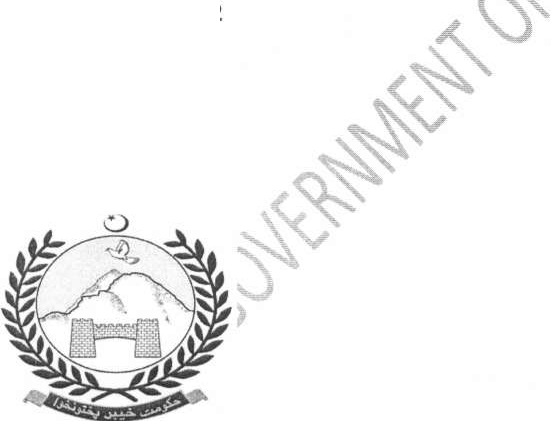
GOVERNMENTOFKHYBERPAKHTUNKHWA COMMUNICATION & WORKS DEPARTMENT

SPECIFICATIONS

\_FOR

SUPPLY AND INSTALLATIONS OF SOLAR PANELS AND ALLIED





EQUIPMENTS

APPR0VED BY STANDARIZATION COMMITTEE OF

**,t�**

- KHYBER PAKHTUNKHWA

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NQJIFICAJlQ :

NQ,SQCBJDMWSotar; **Panola(**PBCfiQ18:1'9{C&WP:Pt1td-3Q(Q1(2Qtf; The r-ecommeno'atlons of lhe

Sub\*Commlltee a'S arrived In rts .m.eetmg held on 08/011'20191, the Standardlzatior, Ccmmlrt no11fH d vtde Planning & I0:pment Department letter No. ChiafllNFJP&&O/601/03/2017'378-

483 dated 21l02J2O17 regardmg standarcflzatton of Engineering products / Materials *I* Equipment's has approved tlrle llRevis.edl TedmicaJ Sp,eciflcatlons For Solat **Panea..,.** nd AUlod Equipment (Rav 201 " in rts meeting he-1d on 11101/2019 as per following dela\ls nd nobf,ed with Lhe direction that u,ese speclflcallons, will be appflcab1e fe>r the works wolc would **be**



lenoered on or elter 01/0412019 These speaf1catlons witl also **be** available on O& ,Qepartmen1 ott1c1al website 1-e www cwd gkp.pk

**A -$PICJB'CADQNS£OB SOLAR SYSTEMS•COM rRr**

1. **S-OILAR PANELS;**

.i The PV module(s) shctll corttaln mono avstalllne silicon G)a *A* 'Solar cells. (Ill-Type Mono P'V Cell Modufes and Bifaclal Double Glass Modules due to its better pern,,rmal"IO! wlll **be** glV@n preference).

b The PV module 51,ould Work weil with lhigh-V<Jttage ln ut Irwerters/ charge controllers (1000

Vdi:}.

1. The fJV Panel must have dear anodized a..tumlnlum frame with Antl·relleaive, hydrophobic, low·

Iron Tempered cover glass.

1. The Solar Modules shaJI meet Uie ro11ov,i valid1ec Standards or latest:
   * lEC 61215-1, lEC 61215--1-1, tee 61215-2 :2016 (Design Qual11'rcaooc,}
   * IEC6l 730-l·2.016 {Safety .. Requlrements for construction)
   * U:C61/30•2:2016 (SalC!l',' .. R<!qulrements *ror* testing)
   * U:C TS-628 -.L. (f:e; TlJV PP-P·5'8 2 or E'ciulvale.nt) MtJ-P'lD **Certiricabon.**
   * IEC 617015aLt l't1$\ COrrosi()n esist1f1Ce 1\?st (ll!tl!St)
   * lEC62716 Ammonia Corrosion Resistance Test (latest)
   * lEC 60068-2-68 Sand and Dust Erosion eslstance Test
2. unique SOfl.81 number, Name / LogO or manufacn.mn and separate date of manufacturing (00/MM/YYYY) shollld be lamlnated lnme e modY!e sc as to be clearly vts[ble rrom tl'le '1ont side.

A properly amlnulr.."d !.1.tdlcr CorG1n11'\{j th!! fc,tlO'Wing detalls Sl'lould be awtlable at the back side of the module



#'.

,

',

Name ot the manufamuer / dlstlnl:t)ve logo. Model Name and Type 0r ceI1Techoot.ogy.

Peal( Watt Ratting {Wp) and Power Tolera"ce Range

, Voltage (V,n11) and Current (J. 11} al STiC

, Open Orcu,t **Vol[.i)ge** (Voe) and Short ClrcULt Cu,rellt (Isc)

,. MalGimum System Voltage (\/ad {i.e: This 5hould **not be** k?ss than 1000 Vo.)

, OimensicrtS of PV Module

►

Test Standard(s) to which the modt.tte lhas been tested and cettlfied.

1. FoUow1ng essential technical parameters or solar panelJmcxlules should be provtded with each pan so plied as well as In the t«htilcal proposal.
   * r-v c:u.M! for the solar photovoltait module/par-el.

**P.ige** *2* of 25





* Date and year of obtaining IEC PV module standardization qualification certificate.
* Electrical Data (i.e: Pmax, Voc/Vmp, Isc/Imp at nominal Cell Operating Temperature

**(NOCT).**

* PV Module efficiency at STC.
* Working temperature range of PV Module.

1. Each panel should have factory equipped weather proof terminal junction box having at least IP67 protection with provision of opening for replacement of DC cables, blocking diodes and easy debugging if necessary.
2. Limited performance guarantee: panel power, in standard conditions, will not be less than 90°/o of

'-

nominal power by the end of 10 years of operation and at least 80% at the end o 25 years of

operation with 25-year limited power warranty. " ..

1. The PV Module should have at least 10-years warranty for any defects and efficiency :p,entioned above. It should be provided On Stamp Paper Signed and Sealed by Con!\_l' r at the time of Handing/Taking Over.
2. The PV Module should have at-least 17.50 % Module efficiency with Positive P.,\_ower Tolerance.

I. The PV modules offered should not be more than 12 months old from the date of issue of work order. ""\-.

1. PV Module should have a Snow Load bearing of 5400 Pa and4Wind Load Bearing of at least 2400 pa however if department deem appropriate may go for 3800 pa wind load depending upon their

requirement. -"'

1. The Solar Module should be free from visual and cosmet.i,cs defects.

**0.** The department/consultant on the expense of c ntractor/supplier shall verify Flash test reports

with serial numbers from manufacturer for each pa I(atthe time of supply).

p, All information regarding solar panel with above mentioned featured data should be accessible and verifiable online on the manufacturer website.

1. IEC accredited lab test for solar panels is mandatory.
2. EL (Electro-luminous) test will be performed randomly for each individual project at the cost of contractor/supplier.
3. CABLE & WIRING:
4. The AC / DC cables should be made of 99.9% copper strands and Flexible.
5. From PV Panel to }unction Box, XLPE or XLPO insulated & XLPE/PVC Sheathed, UV stabilized single core, Double Insulated. Stranded /flexible cables (Conforming preferably to EN 50618 or IEC FDIS 62930) be used.
6. From JB to Inverter, the DC cable must have Single Core, double insulated and suitable for

minimu011boo Voetransmission.

1. From Inverter to batteries, the DC cable can be single insulated, Single Core and suitable for minimum 300 Voe transmission.
2. DC,.circuit breakers (not fuse) of Voe of String Voltage and suitable ampere rating (1.25 to 1.50 Times of Rated Current of all strings connected) must be installed between PV modules and

*(* controller/ inverter.

1. AC Circuit Breaker (s) of suitable rating (1.25 to 1.50 Times of connected Load) must be installed between Controller / inverter to Load and Grid to Controller/ Inverter.
2. AC/ DC breakers should be marked with the manufacturer model number, rated voltage, ampere rating and batch/serial number.
3. DC/ AC breakers rating should be approved from Engineer In-charge before installation at site.
4. To prevent solar panels from damage an appropriate size of DC Breaker/ Fuse should be installed for each PV string and Surge Protection should be installed for combined Array (before Main DC Breaker / Inverter).
5. DC Breaker, AC Breaker & Change overs should be placed in an enclosure. All Enclosures / Junction boxes should be made from Hot Dipped Galvanized Sheets of minimum 16 SWG.



1. cables shall be clearly labelled with essential electrical parameters including manufacturer name, Voltage Range, standards etc.
   1. All DC Wiring shall be aesthetically neat and clean, over all wiring/connection losses shall not

exceed 1% of the total rated output power.

1. All connections/ socket outlet among array, controller, inverters, batteries, and pumping set etc must be made in junction boxes of adequate protection level.
2. All wires/cables should be in standard flexible UV-Resistant conduits / HDPE of PN12, DR 13.6, PEl00 for outdoor installation & (2-3 feet deep) for underground wiring / cabling an PVG,,ducts for indoor installation. ***f"'.***
3. The DC Combiner Junction Box should be properly earthed including earthing of door fs y,iell.
4. The DC Combiner should contain proper bus bars of adequate size each for Po xe, tre°gative and Earthing. ,
5. The Inverter Junction Box should be properly earthed as well as per vetted destgn of the Engineer in charge.
6. All wiring should be in proper conduit of capping casing. Wire should- ot.be°"hanging loose.
7. All wires should be terminated properly by using lugs/ thimble connectors/ sleeves.
8. Distribution board must be installed with proper screws. ..;
9. Electrical Hazards Safety Labels should be pasted on DC'"°cbmbiner /VFD Enclosure / Charge Controller /Battery Enclosures.
10. Following lab tests are mandatory.

Conductor resistance test, Insulation resistance.test, Pressure test, Spark test.

1. DC Cable from PV Module to Junction Bo)v / Inverter for each string should be minimum size 6 mm2•
2. DC Cable sizing (For Pumping Schemes) from Junction Box to Inverter as per details below;

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No | Nos of Strinqs - | | | Cable Size ((mm2) | Remarks |
| 1 | 1 | | | 6 | If Cable length is  >200 ft (One Sided) than cable size should also be increased  accordingly. |
| 2 |  | 2 | **'-\_j** | 10 |
| 3 | 3 | | | 16 |
| 4 | * 4-5 | | | 25 |
| 5 | **t,,,.,\_** | 6-8 |  | 35 |

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1. **PANEL MOUNTING & STRUCTURE:**
2. The panel mounting and structure should be made of hot dipped (80 microns Average) galvanized steel of minimum thickness of **12 SWG / 2.64 mm Channel / Pipe or 8 SWG**

/ **4.06 mm Angle** (Profile of channel and Sketch Attached for Reference).

1. 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.

C. PV to ground clearance must not be less than 1.5 feet. The height *of* the upper edge *of* the structure should not exceed 10 feet above the ground and 6 Feet for Roof Top Installations.

1. 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.
2. The pit size for concrete works should be minimum 1.Sxl.5x2 feet for each individual leg or

1.Sx2.Sx2 for double leg and the concrete should be extended at least 1 foot above the ground. The concrete ratio should be 1:2:4.

1. The Surface azimuth angle of PV Module 180° and the Tilt angle (slope) *of* PV Module should

be 33°.

1. 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.
2. Due to land Non-availability or any other problem, Structure design can be modified as per site requirement. Pole Mounted or manual Tracker Structure can be provided with the approval of Engineer In-charge.
3. Array fasteners (nut/bolts/washers) between PV Module and Structure shall be stainless steel. Washers should be installed on both sides of Module frame.
4. The minimum space between two PV Modules should be 2.54 cm (1 inch), to avoid air push over PV Modules.
5. Mechanism / arrangement for cleaning of PV Panels should be provided. i.e(Space and

ladder between panels or at the back side of structure, so that the operator ca afely climb and clean the panels.

* 1. All other array fasteners Structure shall be stainless steel or galvanized st lthat provides the

required mechanical strength. '

m. The PV modules will be mounted on metallic structures at the in er, es for cantilevered installation, which will evenly distribute the load of the panel arQtiQ.\_d the support structure on

both sides and in the middle. **t"'\** , "

1. EARTHING/ GROUNDING:
2. The PV Panel frame and structure should be connected by the shortest practical route to an adequate earth contact (of Less than 5 Ohms Resfstance) as per requirement of equipment manufacturer and site earth conditions, using an uninterrupted conductor. Grounding can reduce the risks of damage from lightning-induced surges.
3. The Sizing of Earthing conductor will be done as per NEC Table 250.122
4. The grounding conductor should be 99% Copper and PVC insulated / Bare Copper if installed underground along a defined path where size & Design shall be approved from Engineer In- charge before installation at site. '-
5. Motor, inverter, Battery / Batt ;}:Box (if required), Main Distribution Board should be connected to an adequate earth contact / Grounding.
6. Ground enhancement material (GEM) shall be used below and above the Earthing plate for proper grounding. Gravel or coarse sand shall be pour along with soil in the pit.
7. Grounding / Earthing plate should be made of Copper plate of 4mm thickness & Size minimum 1.0 x 1.0 Ft.
8. Grounding / Earthing conductor should be connected to the plate / Rode / GI Pipe by proper connector of minimum depth of 6 feet.
9. Alternatively Earthing Rod of suitable size and length can be installed. (Instead of Plate). If given / mentioned in the BOQ/Design and Engineer In-Charge Approval.
10. All nut / bolt and Earthing clamp shall be stainless steel or galvanized steel.
11. BATTERIES:

**c.....:**

1. The battery should be Deep Cycle, GEL, OPzV/OPzS, Lithium LiFePO4, Lead Carbon Type or equivalent. (Note: Battery type shall be specified in the bidding documents.)
2. The battery must ensure safe and reliable operation in the whole range of ambient temperatures from -5° C to + 50° C.
3. The maximum permissible self-discharge rate should not be more than 5 percent of rated capacity per month at 25° C.
4. The battery shall have a certificate of compliances, issued by a recognized laboratory.
5. The Batteries should have three years Comprehensive replacement warranty.
6. The battery shall meet the requirements and recommendations given in IEC 61427, IEC 60896 21/22 (For VRLA) or equivalent. Lab Test Reports for battery cycle life should be provided.

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1. The Battery must support parallel connection to increase capacity in case of future expansion. Each Battery should have following minimum information printed on battery:
   * Model Number, Serial Number and Type of battery.
   * Rated Voltage and Capacity (AH) at discharge rate of 10 Hours.
   * Origin of made.
   * Manufacturer Name with distinct logo.
2. The following information must be provided in the data sheet while submitting technical bid.
   * Certification/Test Standard(s) of the battery.
   * Information regarding cycles & self-discharge rate. ""-
3. In case of rechargeable battery bank (having more than one battery), the intercon('ectidnrshall be made using lead plated copper bus bars or properly insulated flexible copper co ducto .
4. Battery disconnect switch / breaker of suitable size should be installed be en batteries and inverter/ charge controller. , "-
5. The Battery must have Low self-discharge rate, No memory effect and No gassing.
   1. GEL BATTERIES: 
      1. Cycle life of the GEL battery (12V) before 80% capacity of Initial Capacity must be minimum **1000** cycles@ 50% depth of discharge (DOD) at discharge rate of 10 Hours
      2. Cycle life of the GEL battery (2V Cell) before 80% capatity of Initial Capacity must be minimum **1300** cycles@ 50% depth of discharg-e'"(DOD) at discharge rate of 10 Hours

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* 1. LEAD CARBON:
     1. Cycle life of the Lead Carbon batte!)'c{l2VJ before 80% capacity of Initial Capacity must be minimum **2000** cycles @ soo;o,d¥°t,!lbf discharge (DOD) at discharge rate of 10 Hours.
     2. Cycle life of the Lead Carbon -battery (2V) before 80% capacity of Initial Capacity must be minimum **2500** cycles @"150% depth of discharge (DOD) at discharge rate of 10 Hours.
  2. OPzV / OPzS BATTERIES:
     1. Cycle life of the OPzV / OPzS battery (12V) before 80% capacity of Initial Capacity must be minimum **2000** cycles @ 50% depth of discharge (DOD) at discharge rate of 10 Hours
     2. Cycle life of the OPzV / OPzS battery (2V Cell) before 80% capacity of Initial Capacity must,be minimum **2500** cycles@ 50% depth of discharge (DOD) at discharge rate of 10 Hours
  3. � LITHIUM BATTERIES (LiFeP04);

**5.\_4.1** Cycle life of the Lithium LiFePO4 battery before 80% capacity of Initial Capacity must be "' minimum **5750** cycles@ 50% depth of discharge (DOD) at discharge rate of 10 Hours.

**�.4.2** The battery must have Integrated Battery Management System (BMS) to ensure battery safety and reliability.

* + 1. The BMS of the battery must have the following specifications:
       - Temperature protection
       - Over charge protection
       - Low voltage disconnect
       - High Voltage Disconnect
       - Short circuit alarm function
       - Self-balancing function
    2. The LiFePO4 Battery must have LED status and alarm indication.



* + 1. The charge and discharge rate of the battery must be designed at 0.2C minimum but capable of handling 0.5C charge and discharge currents.

**Note:**

* **Product brochure, catalogue and certificates must be attached with the Technical Bid.**

1. BOX/ STAND FOR BATTERIES, SHS-INVERTER & CHARGE CONTROLLER:
2. The batteries should be housed in a vented compartment/stand that prevents users from coming in contact with battery terminals. This compartment/stand should be strong enough to accommodate the weight of the battery.
3. A mechanism to prevent opening and entry of the battery should be provided. ,\ "(
4. This compartment should be manufactured of mild steel of at least **18 SWG.** •
5. The compartment should be powder coated paint.
6. The entire enclosure/stand must be constructed to last at least twenty )ears without maintenance and should be protected against corrosion. The enclosure shoulo. have a clean and neat appearance. Battery Box /stand should be installed at a plc!ce iQ accordance with user's preference "-.:
7. LED FLOOD LIGHTS: 
8. Solar Based LEDs/Light fixtures shall conform to the latest IEC:/1SO internationally recognized standards. "
9. LEDs/Light fixtures should not be Chip-on-board (COB) Single'thip type due to their poor heat dissipation.
10. LEDs/Light fixtures shall be modular type with proper heat sinks.
11. Solar based lights (LED fixtures etc) should provicle at least 100 Lumen/watt.
12. The Color rendering Index (CRI) must be equi orgreater than 70
13. LEDs/Light fixtures should be designed to deliver at least 10 years of service.
14. Complete lightening unit shall be weather.proof (Protection Class IP65).

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1. The output from the LEDs/Light fixtures should be constant throughout the duty cycle.
2. AC ENERGY EFFICIENT LED LIGHT BULBS:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Shap e** | **Cap/Fittin g/Base Type** | **Colou r** | **Lumen s Per Watt** | **Colour Temperatur e** | **Colour renderin gindex**  **(CRI)** | **Life Time of Lamp (Hours)** | **Power Factor** & **Rated**  **Voltage** |
| Globe | E27  "-.... | Cool or Warm  White | Min 100W | 2700K /  6500K | 70 | 10,000 | :::: 0.70  & 220 Vac |

**Note:**

* LED Light Bulbs should be marked with the manufacturer model number, rated voltage, Wattage.

1. AC ENERGY EFFICIENT CEILING FANS:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sweep** | | **Rated**  **Power** | **Speed** |  | |  |
| Inches | MM | Watts | Rpm |  |  |  |
| 56 | 1400 | 50 Max | :::: 320 |  |  |  |

1. 10% + in Power Consumption is Allowed as per PSQCA Standard
2. Rated Voltage: 230 V~ (±lOV)
3. Rated frequency: 50 Hz
4. Insulation Class: 155 (f) or better
5. Motor Core: Electrical Steel Sheet
6. Winding Wire: 99.99% Super Enamelled Copper CA Wire or 99.99% Pure Copper Wire.

**Note:**

* Energy efficient fan should be marked with the manufacturer model number, rated voltage, and wattage.

1. DC ENERGY EFFICIENT LED LIGHT BULBS:
2. The LED lamps must have luminous efficacy of at least 80 lm/W (at 25 °C ambient temperature). ( ... ·
3. The LED lamp must be protected against reversed polarity of the operation voltage,,
4. Base shall be an E-27 thread type.
5. The emitted light shall be cool or warm white. "
6. The wide angle shall be between 120° to 125°. (

**V**

1. Operating Voltage 12Vdc / 24Vdc
2. Lamps should be marked with the manufacturer model numb ed voltage, wattage and date of manufacture or batch number. ··

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1. **DC CEILING FANS:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sweep** | **Rated Power** | **Speed** | **Service Value** | **Operating Voltage** |
| Inches | Watts |  | Air Delivery/W | V |
| 48 ((with Speed Control)  Metal Blades | **30-36** "• | ***l***.. > =320  RPM | 9.54 | 12 / 24 |

**12, DC PEDISTAL FANS: **

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sweep** | **Rated Power** | **Speed** | **Service Value** | **Operating Voltage** |
| Inches | Watts | Rpm | Air Delivery/W | V |
| 18 Inch (with Speed Contr:ol) | 18-30 W | 1250 RPM  (full Speed) | 5.22 | 12 / 24 |

1. **INVERTER BASED SPLIT AC**

Inverter based AC with both heatinq and coolinq ootion.

|  |  |  |  |
| --- | --- | --- | --- |
| **s.No** | **DESCRIPTION** | **UNIT** | **DETAILS** |
| 1 | Compressor | Type | Multistage Rotary |
| 2 | Noise Level (Indoor) | Db (Max) | 50 |
| 3 | Voltaqe Ranqe | Volts (Min & Max) | 180 to 250 Vac |

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**14.**

PVC CHANNEL DUCTS & PIPES

* 1. A product of good quality standard material standardized by the provincial standardization committee with suitable size to be provided / used, as per direction/approval of Engineer In­ charge.



* 1. Ducting must be done with proper steel nails and clips.
  2. All ducting (wiring) must be align.

1. FLEXIBLE PVC PIPE
   1. The flexible PVC pipe should be of good quality material standardized by the provincial standardization committee with suitable size to be provided/ used, as per direction/approval of Engineer In-charge.
2. CIVIL WORK:

The following Civil Works should be carried out for ground Modules/mounting structures.

* 1. Minor Cutting and clearing of trees/plantation to avoid shadows.
  2. Civil work for earthing system as per the statutory requirements.

1. REFLECTIVE / INSULATING PAINT

installation of SPV

The Roof Paint should be ultra-white, high reflective,100% acrylic elastomeric roo.f sealer designed for fixing leaks in roofs the paint should contain heat reflective pigments and, at!dit1\l s that provide an excellent, highly protective barrier which reflects the sun's heat and destrOcti e UV rays leaves



a brilliant ultra-white finish, reducing surface heat absorption up 20°F. *1*

The Reflective paint should comply with ASTM D6083, Fiber Reinforced for more protection,

strength and durability which allows for contraction and expansion, esists surface fungal growth.

1. WARRANTY /AFTER SALE SERVICE:

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Three years Comprehensive Free Replacement, Repair and·maintenance Warranty at site (Free of Cost) should be provided for all the components of,Sola(°System. (if not mentioned separately otherwise).

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B - SPECIFICATIONS FOR SOl.;A�PUMPING SYSTEMS

1. **PUMP (SUBERSIBLE): **

Pump should be supplied having st ndard 1SO-9906 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 standard. The pump should be suitable for installation and operation in tube wells/dug wells/open well with clear water discharge. Pump shall comprise of 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 steer xagonal sleeves. Suction casing must be between pump and motor with suction strainer as protection of pump against coarse impurities of the liquid handled.

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 / 316. |
| **2** | Impellers | Stainless steel AISI 304 / 316. |
| **3** | Driving Shaft | Stainless steel 304/420 / 316 |
| **4** | Sleeves | Stainless steel AISI 329/ 304 / 316 |
| **5** | Gaskets | Rubber Gaskets |
| **6** | Bearings | AISI 329 stainless steel |

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|  |  |  |
| --- | --- | --- |
| **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 PN16 (16 Bar) or Above (As Per Site Requirements) PN Value / Bar Capacity of Valves must be more than Installed Pump Max/Shut-off Head Minus Static Water Level of Bore.  (Leakages in Valves are NOT Acceptable). |
| **9** | Pressure Gauge | As per British standard specifications (BSS), having PSI or Bar ()  scale ( 4 Inch Size), Liquid Filled, minimum 350 PSI Range, '\ Looped Siphon tube Pipe, Stainless Steel/polypropylene Qising¼ "r |
| **10** | Clamps | Steel - Pressed |
| **11** | Pump Efficiency | **Minimum efficiency of the pump (For discharge3000 GPH and more) should be 70% ensured 'at duty point. (Duty Point of the Pump be preferably selected at the peak efficiency point or (Within ±10% of discharge) of**  **Pump Peak efficiency Point)** = - - - |

1. MOTOR:



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The winding material should be 99.99% copper. The mo..t.o.. r: should have wet type, water cool rewind-able/repairable stator. The motor should have-non-aisposable/non-hermetically sealed



winding. The insulation class of the winding material stiould 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 pro¥idelat, the time of pre-supply testing. The testing report with all basic parameters should als be provided at the time of pre-supply testing.

The motor shall be manufactured in comRliance with National Electrical Manufacturer Association (NEMA) standards. The motor shall b thr}e-phase submersible and shall be capable of operating at rated voltage of 380 Volts at SO'Hz.. 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

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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 40°C. 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 AISl.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 in open well / water tank should be installed with cooling jacket / shroud / sleeve and when motor is installed in bore then installing of cooling jacket is also required. Motor shall be capable of maximum of 20 starts in an hour. Motor efficiency of motors 7.5 HP and above should not be less than 75% at Full Load and 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 and the winding insulation should  be suitable for > 1000 Volts 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 th  high grade copper bars. M800 or M600 magnetic are- preferable to use. , | | | | | |
| 4. | Spline Shalt | | AISI 420 stainless steel, flange dimension acc ding tiYNEMA  standard, over size design to ensure stiffness ii) sey.grs c-ondition. | | | | | |
| 5. | Shalt bearing | | Water lubricated guide/general bearings fix$ !per and lower brackets should be made of metal impregne\_t , r on. | | | | | |
| 6. | Lower  bearing | thrust | Thrust sliding block bearings, self-aliQDing tcnell type, should be  able withstand **20000N** axial load , | | | | | |
| 7. | Mechanical (Stationary Rotary | Seal  & | Silicon carbide or tungsten car\_bide mechanical seal. | | | | | |
| 8. | Cooling filling fluid | | Water mixed with non toxic anti-freeze provide cooling and  lubrication also protect and prevent inside parts from corrosion. | | | | | |
| 9. | Degree  protection | of | IP68  *I* ... '' | | | | | |
| 10. | Insulation Class | | Insulation Class B ( 130°C) NEMA Insulation Class F (155°C) **NEMA**  Preference.. | or | above | Will | be | given |
| 11. | Voltage Tolerance | | +6% to 0% | | | | | |
| 12. | Mounting position | | capable of both Vertical or horizontal Installation | | | | | |
| 13. | Class | .,.. | IC40 | | | | | |
| 14. | Maximum "  Immersion | | 150 Meters | | | | | |
| 15. | Starting per hour | | 20 | | | | | |

##### SUBMERSIBLE FLATE ELECTRIC CABLE (4-Core):

The Suomersible cable (4-Core) 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. Cable size should be selected so that the Voltage drop Losses in the drop cable should not be more than 2.5%.

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.



1. COLUMN PIPE:

The column pipe shall be flanged ERW steel pipes confirming to ASTM designation A-53 with a minimum thickness of **3.6 / 4.0 mm (3.6 mm for pipes upto 2.5" dia and 4 mm for pipes above 2.5" dia)** and shall be painted with corrosion resistance paint of suitable thickness. Flanges

thickness of 19-20 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. ( ..., .., Column pipe size should be selected so that the Head Losses in the column pipe,s ould not be more than 5%. ,(. '-..,

For Reference a table-1 is given below. \.. "-

HOPE Pipe of 0.75 Inch diameter, SDR 13.6, PElO0, conforming to :A.STM, F-2160 Standard without Joints to be installed/included along with and equal to Column for confirming Water Level testing purpose.

**FEATURES:** , ..

* Manufacturer's pipes should meet international standards like BSEN 10255 & ASTMA 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)

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* Pipes should be hydrostatically pressure as per manufacturing standard.
* Pipes should be gone through straight'ening process to remove bendiness.

1. TOPSET:

Top set shall comprise of Bore covers plate, (covering bore hole completely and securely), installation/suspension clamps (2-Nos), sluice valve (BSS/ASTM), reflex valve (BSS/ASTM), Washout Valve approx. 3-4 feet above the ground CT-Connection For Testing Pump's discharge), connector and cable jointing material (Cable connection from motor to switching device shall be joint free), Liquid Filled Pressure gauge minimum 4 Inch diameter suitable / appropriate for the required head pressure and cable ties. Bore Cover Plate should have provision for water level testing facility {r:e; Hole for Sonic Water Level Meter/ HOPE Pipe insertion)

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

E\"l r:y. W>ater Supply Scheme should have a non-removable name plate fitted at suitable place / box having essential information and bearing the name of supplier, Consultant and client.

1. SOLAR PUMP INVERTER / CONTROLLER:
   1. The solar pump inverter/controller should have built-in advance version of Auto MPPT controller, over load protection, Soft start/Soft Stop Features and Variable Frequency Drive (VFD) with integrated Gate Bipolar Transistors (IGBTs) of European, USA or Japanese origin or atleast equivalent.
   2. The make and origin of the inverter/controller should be clearly mentioned in the catalog and submitted in the technical proposal.
   3. The inverter offered should comply to or Equivalent standards:
      1. CE/RoHS



* + 1. Low Voltage Directive 2014/35/EU
    2. EMC Directive 2014/30/EU
    3. IEC 62109-1 (Safety of Power Converters for use in PV Systems)
  1. The complete datasheet showing all the electrical parameters like input & output voltage ranges should be provided in the technical bid.
  2. All the electrical parameters like input & output voltage ranges, and efficiency should be provided at the time of pre-supply testing and inspection.
  3. Effic ency of inverter should be 96% and above at Rated Capacity. ,
  4. Efficiency of MPPT should be 98% and above.
  5. The inverter < 25kW ingress protection of inverter must be minimum IP 65 Ratingcc0 abov and for inverter 25kW ingress protection of inverter / enclosure **will** be minimum IR Rating or above.
  6. Inverter / Controller having the capability to run both on AC and DC Po er would be given preference. ..
  7. Inverter should have at least three (3) years product and performance **Wartf!tll:y.**
  8. The Pump Controller/Inverter should have an ON/OFF Switch/Butt Start and Stop the Pump.

I. Inverter should have active RS232/485 etc communication port available, the Data available through this port can be used for Remote Monitoring.

1. Inverter circuit must include protection against: , '°"-
   1. Over or Low voltages and currents beyond critical leve f,the inverters circuits.
   2. Protection against accidental short circuits & reverse polarity connections.
   3. Protection against lightning induced transients.
   4. Over load protection. '
   5. Low RPM Protection (i.e: Frequency < 30 Hz or as per pump characteristic curve) Motor Should Stop.
   6. Dry run protection. (PF/ Current Based).
2. **dV/dT or Sine FilteWith Inverter (VFD):**
   1. The use of loadxeactors increases the reliability, performance, and efficiency of VFD systems, extends tl)e life of both drives and motors, and reduces the amount of energy consumed by the motor/drive system.
   2. Output dV/dT or Sine Filters (between VFD and Motor) of appropriate size (for 3-phase

380Vac Motor of Class B Insulation) should be used where the cable length between mot0r and inverter is more than Fifty (50) Feet or as advised / recommended by the

***r-.*** inverter manufacturer in their Technical Documentation. For Cable lengths of more than

' 150 meters sine filters should be used.

* 1. Filter should be enclosed in a vented box.
  2. Filter Efficiency should be minimum 97%.
  3. Filter should have a current rating of equal or greater than Motor FLA Rated Current.
  4. Distance between filter and pumping inverter should not be more than 2 meters.
  5. Motors with Insulation Class F, H or above are exempted from the requirement of dV/dT Filter.

1. SYSTEM DESIGN FOR PUMPING SYSTEM:
   1. Suitable factor of safety should be applied while designing the system in order to have compensations for variations in irradiations.
   2. For Fix Structure and Auto Tracker, the PV panel **peak power at STC (Wp) should be 75%**

**more** than the Motor basic input power **(PV Loss Compensation Factor= 1.75).**

* 1. For Auto /Manual Tracker, the PV panel **peak power at STC (Wp) should be 50% more** than the Motor basic input power **(PV Loss Compensation Factor = 1.5)** as per direction of Engineer Incharge
  2. If Single Axis Auto Tracker Structure is installed on the above factor, then daily operational timings of pumping can be increased by 10-20%, as compared to fixed structure installation.
  3. Total PV Power (Wp) (Imperial Gallons) = 0 **{iGPH}** \* TDH (ft)\* 746 \* PV Loss Factor

60 \* **3300** \* llpump \* llmotor

* 1. Total PV Power (Wp) (US-Gallons)= 0 **{US-GPH)** \* TDH (ft)\* 746 \* PV Loss Factor

60 \* **3960** \* llpump \* llmotor

* 1. Total PV Power (Wp) (Metric Units) = O **{m3 /hr}** \* TDH (m} \* 9.81 \*1000 Jltpv toss Factor

3600• n,..,• n "' ,

* 1. Voltage (Vmp) of Each String of PV Panels should be as per detaj!\_s en below and String Voltage (Vmp) should be within the MPPT range of Inverter. , '
  2. For 380 Vac 3-Phase Motor= 380 \* 1.414 \* 1.06 = 57!fVclc String, minimum

1. For 220 Vac 3-Phase Motor= 220 \* 1.414 = 310 Vdc String.
2. Small Inverters (i.e: 3-Phase, 220 Vac) with voltage boost function are exempted from the above string voltage requirements. String can made as per boost Inverter / Controller recommended String DC Voltage and should not be less than 230Vdc in any case.
3. Details of each PV Panel string should be submitted in Technical proposal (i.e: Nos of total strings and Nos of PV panels in each stdng along with wattage and Vmp of each PV panel).
4. Unjustified Oversizing in PV Panels Wattage is not allowed.
5. To avoid any oversizing, all commercially available PV Panels should be considered.
   1. Solar Pump Inverter should have a kW capacity equal or greater than the Motor Rated Input Power.
6. Solar Pump Inverter/ Con\_troller Size (kW) (Motor Rated Power in kW / Motor Efficiency).
7. Solar Pump Inverter / Controller should have a current rating of 1.15 limes (minimum) of Motor FLA Rated Currel)t.
8. Motor should *not* be loaded more than 90%. (i.e: Design / Calculated BHP should not be more

than 90% of Motor Rated Horse Power)

1. Along with th1s specification, contractors should also follow manufacturer's recommendations for a majqr components of Solar Pumping System.
2. Requirement of Efficiency for Motor i.e. 75% will not apply on Motors smaller than or equal to S.SHP and the requirement of efficiency for pump i.e. 70% will not apply on pumps having discharge equal to or lower than 3000 GPH.

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PRESSURE PUMPS (UPTO 5.5 HP}:

1. Submersible pump confirming to ISO-9906 Standard.



1. Pump + AC Motor (3-Phase-220V/380V) or DC Motor and Pump with Display Unit.
2. Solar pump inverter/controller should be MPPT based and Minimum Ingress Protection of IP65.
3. In case, where the column pipe diameter is less than or equal to 1.5-inch (For discharge equal or less than 6000 LPH and/or for Motor 4 HP and below), HDPE pipe of at least PN12 / SDR

13.6 / PE100 (For TDH of equal or less than 300 ft) without joint may be used instead of MS

pipe for better economics and to avoid hydraulic losses. However stainless steel rope of minimum diameter of 6 mm (28 mm2) for suspension of pump-set must be supplied with HDPE

pipe. (Note: For TDH of more than 300 ft, HDPE Pipe type / thickness may be increased/changed accordingly)

1. Top set shall comprise of Suitable Galvanized stand (Design should be verified from Engineer In-Charge before start of work)
2. For Pressure Pumps 5.5 HP schemes, Solar Module efficiency requirement is minimum 16%. (Only for Cut Cells PV Modules or Cell Size of 5 Inches PV Modules).
3. Connection to overhead water storage tank. Top bend, S.S Fasteners & Erection clamps.
4. Civil work to protect borehole i/e foundation.
5. The pump should operate safely with Sand particles up to (50) gram/m3• <• ,\
6. DCSOLAR WATER PUMP-SETS (UPTO 5.5 HP) ,,,..,\_
   1. DC Motor can also be provided for Equal or less than 5.5 HP. · '-"-
   2. Motor should be capable of both AC and DC operation. There must be **a'Oto** e source

recognition feature.

* 1. The motor should be brushless, permanent magnet type.

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* 1. The Controller must have a display Unit, showing all essential parameters (j.e: Current, Voltage etc).



* 1. The Controller must be of MPPT type. MPPT efficiency should be al ormore than 98%
  2. Pump should have auto and soft start/ stop feature. -, \_ ...,,.

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* 1. The pump-set should have following protections
     1. Dry Running Protection ,..
     2. Reverse Polarity Protection \::)
     3. Over phase protection (.,.""

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* + 1. Over Head Protection
    2. Lose Phase Protection "-.\_ "-
    3. Electronic Protection *:* .'-..
    4. Over Current/ Overload ProtectiOQ,.\,'

1. SOLAR AUTO TRACKER; J
   1. 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.
   2. Individual Auto-Tracker should be 4 kW each and Tracking Accuracy should be within ± 5°.
   3. 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).
   4. All11uts1 bolts, washers and other fasteners for mounting structure shall be made of minimum A2 grace stainless steel.
   5. Foundation and other details will be separately provided.
   6. Three years Comprehensive Free Replacement, Repair and maintenance Warranty (Free of

* Cost) should be provided for all the components of auto Tracker (including Batteries).

1. PV MOUNTING FRAME WITH MANUAL TRAKERING :

Suitable for 2.5 or 3.5 KW PV Panels easily movable in multi directions having flanges with bearing balls ½" and having angle adjustment. Base steel cage ¾", MS rod 3.5 feet length with nut-bolts system for strong anchoring. Pillar pipe 6 mm with 5.5" dia, base plate 15"x15"xl/2" size with 04 numbers of supports. Support for PV, 5 mm thickness 4" dia pipe and 24"xl2"x 1/4" side plates. MS Angle side bracing 2"x 2" x ¼". MS Angle frame 2"x 2" x ¼" for panel mounting. Steel structures/frames shall be powder coated. Galvanized nuts, bolts and washers for tracker fitting.



Steel frame shall be properly designed and shall withstand wind speed/load of at least 130 km/hr and tough weather condition.

1. PRE-SUPPLY TESTING & INSPECTION:

The firm applying for the tender has to provide the recent test bed reports from the pump/motor manufacturer or any other third party as per ISO-9906 standard. Each of the offered pump set models must undergo these test prior to supply and installation, In order to ensure the quality and standard of the equipment contractor may be asked to provide test result conducted by third party for re-verification.

1. OPERATION AND MAINTENANCE MANUAL:

An Operation and Maintenance Manual, in English and Urdu language, should be:,,r red and provided by the contractor with the solar PV pumping system. The Manual sho d ha\ formation about solar energy, photovoltaic, modules, DC/AC motor pump set, tracking s tem (if any), mounting structures, electronics and switches. It should also have clea nstructions about mounting of PV module, DO's and DONT's and on regular maintena e and Trouble Shooting of the pumping system. Name and address of the person or Centre t contacted incase of failure or complaint should also be provided.

**c- SPECIFICATIONS FOR SOLAR HOMES & BUILDING SVSTEMS,**

1. **GRID TIE INVERTER (ON'-Grid withoubt attery backup / Hybrid with battery backup)**
2. UL-1741 Certified or IEC 62109-1 and IEC ?}109-2 or Equivalent Certificates.
3. Minimum 95% Conversion Efficiency at Rated Capacity (High Frequency Inverters).
4. Minimum 87% Efficiency for Transforme11 based inverters (Low frequency Inverters).
5. The inverter should have built-in MPPT controller
6. The Priority of the inverter should be set that load will be running from the solar energy then Grid and in the end will be running from the Battery Backup.
7. Inverter (Hybrid Only) must be capable of configuring for Charging GEL, Lead Carbon, OPzV/OPzS

Batteries and Lithium Iron Phosphate batteries (LiFePO4).

1. Hybrid Inverter (If Quoted along with Lithium Batteries) must be capable of communication with the BMS of Lithium Batteries.
2. Rated output voltage of inverter / Controller shall be pure sine wave AC.
3. Total harmbnic distortion (THD) in AC output should not exceed 3% at rated capacity.
4. The degree of protection of the ON-Grid inverter Installation should be IP-65 rated and for indoor Hybrid Inverter installation, the IP rating should be IP-20 or above.
5. Wide input voltage range capability. (i.e: Voltage Range can be adjustable/ selectable)
6. Natural convection cooling for maximum reliability
7. Outdoor enclosure for unrestricted use under any environmental conditions

( 1-4. Capability to connect external sensors for monitoring environmental conditions.

1. The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid.
2. The Inverter should have the capability of Parallel operation upto three units. (Only For projects, where more than one inverter should be installed).
3. Inverter should have active RS232/485 etc communication port, the Data available through this port can be used for Remote Monitoring.
4. Liquid crystal display should at least be provided on the inverters front panel or on separate data logging/display device to display following
   1. DC Input Voltage
   2. DC Input current
   3. AC Power output (kW)
   4. Current time and date
   5. Temperatures (C)
   6. Converter status
5. Inverter circuit must include protection against:

* Over or Low voltages and currents beyond critical level of the inverters circuits.
* Protection against accidental short circuits. ,\
* Protection against lightning induced transients. (
* Over load protection. *('\,\_*'.

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1. OFF-GRID / HYBRID INVERTER: ,(.\_
2. The Inverter must be pure sine wave output suitable for 220 Volt, SO Hz. ... "-.
3. Inverter must be capable of configuring for Charging GEL, Lead Carbon, Vf,QPzS Batteries and Lithium Iron Phosphate batteries (LiFePO4). ..'- ,'-'
4. The Inverter/ system must have a MPPT Solar Charge Controller. ',
5. Minimum 92% Conversion Efficiency at Rated Capacity (High Fre nverters).
6. Minimum 87% Efficiency for Transformer based inverters (Low frequency Inverters).
7. Total harmonic distortion (THD) in AC output should not ex....ce .3%' t rated capacity.

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1. The inverter must be user programmable for selecting Grid and Battery Priority as well as Built-

in programmed and user defined voltage and current settlngs of the charge controller for GEL, Lead Carbon, OPzV/OPzS batteries and Lithium Iron Phosphate batteries (LiFePO4).

1. The Inverter must have Protective function liJ11itsJor.
   1. AC under voltage protection '' "'
   2. AC over voltage protection "'\.,

'

* 1. Battery under voltage Alarm
  2. Low Voltage Disconnect
  3. High Voltage Disconnect
  4. Overload and Short Circuit Protection
  5. Over Temperature Protection

1. The inverter must be ISO 9001, ISO 14001 and CE Certified.
2. The inverter must have !EC 62109-1 and IEC 62109-2, or Equivalent Certificates.
3. The degree of protection of the outdoor inverter Installation should be IP-55 rated and for indoor Inverter installation, the IP rating should be IP-20 or above.
4. Wide inputvoltage range capability.
5. Inv er sh.\_ould have active RS232/485 etc communication port, the Data available through this po anbeused for Remote Monitoring.
6. In rter (If Quoted along with Lithium Batteries) must be capable of communication with the BMS

otBithium Batteries.

( **Note:**

* Product Brochure, Catalogue and certificates must be attached with the Technical Bid.

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D - SPECIFICATIONS FOR SOLAR STREET LIGHTS

1. **SOLAR STREET/ ROAD LIGHT SYSTEM DESIGN:**
   1. Assessment of Wattage of the LED Luminaire, Pole Height, Pole thickness, Pole top diameter, Pole base diameter, Base plate size, Base Plate thickness, Stiffener size, Stiffener thickness, Pole arm design, Pole Arm Length, Pole arm thickness, Pole arm diameter, Pole arm Placement / Fixing position, RCC foundation size, Anchor/ J-bolt size, Steel Rebars cage (Mesh) and Number of Poles (Pole to Pole distance) should be according to the design provided / approved by the Engineer"In-

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* 1. Round Conical or Octagonal Hot Dipped Galvanized Pole of average 80 Microns shou,ldn1taJled.
  2. All Nuts, Bolts and Washers should be stainless steel. "
  3. Pole base plate should be tightened in between two stainless steel nuts and was'.er ne nutand washer at upper and one nut and washer at lower side of the base plate). ,
  4. All Anchor / J-bolt shall be in level and align to each other. ...\_,,,

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* 1. All Anchor/ J-bolt shall be galvanized.
  2. All Anchor/ J-bolt shall have at least 150 mm minimum threads. ,
  3. All poles shall be installed on levelling nuts secured to the anchor bolts and with locking nuts on the top of the base flange.
  4. The concrete ratio should be 1:2:4 for RCC foundation. \_.
  5. Proper sketches of Pole, base plate, RCC Foundation\_and Steel Rebars cage (Mesh) should be provided and approved from Engineer In-charge. •,
  6. In order to focus on winter sun availability and -Easy cleaning of Solar panel from dust etc with Rain water, Solar Panels should be installed at 180°Azfmuth Angle and the Tilt angle (slope) of PV Module should be between 45° ±5° (Only for Solar Street Lights).

1. LED SOLAR ROAD/STREET LIGHT FIXTURE:
2. LED Efficacy must be greater than or equal to 130 LumensjWatt.
3. The fixture must be IP-66 Rated or above.
4. The Color temperature of the LED should be Pure white in the range of 5000-6000 K.
5. The LED Light distribution must be !ESNA Type-II
6. The LED must be suitable for working Temperature from -40 ~ + 60°C with relative humidity of 15% ~ 90%
7. The Color rendering Index (CRI) must be equal or greater than 70.
8. The LED Light Fixture must be LM79 and LM80 Tested.
9. LEDs/Light fixtures should not be Chip-on-board (COB) single chip type due to their poor heat dis tion'.
10. LEDs/Light fixtures shall be modular type with proper heat sinks.
11. i.fhe output from the LEDs/Light fixtures should be constant throughout the duty cycle
    * 11. LED Life should be greater or equal to than 50,000 Hours. (' "' 12. The LED Light Fixture must have the following certification:
      + ISO 9001
      + ISO 14001
      + CE (EMC and LVD) Certified or equivalent.
      + International standard Certifications

***Note: Product Brochure, catalogue and certificates must be attached with the Technical Bid***

1. SOLAR CHARGE CONTROLLER {FOR STREET/ ROAD LIGHTS):
   1. The charge controller must be suitable for the required battery voltage, auto voltage recognition feature and capable of charging OPzV & Lithium Ferrous Phosphate (LiFePO4) Batteries
   2. The charge controller must be IP-67 rated or above for outdoor installation
   3. The charge controller must be Remote Controlled for parameter setting. The system must have the following feature:

* *Remote Parameter Setting and Monitoring*
* *Remote control of the Lights (on/off, timer setting etc)* (\
  1. The charge controller must have MPPT Technology ,
  2. The charge controller must have at-least three stage Flexible dimming function (0-100°
  3. The Maximum power point tracking (MPPT) efficiency should be minimum 97%. ..
  4. It must have temperature compensation for charging batteries in higher tempe ature5"-'
  5. Charge controller must have the following protections:

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:'\,.

* PY Short circuit (



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* PV reverse polarity ....\_
* PV over voltage ...\_ '
* PV over current **<i.\_**

,<,'(;:--'

* Battery over charging

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* Battery over discharging

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* Battery reverse polarity protection
* Load short circuit '-".' .)
* Load overload protections
  1. It must have proper heat sink to dissipate excessive eat

'-.

* 1. The charge controller must have protection for·reverse flow of current through the PY modules
  2. Controller should have active port for GSM based communication for Remote Monitoring.

I. Mid Night based timing controller Vyill be preferred.

1. The Solar Charge controller must have the following certification:
   * ISO 9001
   * CE Certified

**Note: Product Brochure, catalogue & certificates must be attached with the Technical Bid**

1. **Battery and Controller Box:**
   1. The battery box should be made of Hot Dipped Galvanized Sheet of average 80 Microns.
   2. The battery box must have vented compartment having inverted louvers.
   3. For Pole Mounted batteries Battery boxes must be made of minimum 16 SWG sheet and must have proper locking arrangement for protection against theft.
   4. For underground battery installation, the battery box should be made of minimum 16 SWG sheet and should be properly sealed to ensure protection against water. Proper cable glands and packing material should be used to ensure water proofing of the box.
   5. The battery and Controller Box should be at least IP65 ingress protection.
2. **..Electric Cable:**

The specifications of Electric cables are as under:

* 1. Flexible copper cable of proper size along with MC-4 connectors (TUV Approved) from solar panel to charge controller and charge controller to battery as well as to light fixtures.
  2. The cables should be made of minimum 99.9% Pure copper cable

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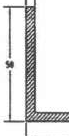
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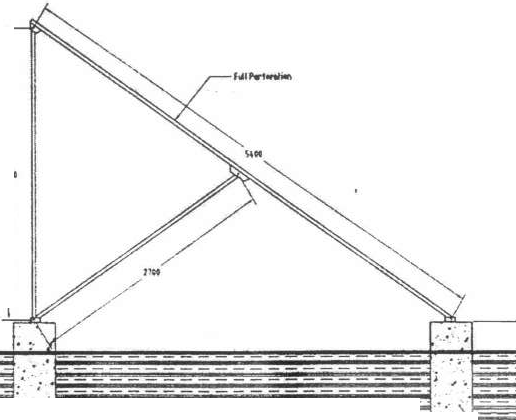
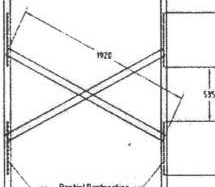
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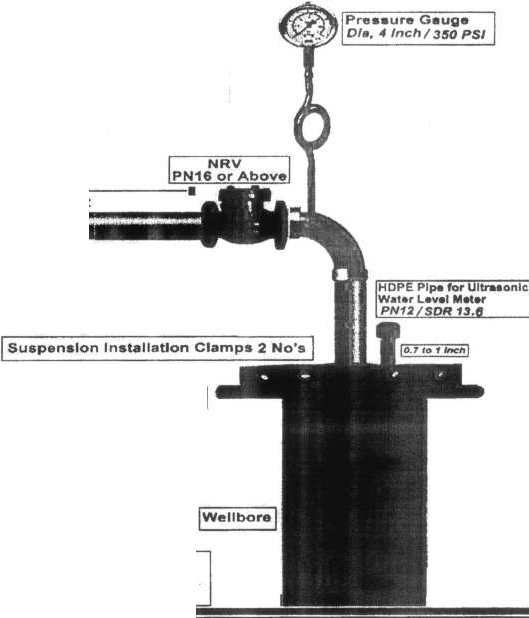
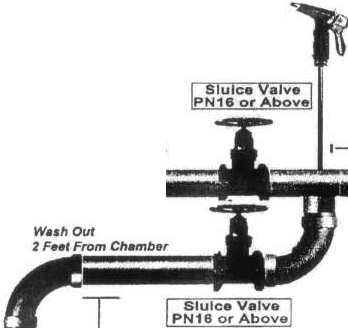
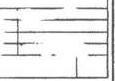
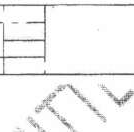
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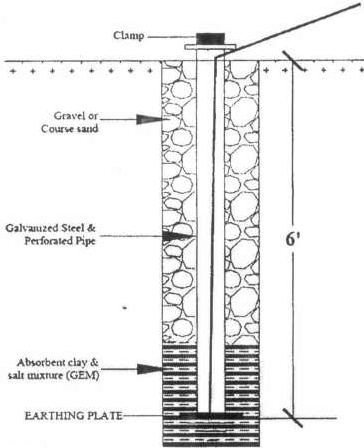
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**ANNEXURE-2** <EARTHING *I* GROUNDING DRAWING)

LAYOUT FOR EARTHING/ GROUNDING

01\0VNOCONDUCTOJ\ SIZE16MM"2

(Sl'fC:A$PU NECTABLE250.122)

C...CoofvmTo IEC42 1-7

**ANNEXURE-3** JOPSEJ LAYOUT:

I **Wuh** out for PV Modules I

*C<>nnectlon to T•nlt* 2 **feet**

IBore Cover Plate I

!3-4 **feet** from groundI

Page 21 of 25



ISTIUNG-1

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SINGLE LINE DIAGRAM FOR SotAR PUMPING SYSTEM

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CA.BU:SIZ.E

I PANELTO JB-6MM"2

mro1NVEJtro1t

CABLE SIZE,IF

i) I STRING - *6* MM"2

u) 2SI1UNGS •10MM"2

m) 3STIUNGS • 16 MM'-2

iv) 4-5 STIUNGS• 21MM"2

1. 6-&STIUNGS• 31 MM"2

NO'l'E:

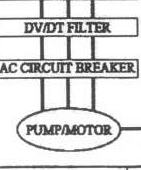
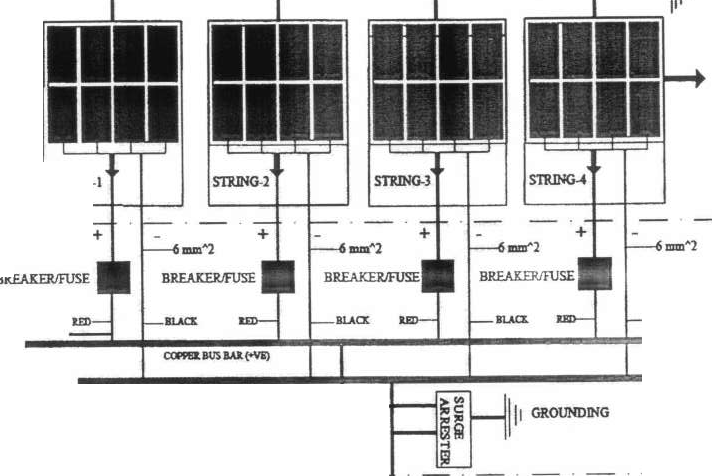
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* 1. I I LUG/SLEEVE

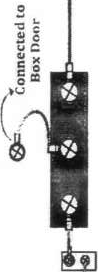
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## 31-1

COPPER BUS-BAR

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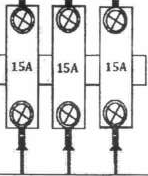
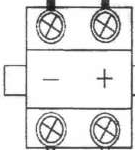
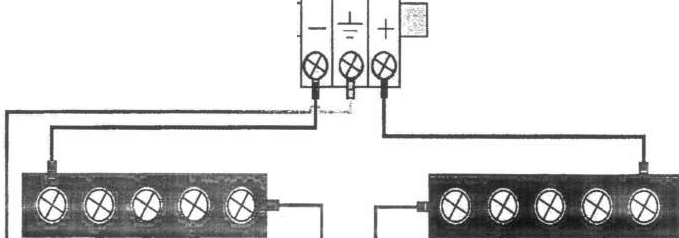
CABLE

CONNECTOR

EARTH PIT

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**NO.SO(B)/11-1 0!Solar Panels/PBC/2018-19IC&WD-Dated-30/01/2019**

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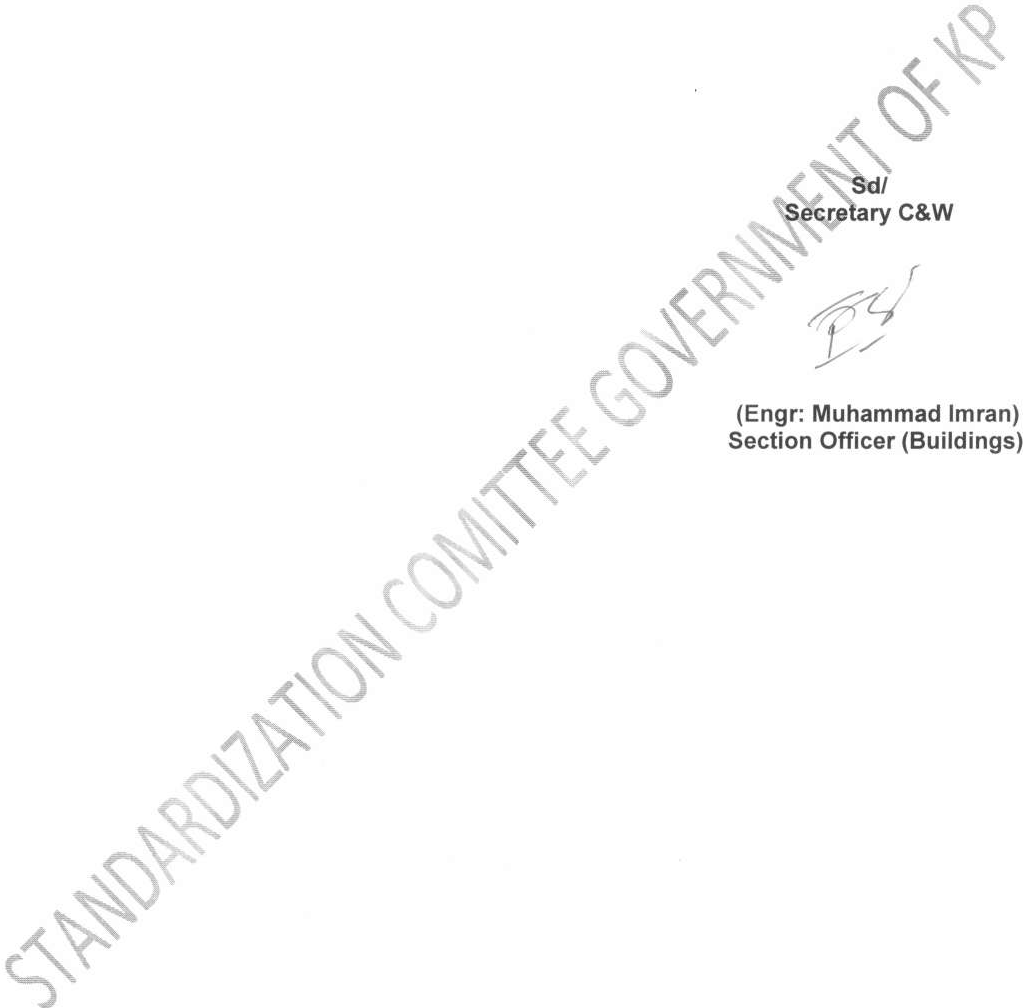
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