

Al-Mukalla

1. Solar PV Modules:

- Quantity: 20 pieces.
- Module capacity should not be less than 650 W at STC
- Must conform to IEC 61215, 61730, 61701, 62716, ISO 9001, ISO 14001, and ISO 45001 certificates or equivalent.
- The PV manufacturer should be approved as tier-1;
- The module type shall be monocrystalline, n-type, TOP Con and bifacial dual glass.
- Module efficiency: should not be less than 22%.
- The PV modules junction box not less than IP68 & with 3 diodes.
- Module Voltage: Not less than 1500 VDC (IEC).
- VOC: -0.25% /C° or less.
- Nominal operating cell temperature (NOCT): Not more than 45°C.
- Tolerance of maximum power rating: 0-5 W.
- Operating temperature: -40C° to 85C°.
- Weatherproof DC rated MC4 connector & Fully Secured, not allowing for any loose connections & PID resistance.
- Certificates and Data sheet of PV module that contains the P-V & I-V Curves, material and thickness of the frame and glass layer, all electrical and mechanical Data, Dimensions and Module area should be provided by bidders.
- Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years.

2. Hybrid Inverter (12 kW) Built-in MPPT Solar Charger controller

- Quantity: 1 piece.
- Rated AC Input/Output Active Power (W): 12,000.
- The inverter shall produce pure sine wave form with provision for battery charger, and it can be configured individually or in parallel.
- Battery Type: Lithium-ion.

- *Battery Voltage Range (V): 40-60.*
- *Max. Charging Current (A): Not less than 220.*
- *Max. Discharging Current (A): Not less than 220.*
- *Charging Strategy for Li-ion Battery: Self-adaption to BMS.*
- *Number of Battery Input: Not less than 2.*
- *Max. PV Input Power (W): Not less than 15,600.*
- *Max. PV Input Voltage (V): Not less than 500.*
- *Start-up Voltage (V): Not more than 125.*
- *MPPT Voltage Range (V): 150-425 or wider.*
- *Rated PV Input Voltage (V): 370.*
- *Max. Operating PV Input Current (A): Not less than 26.*
- *Max. Input Short-Circuit Current (A): Not less than 44.*
- *No. of MPP Trackers/ No. of Strings MPP Tracker: Not less than 3/2+2+2.*
- *Total Current Harmonic Distortion THDi: Less than 3.*
- *Output frequency shall be 50 Hz.*
- *Ingress Protection (IP) Rating: IP65.*
- *Maximum efficiency should not be less than 96 % at full load.*
- *The device should be integrated with LED indicators and LCD display.*
- *It shall allow adjustment of battery voltage and charging current.*
- *The device shall allow connection to grid and backup generator.*
- *The device shall have two outputs to the loads (Back-up and Smart Loads).*
- *Communication Interface: RS485/RS232/CAN*
- *Monitoring: shall include Datalogger to be controlled and monitored online.*
- *Operating Temperature Range: -40 to +60 °C.*
- *Derating Temperature: Not less than 45 °C.*
- *To be certified to meet at least CE and UL marking and complaint with IEC 62109.*
- *Protections required: DC Polarity Reverse Connection Protection, AC Output Overcurrent Protection, Thermal Protection, AC Output Overvoltage Protection, AC Output Short Circuit Protection, DC Component Monitoring, Overvoltage Load Drop Protection, Ground Fault Current Monitoring, Power Network Monitoring, Island Protection Monitoring, Earth Fault Detection, DC Input Switch, DC Terminal Insulation Impedance Monitoring, Residual Current (RCD) Detection, Surge protection level.*

3. Lithium-ion Batteries with Rack (LiFePO4)

- Quantity 2 pieces.
- Type: Low-Voltage (LV) Lithium Iron Phosphate (LiFePO4) battery.
- Nominal Energy: 14,336 Wh per piece.
- Nominal Capacity: 280 Ah per piece.
- Nominal Voltage: 51.2 V.
- Operating Voltage Range: 40 - 58.4 V.
- Max. Continuous Charge/Discharge Current: 150 Amps.
- Max. Parallel Quantity: 15 batteries.
- Cycle Life: not less than 6,000 cycles at 25°C.
- Protection Degree: not less IP52..
- Installation Method: Can be wall-mounted or floor-mounted. Battery Chemistry: LiFePO4.

4. DC Combiner Box (DCCB)

- Quantity 1 piece.
- 3 DC inputs & 3 outputs.
- Enclosure materials: Powder coated metal with lockable door.
- Enclosure protection: not less than (IP65 or equivalent) or higher.
- MCB circuit breaker rating shall be 32A, 2P, 1000VDC.
- DC fuse rating for each string: 20A, 1000VDC.
- Built in surge protection device: 3P, 40kA, not more than 500VDC or the inverter max. input voltage.
- Anti-backflow diodes.
- All wires/cables must be terminated through cable lugs with using heat shrink tubing & suitable glands.
- Internal connection should be through busbars.
- Product warranty shall be at least 2 years.
- The brand shall be (Suntree or equivalent).

5. System Cables:

- *All cables shall be marked properly according to the approved design so that cable can be easily traced and identified.*
- *All outdoor exposed wiring to be protected from UV radiation and physical damage.*
- *All cables above ground should be suitably mounted inside cable trays with proper covers, or inside UPVC conduit with 60 % clearance.*
- *Underground cables should be housed inside UPVC conduit with 60 % clearance.*
- *All underground cables shall have warning tape installed.*
- *All cables inside the control room shall be installed inside cable trays.*
- *All cables outside the control room shall be installed inside UPVC conduit with 60 % clearance.*
- *Ends of cables' connections are to be made through suitable lugs or terminals, crimped properly with use of cable glands and heat shrink tubing.*

5.1. AC Cables

- *Flexible copper conductor and shall be double insulating material (PVC insulated and PVC sheathed) CU/PVC/PVC.*
- *Voltage rating:450/750VAC.*
- *Conductor: Plain annealed flexible copper conductor class 5 as per BS EN 60228.*
- *Insulation: Extruded layer of Polyvinyl chloride (PVC) insulation with temperature rating at least 90 °C at normal operation as per BS EN 50363-3 type TI1.*
- *Sheath: Extruded layer of Polyvinyl chloride (PVC) compound applied over the laid up assembled cores with temperature rating at least 90 °C at normal operation as per BS EN 50363-4-1 type TM2.*
- *Flame retardancy: flame performance standards BS EN 60332-1 or equivalent.*
- *Certification Standard: BS EN 50525-2-11 or equivalent.*
- *The brand shall be (Bahra, Alfancar or equivalent).*

5.2. DC Cables

- *Cable type: H1Z2Z2-K.*
- *The cable shall be designed for outdoor use and weather resistance.*
- *The rated voltage shall be at least 1500VDC.*
- *The maximum voltage shall be at least 1800VDC.*

- The cable shall be flame & fire non-propagation, chemical & oil resistance and UV & Ozone resistant.
- The maximum service temperature shall be 120°C.
- Conductor: Flexible Tinned copper Class 5 (K) as per EN 60228.
- Insulation: Halogen-free cross-linked LSOH-XL compound.
- Outer sheath: Halogen-free cross-linked LSOH-XL compound. Sheath' colors shall be black & red.
- TUV certified according to IEC 62930 & BS EN 50618 or equivalent.
- The brand shall be (Bahra or equivalent).

5.3. Cable Tray

- Perforated type Galvanized steel cable trays including cable tray covers, clamping bolts and other cable tray accessories such as coupler plates, bends, tees, reducers, vertical elbows in manufactured accordance with ASTM A653 SS, Grade 33, coating designation G90.
- Hot-dip Galvanized Steel: Straight section and fitting side rails and rungs shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter, and shall be hot-dip galvanized after fabrication in accordance with ASTM A123.
- Perforated cable trays must conform to IEC 61537 and EN ISO 1461 standard.
- The size of cable tray shall be according to the number of cables (X 1.5) for future expansion.
- The brand shall be (Bahra or equivalent).

6. Battery DC Protection Box

- Shall include MCCB breaker.
- The box shall be grounded properly.
- Shall be installed between the batteries and the inverter.

6.1. Molded Case Circuit Breaker (MCCB)

- Shall be MCCB DC type for PV purposes.
- The rated current: 160A, 2P.

- *Tripping Type: Thermal-magnetic type.*
- *Operating voltage (Ue): 1000VDC.*
- *Rated insulation voltage (Ui):1250VDC.*
- *Rated impulse withstand voltage (Uimp): 8kV.*
- *Ultimate short-circuit breaking capacity (Icu): 20kA.*
- *Running short-circuit breaking capacity (Ics): 20kA.*
- *Certification & Standard: IEC/EN60947-2 & CE certified.*
- *Bidders are advised to use high quality breakers preferably CNC or equivalent.*

6.2. Enclosure

- *Shall be made of high-quality electro galvanized steel & scratch resistant powder coating.*
- *Shall include door gasket for ensuring a tight weatherproof seal.*
- *Shall include removable gland plate on bottom side and be prepared with suitable glands.*
- *Shall include earthing studs for both the enclosure and the door.*
- *Lockable front door, wall mounted type, and Protective plates.*
- *Ingress protection must be at least IP65.*
- *Certification & Standard: IEC 60529/62208 & CE certified.*
- *Bidders are advised to use high quality enclosure preferably Alfamar or equivalent.*

7. Inverter AC Source Protection Box

- *Shall include MCCB breaker, SPD, RCCB and MCBs.*
- *MCCB rating: 63A, 2P, 220VAC, 25kA.*
- *SPD rating: 230VAC, 2P, 20kA.*
- *RCCB rating: 63A, 2P, 230VAC, 300mA.*
- *MCB rating: 63A, 2P, 230VAC, 10kA.*
- *The box shall be grounded properly.*
- *Shall be installed between the Grid input source and the inverter at the control room.*

- *Internal connection should be through busbars and the busbars rating should be at least 1.5 main circuit breaker size.*
- *Bidders are advised to use high quality breakers preferably LS or equivalent.*

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- *Certification & Standard: IEC 60529/62208 & CE certified.*
- *Bidders are advised to use high quality enclosure preferably Alfamar or equivalent.*

8. Loads Protection Box

- *Shall include MCB breaker, RCCB breaker and two Voltage Protection Devices.*
- *MCB rating: 63A, 2P, 230VAC, 10kA.*
- *RCCB rating: 63A, 2P, 230VAC, 300mA.*
- *Voltage Protection Device: 2P, 63A.*
- *Shall be installed at the control room.*
- *Internal connection should be through busbars and the busbars rating should be at least 1.5 main circuit breaker size.*
- *Bidders are advised to use high quality breakers preferably LS or equivalent.*

8.1. Enclosure

- *Shall be made of high-quality waterproof enclosure.*
- *Shall be 12-way enclosure.*
- *Lockable front door, wall mounted type.*
- *Shall be prepared with suitable glands.*
- *Ingress protection must be at least IP65.*

9. Earthing and Lightning Systems Earthing and Lightning Systems

- Grounding protection equipment shall include conductors, copper cable clamps, cable lugs, cable glands, earthing rods, busbars, bentonite, investigation chambers pits, removable cast iron covers for pits,
- lightning protection equipment shall include lightning arrestor with its base, galvanized iron pipe, concrete cube above ground, earthing pit, earthing conductor
- All the conductive materials should be made of pure copper.

9.1. AC and DC Earthing

- All the materials, fittings, accessories, etc., which are used for doing earthing, shall conform to BS 7430.
- Earthing installation in accordance with the IEE Wiring regulations BS 7671.
- The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54.
- DC & AC earthing systems must have separate earthing systems and pits.
- Each lightning system shall have its own earthing system and pit.
- Earth resistance should be tested in presence of the supervisor engineer by calibrated earth tester and the earth resistance should not be more than 5 Ohm (for DC or AC systems) or 3 Ohm (for the lightning system).
- The contractor is responsible to find methods and discuss them with the supervisor engineer to decrease the earth resistance in case it is above 5 or 3 Ohm.
- The number of the earthing pit(s) should be defined by fulfilling the required value of the resistance, any expected cost should be covered under this item.
- Two earthing busbars shall be installed, one for the DC system & for the AC system.
- Earthing pit shall have inspection chamber with removable cast iron cover 40cm X 40cm.
- Earthing rod size shall be 16mm.
- Earthing copper plate with (600x600x3) mm dimension.
- Earthing rod and plate shall be well fixed together.
- Each earthing pit shall have 2 charcoal packages (2 X 25kg), one salt package (25kg) and with 12.5kg bentonite.
- Each array structure of the PV modules should be grounded properly.
- All metal casing/shielding of the system and its components should be thoroughly grounded.

The brand shall be (Bahra or equivalent).

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9.3. Lightening

- Lightning System shall be complied with BS EN 62561 or equivalent.
- Lightning air terminals shall have 3 copper air rods (heads) 20cm.
- Galvanized iron pipe shall be taller than any structure by 2 meters at least, medium pressure and 2 inches in size.
- The brand shall be (Bahra or equivalent).

Table 1: Details of Earthing & Lightning Conductors

Cable Routes	Size (mm)
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Lightning System	
<i>Lightning Arrestors to Earthing Pit</i>	25
DC Earthing	
<i>Between PV Modules</i>	6
<i>(PV Array Structure & Cable tray) to DC Earthing Busbar</i>	10
<i>PV Strings to DC Earthing Busbar</i>	10
<i>Combiner Box to DC Earthing Busbar</i>	10
<i>DC Earthing Busbar to DC Earthing Pit</i>	10
AC Earthing	
<i>Each Metal Casing or Shielding to AC Earthing Busbar</i>	4
<i>Inverter to AC Earthing Busbar</i>	16
<i>MTS to AC Earthing Busbar</i>	16
<i>Earthing Busbar to AC Earthing Pit</i>	16

10. Fire Extinguishers

- Ball extinguisher.
- Powder / CO2 extinguishers.
- 5 kg capacity for CO2 extinguisher.

- *6 kg capacity for powder extinguisher.*
- *1.3 kg capacity for ball extinguisher.*
- *Epoxy polyester paint finish.*
- *Approved to EN1866 or Equivalent.*

11. Split Air Conditioners

- *Quantity 1 pieces*
- *Nominal Capacity: 1.5 tons (18,000 BTU/h).*
- *Air Conditioner Type: Split (separate unit).*
- *Compressor Type: Rotary or Inverter. It is preferable to specify the required compressor type.*
- *Cooling Capacity: 17,000 to 18,400 BTU/h, depending on the model.*
- *Noise Level: Low, typically ranging from 40-56 dB.*
- *Electrical Voltage: 220-240 V.*
- *Frequency: 50 Hz.*
- *Refrigerant Type: R32 or R410A. It is preferable to specify the required gas type to ensure environmental compatibility.*
- *Control: Wireless remote control, with optional Wi-Fi control capability.*
- *Filters: Washable high-density filter for removing dust and fine particles, with the option to add multiple filters (e.g., antibacterial or Vitamin C filter).*
- *Additional Functions:*
 - *Self-cleaning feature for the indoor unit.*
 - *Turbo cooling technology.*
 - *Automatic restart system after a power outage.*
 - *Quiet sleep mode.*
 - *24-hour on/off timer.*
 - *4-way air swing.*
- *Approved to EN1866 or Equivalent.*

12. Supplying and installing solar panel holders to achieve the best solar

- *Best angle during the seasons of the year . and installing galvanized*
- *metal structure Columns (H100*200) and Beams Of rails (H70*140),*
- *Tube (GAL.50*100*1.5), support angles (L50*50*4), and flanges. The*
- *price also includes cutting, welding, grinding, drilling, lifting and fixing*
- *in place on height levels. The price includes all connections nuts, bolts,*
- *nuts and welds that necessary for manufacturing, installation and all*
- *required works according to the engineering drawings, technical*
- *specifications and the instruction of the supervising engineer*