isc/MPPT	$\geq 40\text{A}$
Mppt operation voltage	200v – 850v

<b>PV input Imp/MPPT</b>	≥36
<b>THD</b>	<3%
<b>DC Current Injection</b>	<0.5% In
<b>Adjustable PF</b>	-1 +1
<b>Grid support</b>	HVRT, LVRT, HFRT, LFRT
<b>Parallel capability</b>	≥ 6 units
<b>Load balancing of three phase inverters</b>	100% three phase load unbalance
<b>Continues Charge/discharge power</b>	≥120kw
<b>IP rating</b>	IP 66 or better
<b>Cooling method</b>	Smart cool
<b>Battery operation voltage</b>	250v-800v
<b>Communication</b>	Battery BMS CAN, RS485 EMS,USB,LAN
<b>Protection</b>	PV arc Fault, PV In lightning, Pv In reverse polarity, Insulation R, RCD monitor, Output OC, Output SC, Output Surge, Battery reverse polarity, Battery overvoltage, Battery under voltage, Backup overload, short circuits, overvoltage, overcurrent, surge protection, PID protection, and temperature protection
<b>Display</b>	Oled+led/wifi+app
<b>Operation Temperature</b>	-30C – 60C
<b>Manufacturer Warranty</b>	≥ 5 years
<b>Standard and Certification</b>	IEC/EN 61000-6-1 , IEC/EN 61000-6-3, IEC/EN 62477-1 , IEC/EN 62109-1, IEC/EN 62109-2, IEC 62116, IEC61727, and IEC 61683

## 2.6 Battery Storage

### 2.6.1 General requirements:

- The battery must be optimized to achieve at least 15 years of lifetime under daily solar cyclic condition and must demonstrate 80% of its nominal capacity after 6000 charge and discharge.
- Battery cell technology only Lithium-ion LFP grade A is accepted.
- Technical required specifications are as follows:

Parameters	Requirements
Battery cell technology	Lithium-ion LFP grade A tier 1
Rated ENERGY	372
Calendar Lifespan	≥ 15 years
Minimum life cycle @ 100% DoD / 25 °C 80%EOL	6000
Continues Charge Rate	0.5C
Continues Discharge Rate	0.5C
Annual BESS Availability	99%
BMS	Master/Slave
Display	LCD,OLED
Round Trip Efficiency	≥ 90%
Operational temperature	-20 °C to 60°C
Cooling Method	Air condition
IP Protection	IP54 or better
Manufacturer Warranty	10 years

**Standard**

IEC 62133-1 2018, IEC-62133-5-2 2020, IEC 61427-2, IEC 62619, IEC/EN 61000-6-1 , IEC/EN 61000-6-3, IEC/EN 62109-1, IEC/EN 62109-2

**2.6.2 BESS Control Panel**

The BESS shall include a local control panel or console, which is easily accessible, on or within the BESS container. As a minimum, the following operator controls shall be located on the control panel:

- Trip/reset for the BESS AC circuit breaker or contactor.
- Trip/reset for DC circuit breaker(s)/contactor(s).
- PCS on/off.
- Reset toggle or push button. When reset is initiated, the control system shall
- Resume control and proceed to the appropriate operating mode.
- Reset cut-out selector switch to disable remote or local reset signals.
- A selector switch to manually set the operating state (that is, the shutdown, disconnect, or operate state) and to have the control system set the operating state automatically>
- A selector switch to manually set the operating mode and to have the control system set the operating mode automatically.
- The control panel or console shall also include meters, indicators, and displays

**2.6.3 BESS Cabinet:**

- The BESS cabinet shall design and install an automatic fire protection system that conforms to good engineering practice, CEA guidelines and considering thermal runaway fire characteristics of the Battery Unit/ Packs provided by the OEM.
- The BESS cabinet must include Thermal management system.

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## 2.7 Cabling

1. All AC cables must be sized and provided according to IEC 60364-52, IEC 60228 2023 & IEC 60502-1 specifications (voltage rating 1.2kv)
2. All cables must be placed on the cable tray / trunk. Label indicators are necessary to be placed on each cable to ease troubleshooting and maintenance
3. External cables should be placed inside steel conduits (tray cables), while internal cables and wires should be organized within plastic conduits and white trucking, following the consultant's guidelines and best practices.
4. The cable colors must follow applicable international and national standards. Two colors code shall be used in single phase according to the polarity (red for positive, black for negative), while in three phase wiring, for phases marked red, yellow, blue; and black for neutral. Label indicators are necessary to be placed on each cable to ease troubleshooting and maintenance
  - In addition to manufacturer's identification on cables as per relevant standard, following marking shall also be provided over outer sheath.  
Cables must be sized based on the following considerations:
    - iv. Rated current of module
    - v. **. The average voltage drop in the cables (from PV Modules to PCU) shall be limited to 1.5 % of the rated voltage**
    - vi. Short circuit withstand capability.
  - For AC cabling, PVC or XLPE and PVC sheathed single or multi-core copper cable shall be used. Outdoor cable only XLPE must be used and have UV stabilized outer sheath.

## 2.8 Protection, Main and Distributed Boards.

1. All electrical protection devices, and boards must be done according to IEC 60364 2019 (Electrical Installation for building)
  2. Distribution boxes must be thermo-plastic IP65 DIN rail.
  3. MCBs, MCCBs must be installed according to IEC 60947-2
  4. MCBs, MCCBs rated capacity must be 125% of rated power
  5. AC SPDs must be class 2 installed according to class 2 as per IEC 60364-5-53 2019
  6. At least one spare component of each type MCB, MCCB, Fuse must be installed in each panel and boxes.
  7. All busbars must be rated to withstand up to 150% of max load
  8. All metal parts must be properly connected to earth system and work must be done EN 62305
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## 2.9 Earthling requirements

1. Earth system must be install according to EN 62305, IEC 60364-5-55.
2. The grounding must consider both system and equipment grounding.
3. All exposed conductive parts of the PV system, including PV module frame and mounting rails, must be bonded to earth (equipotential bonding).
4. All current-carrying materials must be grounded to limit the grounding resistance with five  $\Omega$ .
5. The PV module structure components must be electrically interconnected and must be grounded by earthing conductors must have a minimum size of 16.0-mm<sup>2</sup> copper,.
6. A minimum of two separate dedicated and interconnected earth electrodes must be used for the earthing of the solar PV system support structure and distribution boxes with a combined total earth resistance not exceeding 5 Ohm.
7. The system should be provided with adequate earthing points. This includes earthing for lighting, system grounding, separately for DC and AC active points. The frame of the PV module array should be earthed at multiple points.
8. To prevent the damage due to lightning, one terminal of the lightning protection arrangement by way of proper earthing is to be provided. The provision for lightning & surge protection of the SPV power source is separately earthed.
9. In case the SPV Array installed in the field separate earth has to be provided for SPV array and System at closer points of the array and the equipment respectively. It shall be ensured that all the earthing are bonded together to prevent the development of potential difference between any two earthing.
10. Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earthing are bonded together to make them at the same potential.  
The earthing conductor shall be rated for the maximum short circuit current. & shall be 1.56 times the short circuit current. The area of cross-section shall not be less than 1.6sq mm in any case.

The array structure of the PV module shall be grounded properly using adequate number of earthing pits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the personal and power plant.

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Automatic ground fault protection circuits to be installed to monitor any unwanted current flow to the ground and should active to prevent any damage.

11. Electrode shall be made of 3 rods each 1.2m 20mm solid copper.

12. The earth resistance of each electrode shall be measured by using a reliable and calibrated earth Mugger and recorded.

## **2.10 Lightning protection requirements**

The lightning protection system shall be designed compliant with class of LPS III and consider the associated risks of lightning as per IEC 62305 or design follow applicable international/national standard for lightning protection system

Table: Lightning protection requirements - Electrical

Condition	Requirement
Connection type	shunt diverter
Nominal voltage	> PV system operating DC voltage
Maximum continuous voltage	1500 V DC
Maximum continuous current rating	PV system short-circuit current
Response time	< 5nS
Maximum surge current (8/20μS):	> 40 kA
Earth leakage current	<10 μA

The following conditions must also be met in the installation of lightning protection:

- The metal portions of the photovoltaic array should be bonded to the existing lightning protection system if available as per AS/NZS 1768 and AS 3000
- Systems larger than 30kW must be provided with a lightning protection system to AS 1768 Level 3
- SPDs installed on the DC side of the PV system must be explicitly designed and manufactured for DC PV application
- Surge protection should be installed for each inverter. Surge protection to meet the following requirements outlined in section

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- To reduce the magnitude of lightning-induced over voltages, the PV array wiring should be laid in such a way that the area of conductive loops is minimized. See AS/NZS 5033 for examples with minimum loop area.

## **2.11 Remote Monitoring System**

The off grid solar plant will be installed in remote villages located far from the regency capital where performance of the solar systems will be monitored through a remote monitoring tool and connected to the local PC server in the power-house. The bidder shall design and procure the local server as well. The remote monitoring data shall be able to be accessed via web-based browser or ethernet or mobile application GPRS/GSM modem by all concerned parties including system operators (provider of two years after-sale warranty), administrators and related agencies. The remote monitoring data shall be able to be sent to a third party web-The following is the minimum technical information that must be presented in the dashboard.

The remote monitoring system shall follow IEC 61724 for PV monitoring performance. The following information must be presented in the dashboard:

- Total irradiance
- Ambient temperature
- PV module temperature
- PV energy yield
- Energy consumption
- Load flow to or from battery (charged or discharged)
- Battery state of charge
- Operational status of PV system

## **2.12 Caution Signs**

Caution and danger signs/labels as per the Egyptian Electricity Standards should be hanged on the following:

- Inverters
- Cable Trays
- Distribution boards

The signs and labels should withstand the outdoors weather conditions (e.g. Non-corrosive).

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## **2.13 PV Modules mounting construction:**

### **2.13.1 General Instructions:**

- Structures must be supplied complete with all members to be compatible for allowing easy installation at the both ground and rooftop site
- PV Modules must be design in strings each contains 18 modules. In such a way that it is neatly arranged with several symmetrical lines as well as able to provide the most optimum energy yield.
- The Structure must be made out of galvanized steel and/or Anodized Aluminum member as per design to be submitted by firm. The structures shall be designed to allow easy replacement of any module.
- The structures must be designed for simple mechanical and electrical installation. There must be no requirement of welding or complex machinery at the installation site. If prior civil work or support platform is absolutely essential to install the structures, the supplier shall clearly and unambiguously communicate such requirements along with their specifications in the bid.
- All self drilling fasteners, nuts and bolts shall be of very good quality stainless steel.
- The PV mounting support structure shall be design for simple mechanical onsite installation without requirement of welding and heavy complex machinery.
- Tilt and The orientation as per drawing.
- Minimum wind speed withstand  $\geq 160\text{km/h}$

## **2.14 control Room**

### **2.14.1 WORKS FINISH Supply**

Supply and installations of finsh works with complete Materials,equipments, accessories and finishing. Before starting any work, should be approved the method of work from the consultant. (Three suppliers name to be submitted before delivery of material).

#### **2.14.1.1 Wall Finishes**

Supply and apply plastering finishes works, clear sand, Sweet water, six bags of cement type I to be used per cubic meter. Plastering Accessories as per consultant instruction to be used. (Water curing 5 days).

a- outer face

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b- Internal face

Supply and apply painting finishes works number of coat ,works method should be followed as per recommendations of consultant.

### **2.14.2 ALUMINUM/GLASSWORK**

Supply and installation with complete hardware's, fittings, accessories and finishes.\*

Aluminum section corner and all other accessories to be submitted before installation for approval \* All the glass will be tempered \*all external glass is double with heat proof

Aluminum frame will be anodized or powder coated \* Design to be typical for the contract

Drawing, Shop drawing required, three different companies to be submitted for approval

smoked glass on anodized aluminum framed window, sliding type with decorative metal grill protection

Size: 1.60 x 1.20 M with necessary locking facilities see the schedule

### **2.14.3 ELECTRICAL WORKS**

Supply, install, connect, test and commission and hand over in good working conditions

complete the electrical system as shown on drawings, specifications, IEE wiring regulations

& as required by Local Electrical Authorities (NEC) for the complete project all up to the

satisfaction of the Engineer. all necessary accessories, eg. Fittings for rigid galvanized steel

conduit, utility boxes, copper wires lighting switches, lighting fixtures with all other

necessary accessories required during installation. Where conduits run embedded in concrete

wall, floor, and ceiling rigid PVC sch.40 shall be used. All conduits run exposed or through

hollow wall, ceiling spaces rigid galvanized steel conduit is to be used. Flexible conduits can

be used if required.

#### **2.14.3.1 Distribution Panel Boards**

Supply, Install, test and commission, Electrical panel boards assembled type tested , as

shown on the design drawing ,complete with main & branch breakers including termination

and all accessories required. Each panel boards 3 $\phi$ , 415V, 50HZ. With natural and earthing

buss bar

#### **2.14.3.2 Lighting Fixture**

Supply, install, Test lighting fixtures as shown on the design drawing complete with

conduits, boxes, lighting outlet, wiring (main and branch) circuits to the switches and Panel

board etc. The lighting fixtures shall include lamps, tubes, starters power factor corrections

and all other pertinent accessories to complete the work.

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2x36W,220V, SURFACE MOUNTED FLUORESCENT FIXTURE, WITH ELECTRONIC BALLAST.WATER PROOF IP:65.

#### **2.14.3.3 Switches with Cover Plate and Utility Box**

Supply, install lighting switches as shown on the design drawing including conduits, boxes, cover plate, wiring and all other pertinent accessories to complete the work in accordance with the drawing and specification.

#### **2.14.3.4 Sockets, Outlets and Disconnect switches**

Supply, install, connect & test of sockets, outlets and disconnect switch as shown on the design drawing including boxes, conduits, conduit fittings, wiring for the branch and main circuit to the branch circuit breaker in the distribution board as per drawing and specification and all necessary accessories to complete the work.

13 AMP, 220V, TWIN, SWITCH SOCKET OUTLET, FLUSH MOUNTED.

30 DP SWITCH, & SOCKET OUTLET FOR AIR CONDATION WINDOW TYPE.

#### **2.14.3.5 Data System**

Supply, install, connect and commission complete data point including all conduits, boxes (flush or surface mounted), cables STP cat6 , RG 45 Cat 6 outlet type ,Data Panel(MDFN) including 1 air patch panels,1 patch, power strip all needed . According to specification and drawings. All Data outlets shall be numbered in sequence.

INTERNET SOCKET OUTLET,RG 45 CAT6 ,FLUSH TYPE WALL MOUNTED,  
TELEPHONE SOCKET OUTLET,RG 45 CAT5e ,FLUSH TYPE WALL MOUNTED,

#### **2.14.4 HVAC WORKS**

Supply and installations, testing of complete HVAC system including wiring connections and other related accessories to have satisfactory operations for the entire systems.

Window type Unit Supply, install and test Fan Coil Unit as per specifications, drawings and schedules of equipment's, all electrical works (components, wiring, pipe sleeves etc.) and all accessories. Electrical power supply shall be provided.

#### **2.14.5 Potable water pump**

Install and operate 20 bar potable water pump for solar panels cleaning with,5000L water tank, 30m 1 inch flexible hose pipes. Act for clearing solar modules

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#### **2.14.6 Perimeter fencing protection**

Supply and install iron protection nets, to be installing over the fence, The item includes all necessary equipment's for installation and operation as per specifications and engineer instructions.

#### **2.15. Spare parts**

Components	Minimum Requirments
PV Module	4
Battery MODULE/packs	2
MCB,MCCB,FUSE,SPD	1 each boxes
Mounting structure clamp ,rail, rack, bracket	5 each type