

Standardization of Solar Panels and Allied Equipment for Khyber Pakhtunkhwa

1. SOLAR PANELS

- > The Solar Panel shall meet the requirement set in IEC 61215:2016, IEC61730-1:2004 and IEC 61730-2:2004, IEC 61710, / international standards.
- > Solar Panels with Anti-PID Certification based on IEC standard TS-62804-1 will be preferred (i.e: TUV PPP-58042).
- > Outstanding conversion efficiency.
- > More Power per square meter than other panels.
- > Positive watt class rating/positive power tolerance (5 to 10 watt above industry average).
- > Low temperature coefficient.
- > PID degradation free.
- > The PV module(s) shall contain mono crystalline silicon, poly crystalline, thin film, multi junction Grade-A Solar cells.
- > The PV module have an ability to Works well with high-voltage input Inverters/ charge controllers (1000 Vdc)
- > The PV Panel must have clear anodized aluminum frame with Anti-reflection cover glass.
- > Split cell standard technology
- > Maximum bus bars.
- > Special glass etching and anti-reflective coating.
- > Solid Warranty, stable and well established company.
- > Ammonia and salt mist corrosion resistance.
- > Tier 1 solar panel producer.
- > Fully automated production cycle, reducing sources of variation in production.
- > Extremely low failure rate.(6 sigma certified)
- > Financial strong company.
- > Multi award winning company.
- > Test Standard(s) to which the module has been tested and certified.
 - I-V curve for the solar photovoltaic module/panel.
 - Date and year of obtaining IEC PV module standardization qualification certificate.
 - Electrical Data at nominal Cell Operating Temperature (NOCT).
 - PV Module efficiency at STC.
- > Each panel should have factory equipped weather proof terminal junction box having at least IP65 protection with provision of opening for replacement of DC cables, blocking diodes and easy debugging if necessary.
- > /25 years performance warranty for 80 % output power.
- > Brand name(s) of PV modules
- > Certified with high wind speed.
- > Flash test reports from manufacturer for each panel given for sample.
- > All information regarding solar panel with above mentioned featured data should be accessible and verifiable online on the manufacturer website.

2. WATER PUMPING INVERTERS / CONTROLLER:

The solar pump inverter/controller should have built-in MPPT controller, over load protection, Soft start/Soft Stop Features and Variable Frequency Drive (VFD) with integrated Gate Bipolar Transistors. The inverter offered should comply to or Equivalent standards:

- > CE/RoHS/international standards
- > Low Voltage Directive 2014/35/EU with Supplements
- > EMC Directive 2004/108/EC with Supplements

The complete datasheet showing all the electrical parameters like input & output voltage ranges should be provided in the technical bid. All the electrical parameters like input & output voltage ranges, and efficiency should be provided at the time of pre-supply testing and inspection. Efficiency of inverter should be 92% and above.

- Rated output voltage of inverter / Controller shall be pure sine wave AC. Total harmonic distortion in AC output should not exceed 2%.
- Inverter should have at least three (5) years extendable to 10 years performance warranty.
- Inverter circuit must include protection against:
 - > Over or Low voltages and currents beyond critical level of the inverters circuits.
 - > Protection against accidental short circuits & reverse polarity connections.
 - > Protection against lightning induced transients.
 - > Over load protection.

 - > Low RPM Protection (i.e: Frequency < 30 Hz) Motor Should Stop.
 - > Dry run protection.
- dV/dT Filters With Inverter (VFD):
 - > The use of load reactors increases the reliability, performance, and efficiency of VFD systems, extends the life of both drives and motors, and reduces the amount of energy consumed by the motor/drive system.
 - > Output dV/dT or Sine Filters (between VFD and Motor) of appropriate size should be used where the motor cable length is more than Fifty (50) Feet or as advised / recommended by the inverter manufacturer in their Technical Documentation.
 - > dV/dT Filter should be enclosed in a box.

3. GRID TIE INVERTER/ HYBRID /OFF GRID INVERTERS:

- i) The DC power produced is fed to inverter for conversion into AC. In a grid interactive system AC power should be fed to the grid at three phase 415 AC bus.
- ii) Power generated from the solar system during the daytime is utilized fully by powering the critical building loads and feeding excess power to the grid as long as grid is available. In cases, where solar power is not sufficient due to more demand or cloud cover etc. the building loads should be served by drawing power from the grid. The inverter should always give preference to the Solar Power and will use Grid/DG power only when the Solar Power is insufficient to meet the load requirement.
- iii) The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid.
- iv) The offered On-Grid Inverter must be of Hybrid type has an ability to synchronize with battery bank as backup system.
- v) Inverter should continuously monitor the condition of the grid and in the event of grid failure; the inverter automatically switches to off-grid supply within 20-50 milliseconds and synchronize with battery bank and fulfil shortcoming from battery bank as PV-Battery hybrid system. The solar system is resynchronized with the grid within two minutes after the restoration of grid or DG set.
- vi) Grid voltage should also be continuously monitored and in the event of voltage going below a pre-set value and above a pre-set value, the solar system should be disconnected from the grid within the set time. Both over voltage and under voltage relays should have adjustable voltage (50% to 130%) and time settings (0 to 5 seconds).
- vii) Metal Oxide Varistors (MOVs) should also be provided on DC and AC side of the inverter.

- viii)** The inverter control unit should be so designed so as to operate the PV system near its maximum Power Point (MPP), the operating point where the combined values of the current and voltage of the solar modules result in a maximum power output.
- ix)** The inverter should be a true sine wave inverter for a grid interactive PV system.
- x)** The degree of protection of the outdoor inverter panel should be at least IP-55.
- xi)** Typical technical features of the suggested inverters must mention as per following sequence.
- Continuous output power rating (1.1 times for 60seconds)
 - Nominal AC output voltage and frequency
 - Accuracy of AC voltage control $\pm 1\%$
 - Accuracy of frequency control $\pm 0.5\%$
 - Grid Frequency Control range ± 3 Hz
 - Maximum Input DC Voltage range
 - MPPT Range DC
 - Ambient temperature -10 deg C to 55 deg C
 - Humidity 95 % non- condensing
 - Protection of Enclosure IP-55 (minimum)
 - Grid Voltage tolerance -20 % and + 15 %
 - Power factor control 0.95 inductive to 0.95 capacitive
 - No-load losses < 1% of rated power
 - Inverter efficiency (minimum) 95%
 - TUV certified, Warranty 5 years.
 - Liquid crystal display should at least be provided on the inverters front panel or on separate data logging/display device to display following
 - a. DC Input Voltage
 - b. DC Input current
 - c. AC Power output(kW)
 - d. Current time and date
 - e. Time active
 - f. Time disabled
 - g. Time Idle
 - h. Temperatures (C)
 - i. Converter status
 - Following should also be displayed like Protective function limits, Over voltage, AC under voltage, Over frequency, under frequency, ground fault, PV starting voltage, PV stopping voltage, over voltage delay, under voltage delay over frequency, ground fault delay, PV starting delay, PV stopping delay.)

4. Cable and DC Wiring for Water Pumping system:

- > The AC / DC cables should be made of 99.9% copper strands and Flexible.
- > The DC cable must have double insulation suitable for 1000 V_{DC} transmission.
- > DC circuit breakers (not fuse) of at least 800V and suitable ampere rating must be installed between PV modules and PV pump controller in order to avoid short circuiting.
- > AC Circuit Breaker of suitable rating must be installed between Pump Controller and Motor.
- > DC Breaker, AC Breaker and Inverter / Controller should be placed in an enclosure of IP55 standard.
- > Cables shall be clearly labelled with essential electrical parameters including manufacturer name, Voltage Range, standards etc.
- > All wiring shall be aesthetically neat and clean, over all wiring/connection losses shall not exceed 1% of the total rated output power.
- > All connections/ socket outlet among array, controller, inverters, batteries, and pumping set etc must be made in junction boxes of adequate protection level.
- > All wires/cables should be in standard flexible UV-Resistant conduits for outdoor installation and HDPE pipes (3 feet deep) for underground wiring and PVC ducts for indoor installation.

5. Panel Mounting and Structure on Ground:

- > The panel mounting and structure should be made of hot dipped (80 microns minimum) galvanized steel of minimum thickness of 2.64 mm / 12 Gauge Channel A sketch of the mounting frame (As per Actual Site Requirements) showing dimensions of the frame parts should be provided at the time of supply.
- > PV to ground clearance must not be less than 2 feet. The height of the upper edge of the structure should not exceed 10 ft above the ground.
- > To avoid Shading, Distance between two rows of PV panels and from walls should be maintained at a minimum of 1.6 times the height of structure/walls.
- > The pit size for concrete works should be minimum 1.5x1.5x2 ft for each leg and the concrete should be extended at least 1 ft above the ground. The concrete ratio should be 1:2:4.
- > The Surface azimuth angle of PV Module 180° and the Tilt angle (slope) of PV Module should be 33°.
- > The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour.

6. Solar Auto Trackers for Water pumping system:

The solar tracker offered should be fully automatic and intelligent, and must be capable of Single axis tracking (from east to West) and should have its own power supply (PV Panel, Battery and Charge Controllers) other than PV Panel used for Pumping Setup.

Individual Auto-Tracker should not be less than 4kW each.

The auto Tracker should also have manual control mode to adjust the tracking angle manually. Structure Material Should be Hot Dipped Galvanized Steel (Minimum 80 Microns).

All nuts, bolts, washers and other fasteners for mounting structure shall be made of minimum A2 grade stainless steel.

Foundation and other details will be separately provided. 06 years Comprehensive Free Replacement, Repair and maintenance Warranty (Free of Cost) should be provided for all the components of auto Tracker (including Batteries).

7. BATTERIES:

- > The battery should be maintenance free, Deep Cycle, Tubular, OPzV Type. (AGM, GEL, LI ion)
- > The battery must ensure safe and reliable operation in the whole range of ambient temperatures from -5° C to + 50° C.
- > The maximum permissible self-discharge rate should not be more than 5 percent of rated capacity per month at 25° C.

- > Cycle life of the battery minimum 3000 @ DOD 80 %.
- > Battery should have maximum discharge rate.
- > The battery shall have a certificate of compliances, issued by a recognized laboratory.
- > The Batteries should have minimum 5 to 10 years.
- > The battery shall meet the requirements and recommendations given in IEC 60896 21/22.

8. LED LIGHTS:

- > Solar Based LEDs/Light fixtures shall conform to the latest IEC/ISO internationally recognized standards.
- > LEDs/Light fixtures should not be Chip-on-board (COB) single chip type due to their poor heat dissipation.
- > LEDs/Light fixtures shall be modular type with proper heat sinks.
- > Solar based lights (LED fixtures etc) should provide at least 100 Lumen/watt.
- > LEDs/Light fixtures should be designed to deliver at least 10 years of service.
- > Complete lightening unit shall be weather proof (Protection Class IP65).
- > The output from the LEDs/Light fixtures should be constant throughout the duty cycle.
- > The LED lights should have minimum 10,000 duty hours.

15. Water Pump

Internationally certified. Pump should be supplied having standard ISO-9906 Grade-1 specifications. The pump must be submersible, made of stainless steel. The characteristic curves (Original from Manufacturer) showing the efficiency at duty point and performance of the pump should be provided in the technical proposal and also at the time of pre-supply testing. The quoted pump should be tested for its performance and certified as per ISO-9906 Grade-1 standard. The pump should be suitable for installation and operation in tube wells/dug wells/open well with clear water discharge. Pump shall comprise off bowl assembly and non-return valve as integral part of pump's parts. Pump and motor shall rigidly couple through NEMA standard coupling. The stage casings of pumps should be connected as per NEMA/ANSI/AWWA /ASTM/BSS standard. Each stage casing must have replaceable wear ring. The impellers shall be secured to the pump shaft with tapered conical sleeves pressed into the taper bore of impeller or impeller secured through chrome plated stainless steel hexagonal sleeves. Suction casing must be between pump and motor with suction strainer as protection of pump against coarse impurities of the liquid handled.

Note: Bronze submersible pump of equivalent standards can also be provided with prior approval.

Specification for main components of the Pumps:

S.NO	Components	Specifications
1	Casing/Diffuser	The Casing/Diffuser should be in fabricated stainless steel AISI 304.
2	Impellers	stainless steel AISI 304
3	Driving Shaft	Stainless steel 304/420
4	Sleeves	Stainless steel AISI 329/ 304
5	Gaskets	Rubber Gaskets
6	Bearings	AISI 329 stainless steel
7	Coupling & Screen + Cable Guard	Stainless steel AISI 316/319/304/420
8	Non-Return Valve / Sluice Valve	As per British standard specifications (BSS), Minimum 16 bar pressure sustaining design
9	Pressure Gauge	As per British standard specifications (BSS), having PSI or Bar scale
10	Clamps	Steel – Pressed
11	Pump Efficiency	Minimum efficiency of the pump should be 70% ensured at duty point. (Duty Point of the Pump should always be selected to the right of Pump Peak efficiency Point)

16. Water Motor

Internationally certified .The winding material should be 99.99% copper. The motor should have wet type, water cool rewind-able/repairable stator. The motor should have non-disposable/non-hermetically sealed winding. The insulation class of the winding material should be mentioned. For each model quoted, all the technical parameters such as rated voltage, power factor, efficiency, full load ampere, speed and other similar parameters should be provided at the time of pre-supply testing. The testing report with all basic parameters should also be provided at the time of pre-supply testing.

The motor shall be manufactured in compliance with National Electrical Manufacturer Association (NEMA) standards. The motor shall be three-phase submersible and shall be capable of operating at rated voltage of 380 Volts at 50 Hz. The motor should be capable of operating with variable

speed through V/F control. Winding of the motor shall of rewind able type with class - IC40 insulation and IP68 protection. The synchronous speed should be 2850-2950 RPM. Motor shall be capable of operating in well water with temperature normally start from 40C. Motor should be designed for continuous operation. Motor must be filled with water without any chemical additives hazards to health for cooling. The motor must be properly protected against the entry of well water sand etc by double mechanical seal one is rotating and other stationary and must be made of Silicon carbide/ Tungsten carbide and must be protected with sand protection guards. All supports shall be high grade cast iron and stator outer side jacket body should be in stainless steel in AISI 304. The excessive pressure due to heating up of the filled water must be compensated by a pressure equalizing rubber diaphragm in the lower part of the motor. The axial thrust of the pump shall be countered by oscillating sliding block type thrust bearing. The thrust bearing of the motor should be able to bear a download thrust force from the water pump and the upward thrust force produced while starting the water pump. Motor shall be capable of maximum of 20 starts in an hour. Motor efficiency should not be less than 75% at Motor Rated Voltage.

Technical specification of rewind-able wet stators, three phase squirrel cage water filled submersible motor.

S.No	Components	Specification
1.	Winding	Made of pure electrolyte copper a non-hygroscopic poly vinyl chloride for normal temperature and must full fill resistant tests range.
2.	Stator	Energy efficient low-losses electrical magnetic sheet should be fixed in stainless steel casing. M800 or M600 magnetic sheet are preferable to use.
3.	Rotor	Energy efficient low-losses electrical magnetic sheet fixed with high grade copper bars. M800 or M600 magnetic sheets are preferable to use.
4.	Spline Shaft	AISI 420 stainless steel, flange dimension according to NEMA standard, over size design to ensure stiffness in severs condition.
5.	Shaft bearing	Water lubricated guide/general bearings fixed in upper and lower brackets should be made of metal impregnated carbon.
6.	Lower thrust bearing	Thrust sliding block bearings, self aligning Mitchell type, should be able withstand 15500N/20000N axial load.
7.	Mechanical Seal (Stationary & Rotary)	Silicon carbide or tungsten carbide mechanical seal.
9.	Cooling filling fluid	Water mixed with non-toxic anti freeze provide cooling and lubrication also protect and prevent inside parts from corrosion.
11.	Degree of protection	IP68
12.	Insulation of Class	With winding wire poly vinyl chloride up to 70 degree C with winding wire polyethylene up to 95 degree C.
13.	Voltage Tolerance	-6% to -10%
14.	Mounting position	Vertical horizontal
15.	Class	IC40
16.	Maximum Immersion	150 Meters
17.	Stating per hour	20

17. SUBMERSIBLE FLATE ELECTRIC CABLE:

The submersible cable should be made of 99.9% copper strands with double PVC insulation for 1000Vac, should be adequately flexible and environment friendly. Stranded and flexible insulated copper wires and cables must be used for all outdoor and indoor installations. The wiring that leads into the building shall be protected in a conduit. The cable must have undergone quality tests as per BSS standards. Following lab tests are mandatory.

- Conductor resistance test.
- Insulation resistance test.
- Pressure test.
- Spark test.
- Note: The Supplier should provide the quality tests certificates at the time of pre-supply testing and inspection.

18. COLUMN PIPE:

The column pipe shall be flanged ERW steel pipes confirming to ASTM designation A-53 with a minimum thickness of 3.5 mm and shall be painted with corrosion resistance paint of suitable thickness. Flanges thickness of 20 mm shall have grooves for cable passage. Each column pipe shall be complete with gaskets, bolts/studs, washers and nuts. All nuts, bolts, and washers shall be made of minimum A2 grade stainless steel.

The column pipe shall be supplied in interchangeable section having an approximate length of 10 feet column pipe shall be flanged perpendicular to the axis of pipe.

HDPE Pipe of 1 or 0.75 Inch diameter conforming to ASTM F-2160 Standard without Joints to be installed/included along with and equal to Column pipe for confirming Water Level testing purpose.

FEATURES:

- Manufacturer's pipes should meet international standards like BSEN 10255 & ASTM A 53.
- Dimensional accuracy circularity and plan end cut should be observed,
- Weld strength of pipe and mechanical properties or raw material should be tested as per manufacturing standards.
- Pipes should be NDT tested (Non-destructive - Eddy current)
- Pipes should be hydrostatically pressure as per manufacturing standard.
- Pipes should be gone through straightening process to remove bendiness.

19. TOPSET Water Pumping system:

Top set shall comprise of Bore covers plate, (covering bore hole completely and securely), installation/suspension clamps, sluice valve, reflex valve, Washout Valve 4 feet above the ground (T-Connection For Testing Pump's discharge), connector and cable jointing material (Cable connection from motor to switching device shall be joint free) pressure gauge and cable ties. Bore Cover Plate should have provision for water level testing facility (i.e: Hole for Sonic Water Level Meter / HDPE Pipe insertion)

For Cleaning of solar Panels, Plastic pressure pipe should be provided of suitable length to reach the furthest / last Solar Panel.

Every Water Supply Scheme should have a non-removable name plate fitted at inverter box having essential information and bearing the name of supplier and client.

20. DC Solar Water Pump:

The equipment must be internationally certified. DC motor brushless, Built inside a cast stainless steel housing. High power rare earth (neodymium) permanent magnets to provide high torque for maximum performance. Driven by a PWM signal from the controller. The PWM signal ensures a soft start and infinite speed control of the motor. Only non-corrodible materials are used, motor windings are cast in resin to provide a very long life, even in difficult conditions.

Control equipment must:

- be separate from the other system components.
- provide direct solar connection as standard.
- have the ability to add on an optional power pack if required in the future.
- provide diagnostic indicators to show status
- have provision for continuous performance measurement
- Storing data with PS Data Module.

Control equipment includes monitoring, power conversion, MPPT (Maximum PowerPoint Tracking) sensors, Software base commission, Mobile Software, Storage data option, frequency control and other equipment related to the solar pumping system.

21. LED SOLAR STREET LIGHTNING SYSTEM:

- Must be certified internationally.
- The W-LED solar lightning system should be designed to operate from dusk to dawn (more than 14 hours)
- The Light source should be white type.

- Color LED used in the system should be in the range of 5500 K to 6500 K (Cool White)
- LED emits ultra violet light is not permitted.
- The light output source should be constant.
- Luminous flux should be 4000 lumens with permissible allowance of 10 %.
- The outdoor housing or luminaries should be all weather proof.
- Heat sink temperature should not increase more than 20 degree centigrade above ambient temperature.
- The charge controller must ensure safe and reliable operation in the whole range of ambient temperature from - 20 to +50 degree centigrade.
- The make, model number and country of origin should be mentioned.
- The performance warranty should cover at least 3 years for replacement upon defect/ malfunctioning.

22. SMD LIGHTS

Must be internationally certified. Modular design, matrix array, light uniformity.

Excellent heat dissipation performance, guarantee lamp long lifespan.

Light effect soft and comfortable, no glare.

Original chip, high luminous efficiency, long lifespan, good stability, high reliability.

No mercury, lead and other hazardous materials, RoHs compliant.

Support several intelligent dimming modes, energy conservation.

Be used on corridors, inside rooms etc.

- A unique, modular design with enhanced optic-lense, makes this IP66-rated area luminaire the most versatile to date, providing exceptional lighting performance and reduced total cost of ownership in variety of applications. The modular design accommodates up LEDs to allow for customization of illumination and economic performance for a wide range of applications. The advanced thermal management system contributes to unparalleled lumen maintenance.

23. Energy Efficient Fans: Must be internationally certified. ISO/IEC/ or equivalent.

24. LIST OF APPROVED LABORATORIES:

- Fraunhofer ISE (Freiburg Germany)
- European Solar Test installation Renewable Energies Unit Institute for Environmental and Sustainability-JRC (Italy)
- NREL –National Renewable Energy Laboratory (USA)
- Arizona State University Photovoltaic Testing Laboratory (USA)
- Centro de Investigaciones Energeticas medio ambientales y tecnologicas Centro de La (Madrid Spain)
- TUV Rheinland Product safety GmbH (Germany)
- Post and Telecommunications Industry Products Quality surveillance and inspection center PTPIC (Beijing China)

25. The authorized dealer must attach List of clients/customers to whom the equipment delivered.