

PRE-QUALIFICATION DOCUMENT (PQD)

FOR

**PRE-QUALIFICATION OF FIRMS/ JOINT VENTURES AS
SUPPLY & SERVICE COMPANIES FOR INSTALLATION OF
SOLAR SYSTEMS FOR OPERATING HIGH EFFICIENCY
IRRIGATION SYSTEMS ON FARMER FIELDS**

UNDER

**PROMOTION OF HIGH VALUE AGRICULTURE THROUGH
PROVISION OF CLIMATE SMART TECHNOLOGY PACKAGE**



**DIRECTORATE GENERAL AGRICULTURE
(WATER MANAGEMENT) PUNJAB
21- DAVIS ROAD, LAHORE**

December, 2016

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1. INTRODUCTION

Agriculture is a crucial driver of economic development in Punjab. It contributes a quarter to Punjab' GDP and about half of total provincial manpower depends on agriculture for their livelihood. Punjab is country's agricultural and economic heartland that contributes to about 80 percent of country's food requirements. More than 70 percent cropped area of the Pakistan's Indus food machine is situated in the Punjab and over 90 percent of province's agricultural production comes from irrigated lands. About two third of the population residing in rural areas rely directly or indirectly on this sector for their livelihood.

Despite critical significance of irrigated agriculture to national as well as provincial development, it could not perform sustainably mainly due to lack of modernization of agricultural operations leading to colossal loss of precious inputs resulting in low productivity.

Government of the Punjab is committed to revamp the agriculture sector to utilize its full potential to drive prosperity in the province for wellbeing of the farmers. Punjab Growth Strategy (PGS), 2018 envisions making a secure, economically vibrant, industrialized and knowledge-based province, which is prosperous and where every citizen can expect to lead a fulfilling life. PGS also envisages to enhance growth in agriculture by facilitating productivity improvement, increasing competitiveness in agriculture marketing & trade by providing a conducive climate for private sector investment, improving supply chain and value addition.

The Chief Minister, Punjab has approved "Khadim-e-Punjab Kissan Package" to stimulate agricultural growth in the province. The CM Kissan Package comprises of several initiatives for facilitating small farmers to improve crop productivity and farm returns. "Promotion of High Value Agriculture through Provision of Climate Smart Technology Package" is one of such initiatives costing Rs.4.7 billion aimed at facilitating farmers to adopt high value agriculture. It envisages provision of 80% subsidy for installation of solar systems for operating high efficiency irrigation systems on 20,000 acres (installed under Punjab Irrigated-Agriculture Productivity

Improvement Project) and 50% subsidy for installation of tunnels on 3,000 acres for growing off-season vegetables.

2. PROJECT OBJECTIVES

The key objective of the project has been designed to maximize productivity of precious crop production inputs (water, fertilizer, energy etc.), besides enhancement in crop yields. The undertaking will have following key objectives.

- i) Enhance crop and water productivity through optimal use of water and non-water inputs by application of modern irrigated agriculture development technologies.
- ii) Support production of off-season vegetable through tunnel technology to meet the domestic demands and for export.
- iii) Promote use of renewable energy in agriculture for promoting irrigated agriculture in remote areas.
- iv) Build farmers' capability at grassroots level for growing high value crops to get higher farm returns for alleviating poverty.
- v) Create job opportunities in rural areas through introduction of climate smart technologies for high value irrigated agriculture.

The proposed project objectives are consistent with overall objectives of the agriculture sector for increasing farm productivity, ensuring food security, reducing cultivation costs, enhancing farm returns, economic uplift of small farmers, and improving agricultural economy of the country as a whole.

3. KEY PROJECT COMPONENTS

The technologies under the proposed project will result in productivity enhancement, efficient resource management, crop diversification, better quality produce and promotion of environment friendly free energy source. Major activities to be carried out under the proposed project would include, inter alia, the followings.

- a) Creation of awareness and mobilization of farmers to adopt Hi-Tech agriculture technologies for crop and water productivity enhancement.
- b) Provision of Solar Systems to the farmers for operating High Efficiency Irrigation Systems on **20,000** acres.
- c) Support farmers for installation of tunnels on **3,000** acres at HEIS installed farms for growing high value crops/ off season vegetables.



Figure-1: Climate Smart Technology Package

4. COST SHARING FOR PROVISION OF SOLAR SYSTEM

The government will provide **80 percent** of total solar system cost as subsidy and remaining **20 percent** will be borne by the participating farmers. This will encourage the farmers for adoption of this new intervention, which may result in greater demonstration effect for up-scaling the technology. The beneficiary farmers will also be responsible for operation and maintenance of installed systems.

5. PROVISION OF SOLAR SYSTEMS TO THE FARMERS ON HEIS SITES

Nature has blessed Pakistan with abundance of renewable energy resources, which have not been harnessed appropriately. Replacing or supplementing the conventional fuels for operating high efficiency irrigation system sites with solar energy seems workable option as sunlight is available for more than 300 days a year in Pakistan/ Punjab with about 8 hours effective daylight period. Most parts of the Punjab receive adequate solar radiation intensities over $5 \text{ Kw/m}^2/\text{day}$ (**Figure-2**). Its seasonal variations are also within acceptable limits. The arid/semi-arid climate of the Punjab, therefore, provides ideal conditions for adoption of solar energy for operating irrigation water pumps. Although solar is one of the renewable energy sources for pumping water but at the same time it has certain limitations in the form of high initial cost and non-availability of locally manufactured equipment.

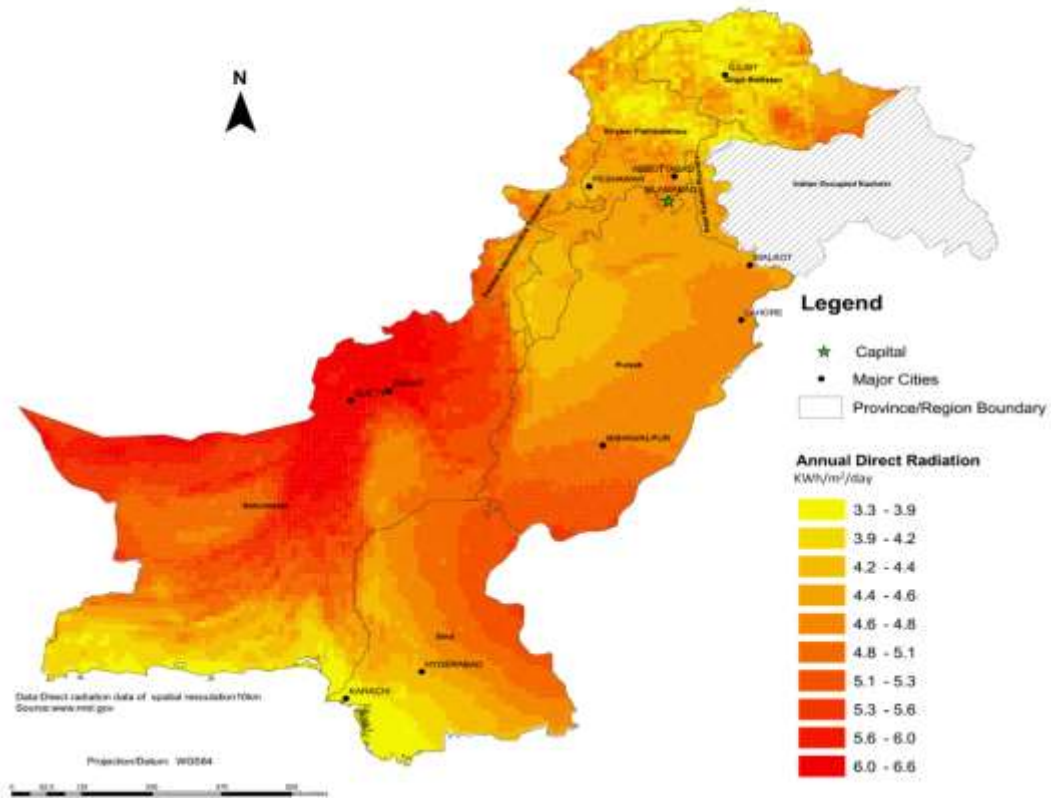


Figure-2: Prospects of Solar Radiation in Punjab

Presently, solar powered water pumps are globally restricted to applications where other energy sources are not feasible/available. The technology is advancing steadily, especially in the developing world like Asia and Africa. Its main uses have, however, been for drinking and small scale irrigation. The Indian government is subsidizing solar water pumping systems on a small scale for these purposes in few states like Rajasthan, Gujrat, and Haryana. Rajasthan government is currently providing subsidy for installation of solar tubewells in 16 districts for irrigating orchards & vegetables with drip system. Likewise, the government of Gujrat is subsidizing 500 solar water pumps to promote high-tech agriculture.

Similarly, in Pakistan, a few solar water pumps were installed by Thardeep Rural Development Program (TRDP) in Kasbo and Rarrkua villages of Nagarparkar district, which are being used to operate family drip systems for growing vegetables/fruits on 2-3 acres. Moreover, solar energy operated small size tubewells have been installed privately at few sites in Punjab for irrigation purposes. The Punjab Agriculture Department has also implemented a pilot scheme for testing of solar powered tubewells at nine (9) selected government farms. The above said

experiences have revealed that although solar water pumping system has high initial cost but it is:

- ◆ system having trouble free operation once installed
- ◆ a reliable option, especially for remote areas, and;
- ◆ more effective if used with drip irrigation.

Use of solar energy for pumping water offers many advantages as compared to traditional paraphernalia such as a diesel engine or electricity operated tubewells/pumps. Solar water pumping system will have following advantages, with albeit some limitations. The major impediment is the low energy output (wattage) available with present affordable systems.

Advantages	Limitations
<ul style="list-style-type: none">• Non-dependant on conventional energy (fuel and electricity)• Little maintenance• Easy to operate and maintain• Uninterrupted water supply for irrigation during day time• Potentially long panel life• Feasibility in remote areas• Environment friendly	<ul style="list-style-type: none">• High initial capital cost• Unfamiliar technology• Equipment economical for only low discharges• Actual economical life not yet established• Susceptible to theft and vandalism

It has, accordingly, been planned to install solar systems at suitable / selected HEIS sites for operating the HEIS to lift water from water storage ponds filled with canal/ groundwater and irrigating the crops with HEIS. Site specific direct coupling with groundwater and gravity systems may also be allowed in special circumstances. These arrangements will help to ensure timely availability of irrigation water for crops, particularly at their critical stages through uninterrupted water supply from solar units. It is indicated that subsidized standard solar system would have the capacity to irrigate upto 15 acres HEIS site by managing its irrigation frequency. The area under solar system would, therefore, be considered equal to HEIS acreage for reporting purpose. The concept has been illustrated in **Figure-3 and 4**.

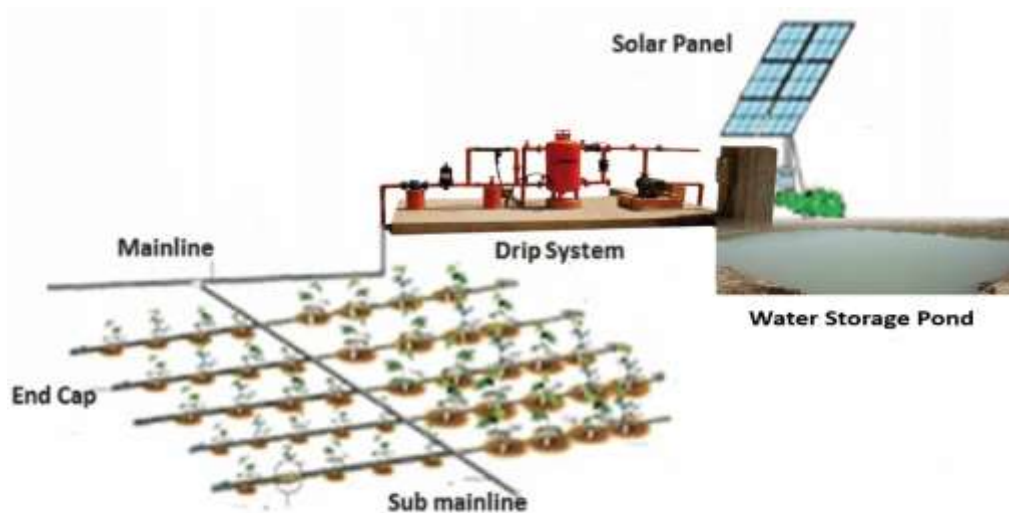


Figure-3: Typical Layout of Solar Powered Drip System (Storage Pond)

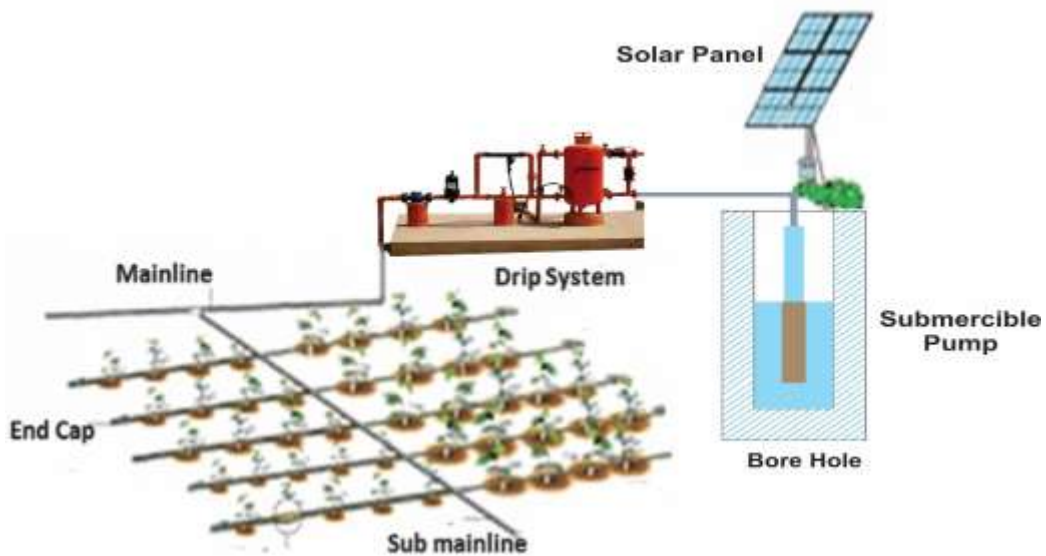


Figure-4: Typical Layout of Solar Powered Drip System (Direct Groundwater Pumping)

6. APPROVED IMPLEMENTATION PROCEDURE

- a) It has been planned to provide solar systems to the farmers who are willing/ have already installed HEIS under the proposed project.
- b) Agriculture Department will develop standards & specifications of solar equipment and get it standardized through standardization committee (**Annexure-A**). The department will also pre-qualify the eligible supply & service companies (SSCs) for installation of solar system at HEIS site. Prequalification Committee (PQC) already constituted under the PIPIP will carry out these tasks and may co-opt additional members for assigned tasks. Alternatively, the task may be assigned to SSC already prequalified for installation of HEIS.

- c) Applications will be submitted by the farmers individually on a prescribed application form and only one member of the family will be eligible. Application forms will be available in the office of District Officers (OFWM) free of cost.
- d) The application will be accompanied by an affidavit containing following declarations for which necessary documents would also be attached to support the claims.
 - i) Canal/ pumped water stored in water storage pond is fit for irrigation
 - ii) Farmer has installed or installing drip irrigation system along with water storage pond being/ to be fed through canal/ groundwater
 - iii) The beneficiary is ready to contribute his share as per approved cost sharing formula as well as willing to bear post installation maintenance costs
 - iv) Applicant is not a defaulter of any government organization or financial institution
 - v) Applicant is willing to get requisite training on operation & maintenance of solar system
 - vi) The beneficiary farmer agrees to use solar system for operating HEIS only
 - vii) The farmer will not sell/ transfer/ handover to any other person in any form within two years
 - viii) The applicant will pay back entire subsidy in case of violation of terms and conditions of subsidy
 - ix) The farmer will be responsible for any physical damage/theft and its rectification at own cost
 - x) The farmer will abide by all directions/ decisions of the department/ authority
- e) The applications will be scrutinized against approved criteria and eligible applicants will be advised to approach the pre-qualified/designated HEIS SSC of their own choice for survey, design, and cost estimation of the selected system.
- f) In case of applications more than the allocated quota/ available facility in a specific district, the District Allotment Committee (DAC) already constituted for carrying out allotment of LASER units under the PIPIP will do balloting/ finalization of farmers.
- g) The selected SSC will survey the site, prepare design and bill of quantity (BOQ), and submit the same to the project consultants for review and approval.
- h) The farmer, after approval of design and cost estimates, will be advised by the concerned District Officer (OFWM) to deposit his/her entire share in the form of pay order/bank draft drawn in favour of selected SSC, which

will be transmitted to Director General Agriculture (Water Management) for issuance of work order.

- i) The work order will be issued by the DGA (WM) and SSC will be bound to deliver the solar equipment alongwith other accessories as per BOQs at site within the prescribed time frame in mentioned Tri-partite Agreement or work order.
- j) The delivered equipment will be inspected against approved specifications and BOQs by the project consultants.
- k) After inspection of the delivered equipment, 50 percent of the system cost including pay order/ bank draft submitted by the farmer and remaining from the project funds will be paid by the DGA (WM) on recommendation of the consultants conveyed by concerned DO (OFWM).
- l) The SSCs will complete the installation of solar system within 30 days after delivery/inspection of equipment. The installed system will be verified by the project consultants for its performance as per approved design and specifications.
- m) The consultants will ensure that coupling of solar system with HEIS is according to the approved guidelines, compatibility, and performs successful operation of the HEIS.
- n) The performance of installed solar system will be evaluated in terms of operation, design and discharge efficiency etc. and solar system will be handed over by the SSC to the beneficiary farmers in the presence of consultants and departmental representatives. At the time of handing over the system, the SSCs would ensure that
 - i) farmer of each site has been trained in operation & maintenance of the solar system;
 - ii) logbook has been provided to the farmers;
 - iii) O&M manual in Urdu has been provided to the farmer; and
 - iv) Warranty card of the equipment has been handed over to the farmer.
- o) On the recommendation of the project consultants conveyed through DO (OFWM), DGA (WM) will make 40% payment to the SSC by keeping 10% as retention money, which will be released after two-year on successful system operation.
- p) Concerned District Officer (OFWM) will submit monthly report to the Regional Project Director (RPD) and Director General Agriculture (Water Management) Punjab on performance of the installed solar system.
- q) The SSCs will be bound to provide the post installation services for at least two years.

7. ELIGIBILITY CRITERIA FOR PREQUALIFICATION OF SUPPLY AND SERVICE COMPANIES

The firms/ joint ventures (having capacity to deliver the complete package of services including survey, design, supply of equipment/ materials, installation & commissioning and post installation back up support viz-a-viz operation & maintenance services for complete system) with the following strength/ background would be eligible for prequalification as SSCs for the project period, which will be renewed every year based on satisfactory performance.

- (i) The local firms are encouraged to make joint ventures with the foreign firms/principle. In case of joint venture of local firm with foreign principal, the experience of later elsewhere in the world may be considered. The joint venture agreement would be required for the purpose;
- (ii) If the applicant is consortium of firms, there must be a leading firm appointed through a Power of Attorney executed by all other consortium members;
- (iii) Must have an office in Pakistan preferably in the Punjab and have/ willing to establish at least three (3) sub-offices/ dealerships/ after sales service centers at Divisional headquarters in the province;
- (iv) Must be registered with Income Tax and Sales Tax Departments (Attach NTN & STN Registration Certificates supported by active NTN& STN);
- (v) Must be in solar business for last three years;
- (vi) Must have experience of completing similar assignments preferably installation of at least 10 solar powered water pumping systems during last three (03) years (Attach following documents to justify the experience claim):
 - *list of completed and on-going projects with location, components, size/scope, cost, period and share/ role (in case of joint venture)*
 - *List of Clients*
 - *Type of Solar systems installed*
 - *Any additional document to support relevant experience*
- (vii) Must possess inventory of solar equipment as per standards & specifications approved by the Punjab Agriculture Department to install solar systems for operating HEIS for 50 acres;
- (viii) Must have mix of professional staff including minimum two Electrical Engineers, two Agricultural Engineers, and five Solar Technicians (Provide list of staff and their CVs indicating qualifications, their registration with professional institutions & relevant experience supported by relevant documents. The firm will also furnish undertaking to recruit the additional staff as per project requirements, if needed);

- (ix) Must have minimum average annual turnover of Rs. 3 million (Attach acceptable document like audited financial statements, tax declaration/ returns etc.);
- (x) Must be manufacturer or sole distributor or authorized dealer of specific make of solar systems meeting approved technical specifications of the Punjab Agriculture Department and must agree to supply compatible complete unit including PV panels and essential accessories (Attach valid sole distributor certificate, complete specifications of PV panels and required accessories alongwith origin certificate of equipment, brochure etc.);
- (xi) Must provide affidavit confirming that (a) applicant firm/ joint venture have never been blacklisted by any government department. (if ever black listed, then provide the case history, current status of the firm regarding this decision) (b) all the information provided by the applicant firm/ joint venture are correct (c) the firm will provide compatible solar equipment as per approved standards & specifications and (d) the firm will deploy staff as per project requirement/ directions of the Client; and
- (xii) Must attach pay order/ bank draft amounting to Rs. 10,000/- in the name of Director General Agriculture (Water Management) Punjab, Lahore as non-refundable processing fee for pre-qualification.

8. PROPOSAL EVALUATION

The evaluation of proposals will be carried out on the basis of applicant firm(s)/joint venture(s) responsiveness to the eligibility criteria/ requirement. A Pre-Qualification Committee (PQC) already constituted by the Agriculture Department will evaluate the proposals and decide about acceptance/ rejection of the proposals. Any misinformation, false and forged statement will lead to disqualification from being shortlisted/ pre-qualified and any other action as per the applicable law.

9. PROPOSAL SUBMISSION

The proposals/ applications will be submitted in the office of Director General Agriculture (Water Management) Punjab, Lahore. The interested firms/ Joint Ventures may collect additional information and pre-qualification document from office of the undersigned.

Director General Agriculture (Water Management) Punjab
21-Agha Khan Soyyum (Davis) Road, Lahore, Pakistan
Tel: +92-42-99200703 Fax: +92-42-99200702
Email: pipipwm@gmail.com

Annex-A

TECHNICAL SPECIFICATIONS OF SOLAR IN CONJUNCTION WITH DRIP Promotion of High Value Agriculture through Provision of Climate Smart Technology Package

General

Type Ground mounted

Material Specifications

Solar Photovoltaic Module

1. Every PV Module has to have a stabilized power, which is equivalent or greater than its nominal power at STC.
2. The Solar Panel shall meet the following requirement
 - a. IEC 61215:2005
 - b. IEC61646
 - c. IEC61730
 - d. IEC60364-4-1
 - e. IEC61701
 - f. IEC60904-1, IEC 60904-3
 - g. Other applicable standards
3. Each module must be labelled indicating/ RFID tag at a minimum:
 - o Name of Manufacturer of solar module
 - o Unique Model Number and Serial Number of module
 - o Month and years of manufacturer
 - o Country of Origin
 - o Peak Watt Rating,
 - o I-V characteristics
 - o *Maximum Performance P_{max}*
 - o *Maximum Power voltage V_{mp}*
 - o *Maximum Power Current I_{am}*
 - o *Open Circuit Voltage Voc*
 - o *Short Circuit current I_{sc}*
 - o *Date and Year of obtaining PV module IEC qualified certificate*
 - o *Name of Test lab issued certificate*
 - o *Other information to trace PV module as per ISO-9000*
4. Solar Panel shall have framed module with Type A junction Box (rain tight) accepting PG 13.5 conduit/ cable fitting
5. Manufacturer of Solar panel along with date of manufacturer must be stated in current production
6. Solar Panel have to be packaged for safe transportation on non-metallic roads
7. The solar panel shall have a certificate of compliance with IEC 61215:2005 issued by any of listed approved laboratories
8. Performance guarantee has to cover at least 25 years of operation
9. Materials and workmanship warranty Minimum of 10 years
10. Duration of Performance Guarantee Minimum of 25 years
11. Power output within 10 years Shall not fall below 90%
12. Power output within 25 years Shall not fall below 80%
13. Type of Performance Guarantee Shall be linear
14. Operating temperature from -20 to +80 Celsius
15. The cell shall lay embedded in transparent EVA behind tempered Glass. The glass is insect deep in an aluminum frame, there by offering maximum protection
16. The wiring shall be terminated in box backside of panel and shall have no activities and completely water tight and is resistant to temperature and UV radiation

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| 17. Solar Cell | Mono/ Poly Multicrysta silicon |
| 18. Module Efficiency | ≥14 % |
| 19. Tolerance | ±5 % |
| 20. Type of array and connections | Parallel / series |
| 21. Array Shading | Minimal Shading |
| 22. Tolerance to wind (maximum load) and hailstone impact | |
| 23. Relative power conversion efficiency reduction and I-V characteristic curves for different light intensities | |
| 24. Type of frame with weatherproof specifications | |
| 25. Manufacturer's installation guidelines must be provided | |
| 26. Manufacturer's confirmation of suitability of PV Module for specific weather conditions and high UV-radiation must be provided | |
| 27. Guarantees and datasheets must be provided | |
| 28. Flash test data must be provided | |
| 29. Key to module serial numbers in relation to production line and production date. Must be provided | |
| 30. Provision of specification and quality test certificates of: glass, encapsulate, cell, EVA, adhesives, busbar, sealant, back sheet, frame, junction box, cable, DC connector | |

Inverter

1. The Contractor shall arrange a full-service package for the selected inverters for a product warranty period of 02 years, including provisions for any necessary replacements and O&M service plan guaranteeing 100 % availability.
2. All documentation, certificates and routine test procedures as well as results for every Inverter in factory shall be provided
3. The Contractor will ensure and prove in written (prior to Contract) with an undertaking that the concerned skilled staff will be made available at the site within 72 hours (03 days) after reporting the defect to the contractor.
4. The solar inverter(s)/ Variable frequency drive(s) with Inbuilt MPPT (Maximum Power Point Tracking) shall be provided for voltage conversion and regulation of the varying amounts of DC voltages and currents generated by the solar modules. Solar inverter capacity shall be determined in accordance with the parameters specified and quantified in the Schedule of Technical Data (STD).
5. Stable operation under changing radiation
6. Digital controls with full automation running and complete protective function
7. Intelligent Power module (IPM) for the main circuit; LED displays operating system
8. Option for up and down water level detection and control circuit
9. Ambient temperature for using -10 to + 50 degree Celsius
10. Rated voltage 380-440 (matching with the pump motor)
11. The product should have the features listed below but not limited to:
 - a. Maximum Power Point Tracking (MPPT).
 - b. Instantaneous output status display (Speed / Power /Amps) etc
 - c. Data logging
 - d. Display and Metering
 - e. Automatic Start and Stop with Solar irradiation
 - f. Self-diagnostic and self-Protection
 - g. Dry run protection
 - h. Stable operation and absorbing water hammer effects due to rapid changing irradiation
 - i. The inverter shall be capable to operate in Off Grid and Grid connected mode.
 - j. The VFD inverter shall be of single/three phase type (configurable)
 - k. Output voltage Filter
 - l. Automatic Power source switching against configurable set point (Solar & Grid)
 - m. Configurable Power source priority
 - n. The inverter shall support multi-string input with string failure detection.
 - o. Grid monitoring.
 - p. Environmental protection rating / electrical connection area shall be IP65 / IP55.

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12. Maximum Power Point Tracking (MPPT) solar invertors shall be provided so as to optimize the voltage of PV array to maximize PVP power & to optimize the hours of operation
13. The inverter shall contain (but not limited to) following protections features:
 - a. Reverse Current Blocking.
 - b. Overcharge Protection
 - c. Low Voltage Disconnect (LVD).
 - d. Under/Over Voltage & Over Current protection
 - e. AC short circuit protection.
 - f. Ground fault monitoring.
14. Body Material Stainless steel/ Plastic
15. Type Wall mounted
16. Invertor Efficiency ≥95 %

Pump / Motor

1. Multistage submersible pump for water supply
2. Groundwater lowering and pressure boosting
3. Made entirely of stainless steel DIN W-Nr 14301 AISE304
4. Motor should be 3 phase 380-440 V 50 Hz
5. Liquid lubricated bearing and pressure equalizing diaphragm
6. Curve tolerance ISO9906

Type	DC Submersible/ AC Submersible/ AC centrifugal <ul style="list-style-type: none"> ▪ Submersible ▪ Surface pump ▪ Pump controller ▪ Pump sensor and accessories
Head (Suction delivery)	≥30 Meter (Subject to system)
Discharge Q (LPH)	8000 Lph/ 8 Cub. M/hr (2.22 LPS) (Subject to system)
Water level switch	Provided
Dry running protection	Provided
Material	Stainless steel
Efficiency	≥80%
Cable length	Provided
Origin	ISO Imported

Panel Structure

Type	Ground mounted (Pole)
Material	Galvanized steel/ Mild steel
Fixed Tracking	Fixed/ Manual

Water Proof Junction box

Type	Wall mount type
Material	Steel plate
Operating temp.	5-50 °C



Installation/Cables/Wires

1. Installation including wiring shall meet the requirements and recommendations given in 8.3 of IEC 62124 ed I.
2. The commissioning and acceptance will be subject to fulfillment of all requirements specified in above mentioned paragraphs of IEC 62124 ed.I and additional requirements as detailed below.
 - a) Stranded and flexible insulated copper wires and cables must be used for all outdoor and indoor installations
 - b) The wiring that leads into the building shall be protected in a conduit
 - c) External cables should be specifically adapted to outdoor exposure (see IEC 60811). The outer insulation must be sunlight (UV)-resistant, weatherproof and designed for underground installation, preferably PVC-coated or PE-coated cables shall be used
 - d) The temperature resistance of all interconnecting wires and cables should be $>75^{\circ}\text{C}$
 - e) The minimum acceptable cross-section of the wire in each of the sub-circuits should comply with the wire sizing table given in SP-11. However, the minimum wire cross-section should not be less than 2.5 mm
 - f) Nevertheless the above minimum wire-size requirements, all wiring must be sized to keep line voltage drop to less than 3% between PV generator and battery, less than 1% between battery and charge regulator, and less than 3% between battery and load, all of them at the maximum current conditions. The minimum cross-section must also allow the circuit to operate within the capacity rating of the wire.
 - g) All wiring shall be color-coded and/or labeled. Following connections shall be followed for two-conductor DC wiring:
 - Positive : Red or brown
 - Negative : Black or blue
 - h) All exposed wiring must be in UV-resistant conduits and firmly fastened to the building and/or support structure. Cable binders, clamps and other fixing material must also be UV-resistant, preferably made of polyethylene.
 - i) Surface-mounted cabling shall be installed using appropriate fasteners at suitable intervals (15 to 20 cm) to prevent sagging.
 - j) Suspended cables shall be mounted so that the lowest point is at least 2.8 m above ground level. The cable shall be held in position by suitable brackets and strain relief to prevent mechanical wear and any strain on the electrical connections.
 - k) The system should be properly earthed

Installation/Switches/Fuses

1. Connectors, fuses and circuit-breakers shall meet the specifications given in 8.5 of IEC 61214 ed.I.
 - a. Fuses and circuit-breakers shall be rated for DC service.
 - b. Have voltage ratings greater than the maximum circuit voltage.
 - c. Have current ratings between 125% and 150% of the maximum design current for the circuit.
 - d. Be marked with the rated capacity and circuit voltage
2. No fuses or circuit breakers shall be installed in a grounded conductor.
3. Light switches shall be installed next to the entrance door of each room at approximately 1.2 m above finished floor level.
4. Only DC switches are allowed for current and voltage of the circuit.
5. All switches should include a clear visual indication of their state (ON/OFF or I/O). However, suitable pull switches may be acceptable for overhead light fittings.
6. Switches shall be installed at a place in accordance with user's preference



Installation/Documentation

1. In accordance with the standards IEC 62124, and IEC 61215:2005 documentation for technicians and user shall be provided. The documentation shall be provided as follows:
 - 2 copies of the technician manual (in English,)
 - For each system, 1 copy of the user manual in English to the Sponsor. The user manual shall be illustrated in order to be understandable by the operator/ Sponsor. The text shall be understandable by technically unqualified users.

 27/09/16

1. Director, Water Management Training Institute, Lahore.

 27/09/2016

2. Director, Agriculture Mechanization Research Institute, Multan.



3. Senior Technical Officer, Agriculture Procurement Facilitation Cell (APFC), Agriculture Department



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