REQUEST FOR QUOTATION (RFQ)

(Design, Supply, Installation, Testing, Commissioning & Maintenance of Three (3) Solar system with the capacity of 10Kwp Solar PV power solution (LOT 1), Two (2) solar system with the capacity of 13Kwp solar PV power solution (LOT 2),Two (2) solar systems with the capacity of 15kwp solar PV power solution (LOT3) and 192pcs of LED lamp (LOT 4) to schools and women's college in Seyoun & Shibam disticts In Hadramout governorates.

DATE: 16 Nov, 2017.

REFERENCE: RFQ-YEM-0061-2017

Dear Sir / Madam:

We kindly request you to submit your quotation for **(Design, Supply, Installation, Testing, Commissioning & Maintenance of Three (3) Solar system with the capacity of 10Kwp Solar PV power solution (LOT 1), Two (2) solar system with the capacity of 13Kwp solar PV power solution (LOT 2),Two (2) solar systems with the capacity of 15kwp solar PV power solution (LOT3) and 192pcs of LED lamp (LOT 4) to schools and women's college in Seyoun & Shibam disticts In Hadramout governorates.**, as detailed in Annex 2 of this RFQ. When preparing your quotation, please be guided by the form attached hereto as Annex 1.

Documents uploaded in the system as part of your quotation must be free from any form of virus or corrupted contents, or the quotations shall be rejected.

It shall remain your responsibility to ensure that your quotation is submitted on or before the deadline indicated by UNDP in the eTendering system . Bids must be submitted in the online eTendering system in the following link: https://etendering.partneragencies.org using your username and password. If you have not registered in the system before, you can register now by logging in using
username: event.guest
password: why2change
and follow the registration steps as specified in the system user guide.

Documents to be submitted[1]	X Duly Accomplished Form as provided in Annex 2 and detail specs, and in accordance with the list of requirements in Annex 1; X Company profile not exceeding fifteen (15) pages, including printed brochures and product catalogues relevant to the goods/services being procured. X CVs for engineers. X Quality Certificates (ISO, etc.) (as mentioned in each LOTs); X Latest Business Registration Certificate ; X Certificate of Exclusive Distributorship in the country (if applicable, and if Supplier is not the manufacturer); X Evidence/Certification of Environmental Sustainability if applicable ("Green" Standards) of the Company or the Product being supplied ; X Complete documentation, information and declaration of any goods classified or may be classified as "Dangerous Goods". X Patent Registration Certificates (if any of technologies submitted in the quotation is patented by the Supplier); X Written Self-Declaration of not being included in the UN Security Council 1267/1989 list, UN Procurement Division List or other UN Ineligibility List;
Period of Validity of Quotes starting the Submission Date	X 60 days In exceptional circumstances, UNDP may request the Vendor to extend the validity of the Quotation beyond what has been initially indicated in this RFQ. The Proposal shall then confirm the extension in writing, without any modification whatsoever on the Quotation.
Partial Quotes	X Permitted as per the LOTs. The vendor shall submit for one lots or for different lots or for all LOTs.
Payment Terms	X 100% upon complete delivery of goods and service.
Liquidated Damages	X 0.5% penalty from total price for each day of delay. Up to a maximum of 10% of the total contract amount. Thereafter, the contract will terminate.
Evaluation Criteria *[check as many as applicable]*	X Technical responsiveness/Full compliance to requirements and lowest price Comprehensiveness of after-sales services X Full acceptance of the PO/Contract General Terms and Conditions *[this is a mandatory criteria and cannot be deleted regardless of the nature of services required]*
PRE-BID submission meeting	**A pre-Bid conference meeting will be held at UNDP office in Sana'a.** Time: 11:00 AM. Date: Sunday 26 Nov, 2017 Venue: UNDP office Sanaa Address: _60st near the Ministry of Human Right,Sana'a ,Yemen Telephone: +967 1 448605

[1] *First 2 items in this list are mandatory for the supply of imported goods*

UNDP will award to:	X One or more Supplier depending to the lots.
Type of Contract to be Signed	X Purchase Order
Special conditions of Contract	X Cancellation of PO/Contract if the delivery/completion is delayed by 20 days
Conditions for Release of Payment	X Passing Inspection X Written Acceptance of Goods based on full compliance with RFQ requirements. X Original Invoice
Contact Person for Inquiries (Written inquiries only)[3]	***Waleed Ahmed OR Samira AlFarah*** *Procurement Associate / Head of Procurement unit (Samira Alfarah)* Any delay in UNDP's response shall be not used as a reason for extending the deadline for submission, unless UNDP determines that such an extension is necessary and communicates a new deadline to the Proposers.

Goods offered shall be reviewed based on completeness and compliance of the quotation with the minimum specifications described above and any other annexes providing details of UNDP requirements.

The quotation that complies with all of the specifications, requirements and offers the lowest price, as well as all other evaluation criteria indicated, shall be selected. Any offer that does not meet the requirements shall be rejected.

Any discrepancy between the unit price and the total price (obtained by multiplying the unit price and quantity) shall be re-computed by UNDP. The unit price shall prevail and the total price shall be corrected. If the supplier does not accept the final price based on UNDP's re-computation and correction of errors, its quotation will be rejectedThe system automatically calculates the final bid prices by multiplying the unit price by the quantity. In the event when the Bidder put a quantity that is different from the quantity required, provided that the Bid is substantially responsive, UNDP will re-calculate the Bidders total price based on the correct quantity and using the unit prices offered by the Bidder. Unit prices cannot be changed.

After UNDP has identified the lowest price offer, UNDP reserves the right to award the contract based only on the prices of the goods in the event that the transportation cost (freight and insurance) is found to be higher than UNDP's own estimated cost if sourced from its own freight forwarder and insurance provider.

At any time during the validity of the quotation, no price variation due to escalation, inflation, fluctuation in exchange rates, or any other market factors shall be accepted by UNDP after it has received the quotation. At the time of award of Contract or Purchase Order, UNDP reserves the right to vary (increase or decrease) the quantity of services and/or goods, by up to a maximum twenty five per cent (25%) of the total offer, without any change in the unit price or other terms and conditions.

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[3] *This contact person and address is officially designated by UNDP. If inquiries are sent to other person/s or address/es, even if they are UNDP staff, UNDP shall have no obligation to respond nor can UNDP confirm that the query was received.*

Any Purchase Order that will be issued as a result of this RFQ shall be subject to the General Terms and Conditions attached hereto. The mere act of submission of a quotation implies that the vendor accepts without question the General Terms and Conditions of UNDP herein attached as Annex 3.

UNDP is not bound to accept any quotation, nor award a contract/Purchase Order, nor be responsible for any costs associated with a Supplier's preparation and submission of a quotation, regardless of the outcome or the manner of conducting the selection process.

Please be advised that UNDP's vendor protest procedure is intended to afford an opportunity to appeal for persons or firms not awarded a purchase order or contract in a competitive procurement process. **In the event that** you believe you have not been fairly treated, you can find detailed information about vendor protest procedures in the following link:
http://www.undp.org/content/undp/en/home/operations/procurement/protestandsanctions/

UNDP encourages every prospective Vendor to avoid and prevent conflicts of interest, by disclosing to UNDP if you, or any of your affiliates or personnel, were involved in the preparation of the requirements, design, specifications, cost estimates, and other information used in this RFQ.

UNDP implements a zero tolerance on fraud and other proscribed practices, and is committed to identifying and addressing all such acts and practices against UNDP, as well as third parties involved in UNDP activities. UNDP expects its suppliers to adhere to the UN Supplier Code of Conduct found in this link : http://www.un.org/depts/ptd/pdf/conduct_english.pdf

Thank you and we look forward to receiving your quotation.

Sincerely yours,

Samira Al-Farah
Head of procurement
16 Nov, 2017

Annex 2

Technical Specifications (LOT 1)

Items to be Supplied*	Quantity	Description / Specifications of Goods	Latest Delivery Date	Unit price USD	Total Price USD
10 Kwp Solar PV Power Solution with Battery Backup	**3 full system**	Integrated solar solution with a capacity of **10,000 watts** including: Solar panels, installation structures, solar inverter (with built-in controller), batteries, DC and AC junction's boxes, cables and earthling materials.			
Warranty period		Please refer to the attached detail specification for LOT 1.			
Installation and transportation	**1**	Installation and transportation fees			

NOTE: For more details and other conditions please refer to the attached detail specification for LOT 1.

The vendor MUST adhere to the detail specification and condition in LOT 1 in-order to quote for the above table.

[Enter name of authorized staff]
[Designation]
[Click here to enter a date]

Annex 2

Technical Specifications (LOT 2)

Items to be Supplied*	Quantity	Description / Specifications of Goods	Latest Delivery Date	Unit price USD	Total Price USD
13 Kwp Solar PV Power Solution with battery backup	2 full system	Integrated solar solution with a capacity of 13,000 watts including: Solar panels, installation structures, solar inverter (with built-in controller), batteries, DC and AC junction's boxes, cables and earthling materials.			
Warranty period		Please refer to the attached detail specification for LOT 2.			
Installation	1	Installation and transportation fees			

NOTE: For more details and other conditions please refer to the attached detail specification for LOT 2.

The vendor MUST adhere to the detail specification and condition in LOT 2 in-order to quote for the above table.

[Enter name of authorized staff]
[Designation]
[Click here to enter a date]

Annex 2

Technical Specifications (LOT 3)

Items to be Supplied*	Quantity	Description / Specifications of Goods	Latest Delivery Date	Unit price USD	Total Price USD
15 Kwp Solar PV Power Solution with battery backup	**2 full system**	Integrated solar solution with a capacity of **15,000 watts** including: Solar panels, installation structures, solar inverter (with built-in controller), batteries, DC and AC junction's boxes, cables and earthling materials. Supply, delivery to site, installation, operation and maintenance.			
Warranty period		Please refer to the attached detail specification for LOT 3.			
Installation	**1**	Installation and transportation fees			

NOTE: For more details and other conditions please refer to the attached detail specification for LOT 3.

The vendor MUST adhere to the detail specification and condition in LOT 3 in-order to quote for the above table.

[Enter name of authorized staff]
[Designation]
[Click here to enter a date]

Annex 2

Technical Specifications (LOT 4)

Items to be Supplied*	Quantity	Description / Specifications of Goods	Latest Delivery Date	Unit price USD	Total Price USD
		LED lamp. - Lamp Shape: **Bulbs** - Cap Types & Bases : Bayonet Bulbs - **B22d-BC/ E27 Light Bulb.**			
LED lamp.	**192 pcs**	- Color temperatures (CCT): at least **5000K.** - Lamp Luminous Flux: **at least 1500 lm.** - Input Voltage (V): **AC220-240V.** - Lamp Power (W): **16 – 20 W.** - Lamp Luminous Efficiency(lm/w): **at least 90.** - Working Temperature(C^0): **-20 – 50.** - Certification: all related certificates shall be provided as **CE, RoHS, SASO, UL** - Working Lifetime (Hour): at least **40000h.** - Warranty: **5 Years.** The bulb should be provided with all accessories needed to installation and operation.			
Installation	**1**	Installation and transportation fees			

NOTE: For more details and other conditions please refer to the attached detail specification for LOT 4.

The vendor MUST adhere to the detail specification and condition in LOT 4 in-order to quote for the above table.

[Enter name of authorized staff]
[Designation]
[Click here to enter a date]

TABLE 1 LOT 1 : Offer to Comply with Other Conditions and Related Requirements

Other Information pertaining to our Quotation are as follows :	**Your Responses**		
	Yes, we will comply	***No, we cannot comply***	***If you cannot comply, pls. indicate counter proposal***
Delivery Lead Time			
Estimated weight/volume/dimension of the Consignment:	N/A		
Country/ies Of Origin[4]:			
Warranty and After-Sales Requirements			
a) Training on Operations and Maintenance			
b) Minimum one (1) year warranty on both parts and labor			
c) Service Unit to be Provided when the Purchased Unit is Under Repair			
d) Brand new replacement if Purchased Unit is beyond repair			
e) Others			
Validity of Quotation			
All Provisions of the UNDP General Terms and Conditions			
Other requirements *[pls. specify]*			

All other information that we have not provided automatically implies our full compliance with the requirements, terms and conditions of the RFQ.

[Name and Signature of the Supplier's Authorized Person]
[Designation]
[Date]

[4] *If the country of origin requires Export License for the goods being procured, or other relevant documents that the country of destination may require, the supplier must submit them to UNDP if awarded the PO/contract.*

TABLE 2 LOT 2 : Offer to Comply with Other Conditions and Related Requirements

Other Information pertaining to our Quotation are as follows :	Your Responses		
	Yes, we will comply	*No, we cannot comply*	*If you cannot comply, pls. indicate counter proposal*
Delivery Lead Time			
Estimated weight/volume/dimension of the Consignment:	N/A		
Country/ies Of Origin[5]:			
Warranty and After-Sales Requirements			
a) Training on Operations and Maintenance			
b) Minimum one (1) year warranty on both parts and labor			
c) Service Unit to be Provided when the Purchased Unit is Under Repair			
d) Brand new replacement if Purchased Unit is beyond repair			
e) Others			
Validity of Quotation			
All Provisions of the UNDP General Terms and Conditions			
Other requirements *[pls. specify]*			

All other information that we have not provided automatically implies our full compliance with the requirements, terms and conditions of the RFQ.

[Name and Signature of the Supplier's Authorized Person]
[Designation]
[Date]

[5] *If the country of origin requires Export License for the goods being procured, or other relevant documents that the country of destination may require, the supplier must submit them to UNDP if awarded the PO/contract.*

TABLE 3 LOT 3 : Offer to Comply with Other Conditions and Related Requirements

Other Information pertaining to our Quotation are as follows :	**Your Responses**		
	Yes, we will comply	***No, we cannot comply***	***If you cannot comply, pls. indicate counter proposal***
Delivery Lead Time			
Estimated weight/volume/dimension of the Consignment:	N/A		
Country/ies Of Origin[6]:			
Warranty and After-Sales Requirements			
a) Training on Operations and Maintenance			
b) Minimum one (1) year warranty on both parts and labor			
c) Service Unit to be Provided when the Purchased Unit is Under Repair			
d) Brand new replacement if Purchased Unit is beyond repair			
e) Others			
Validity of Quotation			
All Provisions of the UNDP General Terms and Conditions			
Other requirements *[pls. specify]*			

All other information that we have not provided automatically implies our full compliance with the requirements, terms and conditions of the RFQ.

[Name and Signature of the Supplier's Authorized Person]
[Designation]
[Date]

[6] *If the country of origin requires Export License for the goods being procured, or other relevant documents that the country of destination may require, the supplier must submit them to UNDP if awarded the PO/contract.*

TABLE 2 LOT 4 : Offer to Comply with Other Conditions and Related Requirements

Other Information pertaining to our Quotation are as follows :	Your Responses		
	Yes, we will comply	*No, we cannot comply*	*If you cannot comply, pls. indicate counter proposal*
Delivery Lead Time			
Estimated weight/volume/dimension of the Consignment:	N/A		
Country/ies Of Origin[7]:			
Warranty and After-Sales Requirements			
a) Training on Operations and Maintenance			
b) Minimum one (1) year warranty on both parts and labor			
c) Service Unit to be Provided when the Purchased Unit is Under Repair			
d) Brand new replacement if Purchased Unit is beyond repair			
e) Others			
Validity of Quotation			
All Provisions of the UNDP General Terms and Conditions			
Other requirements *[pls. specify]*			

All other information that we have not provided automatically implies our full compliance with the requirements, terms and conditions of the RFQ.

[Name and Signature of the Supplier's Authorized Person]
[Designation]
[Date]

[7] *If the country of origin requires Export License for the goods being procured, or other relevant documents that the country of destination may require, the supplier must submit them to UNDP if awarded the PO/contract.*

Annex 3

General Terms and Conditions

1. ACCEPTANCE OF THE PURCHASE ORDER

This Purchase Order may only be accepted by the Supplier's signing and returning an acknowledgement copy of it or by timely delivery of the goods in accordance with the terms of this Purchase Order, as herein specified. Acceptance of this Purchase Order shall effect a contract between the Parties under which the rights and obligations of the Parties shall be governed solely by the terms and conditions of this Purchase Order, including these General Conditions. No additional or inconsistent provisions proposed by the Supplier shall bind UNDP unless agreed to in writing by a duly authorized official of UNDP.

2. PAYMENT

2.1 UNDP shall, on fulfillment of the Delivery Terms, unless otherwise provided in this Purchase Order, make payment within 30 days of receipt of the Supplier's invoice for the goods and copies of the shipping documents specified in this Purchase Order.

2.2 Payment against the invoice referred to above will reflect any discount shown under the payment terms of this Purchase Order, provided payment is made within the period required by such payment terms.

2.3 Unless authorized by UNDP, the Supplier shall submit one invoice in respect of this Purchase Order, and such invoice must indicate the Purchase Order's identification number.

2.4 The prices shown in this Purchase Order may not be increased except by express written agreement of UNDP.

3. TAX EXEMPTION

3.1 Section 7 of the Convention on the Privileges and Immunities of the United Nations provides, inter alia, that the United Nations, including its subsidiary organs, is exempt from all direct taxes, except charges for utilities services, and is exempt from customs duties and charges of a similar nature in respect of articles imported or exported for its official use. In the event any governmental authority refuses to recognize UNDP's exemption from such taxes, duties or charges, the Supplier shall immediately consult with UNDP to determine a mutually acceptable procedure.

3.2 Accordingly, the Supplier authorizes UNDP to deduct from the Supplier's invoice any amount representing such taxes, duties or charges, unless the Supplier has consulted with UNDP before the payment thereof and UNDP has, in each instance, specifically authorized the Supplier to pay such taxes, duties or charges under protest. In that event, the Supplier shall provide UNDP with written evidence that payment of such taxes, duties or charges has been made and appropriately authorized.

4. RISK OF LOSS

Risk of loss, damage to or destruction of the goods shall be governed in accordance with Incoterms 2010, unless otherwise agreed upon by the Parties on the front side of this Purchase Order.

5. EXPORT LICENCES

Notwithstanding any INCOTERM 2010 used in this Purchase Order, the Supplier shall obtain any export licences required for the goods.

6. FITNESS OF GOODS/PACKAGING

The Supplier warrants that the goods, including packaging, conform to the specifications for the goods ordered under this Purchase Order and are fit for the purposes for which such goods are ordinarily used and for purposes

expressly made known to the Supplier by UNDP, and are free from defects in workmanship and materials. The Supplier also warrants that the goods are contained or packaged adequately to protect the goods.

7. INSPECTION

7.1 UNDP shall have a reasonable time after delivery of the goods to inspect them and to reject and refuse acceptance of goods not conforming to this Purchase Order; payment for goods pursuant to this Purchase Order shall not be deemed an acceptance of the goods.

7.2 Inspection prior to shipment does not relieve the Supplier from any of its contractual obligations.

8. INTELLECTUAL PROPERTY INFRINGEMENT

The Supplier warrants that the use or supply by UNDP of the goods sold under this Purchase Order does not infringe any patent, design, trade-name or trade-mark. In addition, the Supplier shall, pursuant to this warranty, indemnify, defend and hold UNDP and the United Nations harmless from any actions or claims brought against UNDP or the United Nations pertaining to the alleged infringement of a patent, design, trade-name or trade-mark arising in connection with the goods sold under this Purchase Order.

9. RIGHTS OF UNDP

In case of failure by the Supplier to fulfil its obligations under the terms and conditions of this Purchase Order, including but not limited to failure to obtain necessary export licences, or to make delivery of all or part of the goods by the agreed delivery date or dates, UNDP may, after giving the Supplier reasonable notice to perform and without prejudice to any other rights or remedies, exercise one or more of the following rights:

9.1 Procure all or part of the goods from other sources, in which event UNDP may hold the Supplier responsible for any excess cost occasioned thereby.
9.2 Refuse to accept delivery of all or part of the goods.
9.3 Cancel this Purchase Order without any liability for termination charges or any other liability of any kind of UNDP.

10. LATE DELIVERY

Without limiting any other rights or obligations of the parties hereunder, if the Supplier will be unable to deliver the goods by the delivery date(s) stipulated in this Purchase Order, the Supplier shall (i) immediately consult with UNDP to determine the most expeditious means for delivering the goods and (ii) use an expedited means of delivery, at the Supplier's cost (unless the delay is due to Force Majeure), if reasonably so requested by UNDP.

11. ASSIGNMENT AND INSOLVENCY

11.1. The Supplier shall not, except after obtaining the written consent of UNDP, assign, transfer, pledge or make other disposition of this Purchase Order, or any part thereof, or any of the Supplier's rights or obligations under this Purchase Order.
11.2. Should the Supplier become insolvent or should control of the Supplier change by virtue of insolvency, UNDP may, without prejudice to any other rights or remedies, immediately terminate this Purchase Order by giving the Supplier written notice of termination.

12. USE OF UNDP OR UNITED NATIONS NAME OR EMBLEM

The Supplier shall not use the name, emblem or official seal of UNDP or the United Nations for any purpose.

13. PROHIBITION ON ADVERTISING

The Supplier shall not advertise or otherwise make public that it is furnishing goods or services to UNDP without specific permission of UNDP in each instance.

14. CHILD LABOUR

The Supplier represents and warrants that neither it nor any of its affiliates is engaged in any practice inconsistent with the rights set forth in the Convention on the Rights of the Child, including Article 32 thereof, which, inter alia, requires that a child shall be protected from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.

Any breach of this representation and warranty shall entitle UNDP to terminate this Purchase Order immediately upon notice to the Supplier, without any liability for termination charges or any other liability of any kind of UNDP.

15. MINES

The Supplier represents and warrants that neither it nor any of its affiliates is actively and directly engaged in patent activities, development, assembly, production, trade or manufacture of mines or in such activities in respect of components primarily utilized in the manufacture of Mines. The term "Mines" means those devices defined in Article 2, Paragraphs 1, 4 and 5 of Protocol II annexed to the Convention on Prohibitions and Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects of 1980.

Any breach of this representation and warranty shall entitle UNDP to terminate this Purchase Order immediately upon notice to the Supplier, without any liability for termination charges or any other liability of any kind of UNDP.

16. SETTLEMENT OF DISPUTES

16.1 Amicable Settlement. The Parties shall use their best efforts to settle amicably any dispute, controversy or claim arising out of, or relating to this Purchase Order or the breach, termination or invalidity thereof. Where the Parties wish to seek such an amicable settlement through conciliation, the conciliation shall take place in accordance with the UNCITRAL Conciliation Rules then obtaining, or according to such other procedure as may be agreed between the Parties.

16.2 Arbitration. Unless, any such dispute, controversy or claim between the Parties arising out of or relating to this Purchase Order or the breach, termination or invalidity thereof is settled amicably under the preceding paragraph of this Section within sixty (60) days after receipt by one Party of the other Party's request for such amicable settlement, such dispute, controversy or claim shall be referred by either Party to arbitration in accordance with the UNCITRAL Arbitration Rules then obtaining, including its provisions on applicable law. The arbitral tribunal shall have no authority to award punitive damages. The Parties shall be bound by any arbitration award rendered as a result of such arbitration as the final adjudication of any such controversy, claim or dispute.

17. PRIVILEGES AND IMMUNITIES

Nothing in or related to these General Terms and Conditions or this Purchase Order shall be deemed a waiver of any of the privileges and immunities of the United Nations, including its subsidiary organs.

18. SEXUAL EXPLOITATION:

18.1 The Contractor shall take all appropriate measures to prevent sexual exploitation or abuse of anyone by it or by any of its employees or any other persons who may be engaged by the Contractor to perform any services under the Contract. For these purposes, sexual activity with any person less than eighteen years of age, regardless of any laws relating to consent, shall constitute the sexual exploitation and abuse of such person. In addition, the Contractor shall refrain from, and shall take all appropriate measures to prohibit its employees or other persons engaged by it from, exchanging any money, goods,

services, offers of employment or other things of value, for sexual favors or activities, or from engaging in any sexual activities that are exploitive or degrading to any person. The Contractor acknowledges and agrees that the provisions hereof constitute an essential term of the Contract and that any breach of this representation and warranty shall entitle UNDP to terminate the Contract immediately upon notice to the Contractor, without any liability for termination charges or any other liability of any kind.

18.2 UNDP shall not apply the foregoing standard relating to age in any case in which the Contractor's personnel or any other person who may be engaged by the Contractor to perform any services under the Contract is married to the person less than the age of eighteen years with whom sexual activity has occurred and in which such marriage is recognized as valid under the laws of the country of citizenship of such Contractor's personnel or such other person who may be engaged by the Contractor to perform any services under the Contract.

19.0 OFFICIALS NOT TO BENEFIT:

The Contractor warrants that no official of UNDP or the United Nations has received or will be offered by the Contractor any direct or indirect benefit arising from this Contract or the award thereof. The Contractor agrees that breach of this provision is a breach of an essential term of this Contract.

20. AUTHORITY TO MODIFY:

Pursuant to the Financial Regulations and Rules of UNDP, only the UNDP Authorized Official possess the authority to agree on behalf of UNDP to any modification of or change in this Agreement, to a waiver of any of its provisions or to any additional contractual relationship of any kind with the Contractor. Accordingly, no modification or change in this Contract shall be valid and enforceable against UNDP unless provided by an amendment to this Agreement signed by the Contractor and jointly by the UNDP Authorized Official.

LOT 1

10 Kwp Solar PV Power Solution with Battery Backup

Detail specification for one complete system of 10KWatt

No.	Technical Specification	
1	**Photovoltaic modules:** - Solar Panel Wattage at STC: Shall be ≥ **250Wp** (Bigger watt size Solar PV module will be **preferred**). - Type of PV Module: Higher cell efficiency **Poly Crystalline.** - Module efficiency:**≥16%.** - Open Circuit Voltage of each panel: **≥42Vdc.** - Max MPPT Voltage of each panel:**≥30Vdc.** - Short Circuit Current (A): **≥8.5 Amp.** - Max. Power Current (A): **≥ 8 Amp.** - No of cells in each panel:**60/72 per panel.** - Total No of panels: **as required.** - Total Wattage:**10,000 Watt p.** - Preferred Arrangement of solar panels: **3 or4 Series, ≥10 parallel of series** - Module frame: **Aluminum anodized** or **corrosion resistant material**. The anodizing Thickness shall be **15 micron or better.** - Conform to **IEC 61215, IEC 61730** and **CE.** or equivalent - PV modules to be used in a highly corrosive atmosphere (Coastal area etc.) must qualify salt mist corrosion testing IEC **61701/ IS 61701.** - Tolerance of maximum power rating: **±3%.** - High transmittance glass: **minimum thickness of 3/4.0 mm.** - Min. system voltage: **≥1000V.** - PV junction box: **IP65** with sufficient at least **3/4 bypass diodes.** Highly heat-resistant bypass diode. - Warranty : **Nominal power output 90% for 10 years, 80% for 25years** - **Weather proof DC rated MC4** connector. Easier and secure, not allowing for any loose connections. - Lead cable coming out as a part of the module: **≥ 4mm², length 1000mm& weather proofed** - **Temperature coefficient: Less than -0.42%/°C.** - Thermal coefficient of voltage: **Less than-0.3/ C⁰.** - With Normal operating temperature coefficient (NOTC):**45 ±2°C.** - **Operational Temperature: -40 ~ +85°C** - Easy to install, easier to grip frame.	

	- Good tab thickness, heavy duty frame. - Resistant of **water, abrasion, hail impact, humidity**& other environment factor for the worst situation at site and **water drainage** structure. Suitable encapsulation and sealing arrangements to protect the silicon cells from the harsh environment.	
2	**Mounting structure For PV Panels** The PV modules shall be mounted on fixed metallic structures having adequate strength and appropriate design, which can withstand the load of the modules and high wind velocities. The support structure shall be hot dip galvanized steel or aluminum. - Angle of orientation: When installation Panel tilt angle **South – South West** orientation with a fixed tilt **angle 20 - 30 degrees.** - Structural material: **hot dip galvanized steel** or **aluminum** alloy. - Hot dip galvanized: **≥ 80 micron galvanization thickness** - Minimum **clearance** of the structure from the roof level should be **300 mm.** - Wind velocity withstanding capacity: **180 km / hour.** - Bolts, nuts, fasteners, panel mounting clamps: **Stainless steel SS 304** - Mounting arrangement for elevated structures: The elevated structure has to be Securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted. - Installation: The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site. - Access for panel cleaning and maintenance All solar panels must be accessible from the top for cleaning and from the bottom for access to the module-junction box. - The prospective Installer shall specify installation details of the solar PV modules and the support structures with lay-out drawings and array connection diagrams. The work shall be carried out as per the designs approved by the Inspector.	
3	**DC Junction boxes / PV Combiner boxes** These combiner boxes are equipped with touch DC fuse-holders, DC fuses, reverse protection diodes, lightning induced DC surge arresters and load disconnect switches. Combiner boxes are installed near their PV arrays (that is, in the weather), and require appropriate outdoor ratings. Installations are expected to last at least the lifetime warranty of PV modules (about 25 years), so installing durable, long-lived equipment that will stand up to the environment in which it is placed is critical.	

	Combiner boxes should be Corrosion resistance, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door, Longer service life, Sun shields (Available for top, sides, and door). - Solar Combiner Box with Circuit Breakers - **16-String PV Enclosure - 10A Breakers.** - **16 String** Solar Power Combiner with **10 Amp Circuit Breakers.** - Each String Continuous Duty Rated at 250 - 600Vdc. - Photovoltaic High-Voltage Protection: Each String with **high-voltage fuses, over-voltage & over-current protection.** - **Lightning arrester** for both poles. - Anti-backflow **diodes**, anti-backflow & anti-reverse protection.(Can be equipped with modularized and encapsulated prevent-reverse diode) - **Circuit breaker output control, short-circuit fault protection, safe and reliable.** - Protection **class IP65** for **outdoor** with **waterproof, dustproof, rustproof, salt fog proof**, can be used outdoors. - Installation requirements. - Touch-safe Circuit Breakers& Non-conductive Box. - All UL Compliant Components Used. - Includes Output cable Glands &**Safety Labels.** - Includes **Lightning/Surge** Protection Module (**1000V**). - Max Total DC Output Current: **100A** - Max Input Voltage Rating: **250 -600Vdc.** - Max Output Voltage Rating: **250 -600Vdc.** - Operational Environment Temperature: **-30 C° ~ +75C°.** - Relative Humidity: **0-95%.** - Cooling Method: **Natural Cooling.** - Dimension: **At least 600*700*120mm.** - Double Flanged Door Opening, Rain Drip Lip, Back Panel and Mounting Tab ...etc.	
4	**<u>ON/OFF GRID Hybrid Solar Inverter</u>** - Type: **ON/Off Grid hybrid Solar Inverter 1/3 Phase with isolated transformer/High frequency output (If it 3ph type, the Unbalancing Tamper feature shall be not required).** - **Built-in MPPT solar controller.** - Solar Inverter modular design, with **parallel connection** to easy capacity expansion.	

	- Rated Continuous Output power: **8KVA with** Power factor: **>0.8 lag. &**THD: **<3%.** Safe and stable. - Output Wave Form: **Pure Sine wave.** - Inverter Efficiency: **>85%.** - Output Voltage: 2line (230VAc±5%) / 4 line **(380VAc±5%).** - Output Frequency: **50Hz±3.** - Inverter Overload Capacity: for load **≥150% 1 Min, for** load ≥ **125% for 2Min** - Battery System Voltage: **As system design required / a suitable Batteries Voltage System with same capacity of batteries in WH that mentioned below in batteries Bank Item.** - Solar charge Controller Type: **- MPPT smart charging** with **temperature sensor** for batteries. **- MPPT. Boost and Float, Smart Charger multi stage (plus) Suitable for AGM battery/ OPZV.** - V_{mpp} Range: **As system design required. (more than 150Vdc Preferred).** - Solar Charge Current: **1/ 2/3 Built-in MPPT solar controller each one of a range from 60 to 100 Amp as system required.** - AC Charge Current: **adjustable from 20A to 80Amp / As system design required.** - Max Open circuit Voltage (Vdc) : **As system design required.** - Max solar PV panels array capacity (Wp): **Not less than11,000W.** - No-load losses : **less than 1% of rated power.** - System Operating Modes/Priority: **Solar>Grid>Battery by default (Auto mode). Can be configured to set priority rates of charging from solar panel.** - Grid input voltage: **165-265Vac/ 380-420Vac.** - Grid frequency range: **47-53Hz.** - Ambient temperature considered : **-20°C to 50°C or better.** - Relative Humidity: **>90% Non-Condensing.** - Operation Temperature Range: **- 20C°≈ 50C°.** - Protection of Enclosure (Body): Indoor with **IP20.** - Cooling: **Heat sinks, Fins (extended surfaces) and Fans with temperature sensors. Intelligent Variable Speed Fan Operation.** - The inverter/s will be protected against grid voltage and frequency anomalies. - Programmable multiple operation mode: **OFF-Grid, ON-Grid (Grid-Tie), ON-Grid (Grid-Tie) with backup battery.** - Battery type setup to get the best charge voltage and node feature. - Hybrid Support main/generator input. - Directly power from PV to loads. - Programmable supply priority for **PV, Battery** or **Load Grid**. - Intelligent battery management and temperature compensation function. - System should be reliable environmentally friendly, high intelligence and	

	other characteristics. - Perfect Protection: DC&AC overload, Under-voltage, SPD, Short-Circuit, Overcharge, Over discharge, Over-temperature, etc. - Display: LCD display + LED status indicator. - Display content: PV status, battery capacity, AC input voltage, AC output voltage, Load, running status, etc. - Comply with applicable **IEC** standard **IEC 61683** and with the safety standard **IEC 62109**. If the design used **Parallel Connection feature** (more than one solar inverter connected together to perform the output power capacity), the following item should be taken: 1- The **output power** should be **not less than 8 KVA with ≥ 0.8 power factor.** 2- The **overall capacity of MPPTs** should be **not less than 11,000W.** 3- The **overall capacity of batteries bank** should be **not less than 14,000WH.** 4- The **parallel connection** of solar inverters must be **safe** and **stable.** 5- The **output voltage** may **1ph (230Vac)** or **3ph (380Vac without phase unbalancing tampering).** 6- The solar input capacity, output power capacity, batteries system voltage, interfacing, display, etc of the inverters must be selected to achieve the **overall function and performance** of system and must be selected accordance to **related international standards and specifications.**	
5	**Batteries Bank :** - Normal range voltage of batteries bank (V): **48Vdc to 200Vdc.** - Capacity of batteries bank (WH): **at least 14,000WH.** - Number of batteries: **Suitable for solar system design.** **Specifications for each battery:** - Sealed construction. - Matching and Balancing **1 cell / 3 cells / 6 cells in series** with nominal cell voltage **2 volt.** - Peak voltage for cells: **2.40V to 2.45V/cell.** - Maintenance- Free Operation (**VRLA**). - **Heavy-Duty Grids, lead plates thick.** - Weight: heavier batteries. - Production Date: must be newer than **10/2016.** - Wide Operating Temperature Range (**$-20C^0 \approx +60C^0$**). - Suitable **Charging / Discharging Current rate** according to solar **PV array & loads (Inverter capacity) / system design.** - Low self-discharge less than **5% per month.** - Low internal resistance less than **4 to 7 mΩ (m Ohm)** - High specific power/energy (**30-50Wh/Kg**), capable of high discharge currents. - Outstanding performance and **long battery life.**	

	- **Deep-Cycle, AGM** batteries feature Or **OPZV.** - Cycle performance: **not less 1500 Cycle @ 50 % DOD.** - Terminations: **Screw Type.** - Applications: **solar system applications.** - Temperature coefficient less than **(-3mV/C^0/Cell), 25C^0.** - Conforms to **IEC 60896 (part 1&2), IEC 60079, CE,** and all standards & certificates &**Success stories** (or previous projects where this product was used) which related. - Service life (**Long shelf life**): **not less than 4 years.** - Container & Cover: **Acid-resistant ABS resin.** - The gelled (**AGM**) electrolyte is a proprietary formulation that delivers consistent performance and dramatically extends the battery's cycle life. - Battery cell designed for maximum capacity. Power density may be compromised.	
6	**Inverter & Battery Rack:** - Should be **closed type** cabinets to use for placing batteries and solar inverter in an efficient manner. - Provide adequate ceiling clearance for ventilation and maintenance. - Should be **Convenient, Easy to clean, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door (Key lock), Longer service life, Sturdy and Rigid design, excellent in finishing and smooth edges.** - Battery Rack should be **smooth finishing** standards and is available in **suitable sizes** as per the system requirements (solar inverter & batteries). - Consist of shelves, **ventilation fans** available in **24V**, and **48V DC/220V AC.** - Ventilation fans (**24Vdc / 48Vdc**) must be connected to the battery bank (**24Vdc / 48Vdc**) to be operated by an external controller to ensure that they operate even when the inverter is switched off. - Standard **ventilation holes** are punctured on all sides including floors of shelves. - The clearance of place **floor and ceiling** of first shelve should not be **less than 20 cm / as required.** - Stable base: The weight should be **distributed** on all loading substrates. - Enclosure Dimensions - Overall: **at least (H) 1.8 m x (W) 2m x (D) 1m or suitable for batteries and solar inverter.**	
7	**AC Distribution Board (ACDB)** The inverter output will be connected to the existing AC Distribution Board (DB). The contractor will verify the compliance of the existing AC DB with EU standards and if needed adapt the ACDB for integration of the solar system. All switches and the circuit breakers, connectors should conform to **IEC 60947, part I, II and III.** All **indoor** equipment will have protection of **IP52 or better**. All **outdoor** panels will have protection of **IP65** or better.	

All the devices / equipment like change over, circuit breakers, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under harsh environmental conditions.

The AC Distribution board shall consist of the following items:

Item	Description	Quantity
AC Circuit Breaker	- **MCB** type. - Voltage:**220 VAC or380 VAC – 420VAC.** - Rated frequency: **50 Hz** - Cutoff Current: It must be cutoff at **8000VA** within less than **3 seconds.** - Opening Time: 40-60 ms - Closing Time: 60-80 ms - Suitable Isolation: Yes - Utilization Category: **B** - No. of Poles: **2/3/4 poles.** - Mechanical Life: at least **15000.** - Rated duration of Short Circuit Current: less than **3Sec.** - Ambient Temperature: **50C°**	**1**
Manual Change Over	- **MCB** type. - Voltage: **220VAC / 380 VAC – 420VAC.** - Cutoff Current: **at least 100 Amp.** - Rated frequency: **50 Hz.** - No. of Poles: at least: **6 poles.2poles for load output, 2 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 1PH.** **12 poles.4poles for load output, 4 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 3PH.** - Ambient Temperature: **50C°** - Mechanical Life: at least **15000.**	**1**

Circuit Breakers shall be provided for circuit protection. They shall be suitable for over load and short circuit protection of the feeders.

The insulating case and cover shall be made of high strength, heat resistant, flame retardant material.

The MCB shall be provided with a quick make- quick break type of switching mechanism which a definite speed of travel of moving contacts is ensured.

All internal wiring shall be carried out with PVC insulated, stranded copper

conductor, single core, **6-10 sq. mm.** or larger stranded copper wires.
The enclosure shall be dust & vermin proof, Rust proof and Corrosion resistance with a degree of protection of **IP-52**.

8 **Cables.**

Sections of cables between **array interconnections**, **array to combiner boxes**, **combiner boxes to inverter**, **inverter to batteries**, **batteries interconnections**, **inverter to ACDB**, etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum:

- For DC cables, the maximum drop shall be limited to **3%**;
- For AC cables, the maximum drop shall be limited to **2%.**

Cables of appropriate size to be used in the system shall have the following characteristics:

- **Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards.**
- **Temp. Range: –10°C to +80°C;**
- **Voltage rating 600/1000V;**
- **Excellent resistance to heat, cold, water, oil, abrasion, UV radiation;**
- **Flexible;**
- **All conductors shall be copper;**

The outside cables :

- Should be **specific solar cables, insulated** with a **special grade PVC compound formulated** for **outdoor** use (**UV, weather protection**).

Cable routing/ marking:

- All cable/wires are to be routed in pipes and suitably **tagged** and **marked** with proper manner so that the cable **easily identified**.

Life Time:

- The cable should be so selected that it should be compatible **up to the life of the solar PV panels**, i.e. 20 years.
- Calculations of the current rating of the cables should be according to **IEC 60287**.

Cables to comply with :

- **IEC 60228 Conductors of insulated cables;**
- **IEC 60502 Power cables with extruded insulation;**

Sizing and length of Cables:

1) Cables between array interconnections:

Description	Type	Length	Size

DC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	single core/ Multi-core Colored	10 meters per System	10 sq. mm

2) Array to combiner boxes:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	Multi-core Colored	20 meters per System	2×10 sq. mm

3) Combiner boxes to inverter:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	Multi-core Colored	20 meters per System	4×25 sq. mm

4) Inverter to batteries:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated. • Multi-stranded flexible copper. • Indoor. • Heat resist.	Single – core Black color	3 meters per System	50 sq. mm
	Single – core Red color	3 meters per System	

5) Batteries interconnections:

Description	Type	Length	Size

	DC cabling; • PVC. • Insulated. • Multi-stranded flexible copper. • Indoor. • Heat resist.	Single – core colored	1 meters per System	50 sq. mm	

6) Inverter to ACDB:

Description	Type	Length	Size
AC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	Multi-core Colored	20 meters per System	4×10 sq. mm

9 Wiring Pipes.

PVC pipe minimum 50mm diameter (or as required) and above depending on No. of wires to be drawn, HMS grade (1 - 2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non-inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid.

Black pipe shall not be used for surface type wiring.

- Pipe type: **Rigid PVC conduits.**
- Thickness: 1.3mm to 2.0mm.
- Color: **white.**
- Size: **50 /70mm dia. / as required.**
- Smooth inner surface for easy wiring.
- Flexibility for long radius bending.
- Long lasting life.
- Non Conductor of Electricity and prevent Electrical shocks.
- High mechanical strength for buried and open application.
- Non corrosive in nature and are immune to Chemical and Galvanic corrosion.
- Do not support combustion and are self-extinguishing.
- Light weight to handle, install and Transport.

10 Earthing & Grounding System:

The contractor shall provide the complete bonding & earthling of the neutral point of power system & non-current carrying metal parts of all electrical equipment & apparatus.

Each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors. All electrical equipment, except those operating at extra low voltages shall be provided

with an earth terminal.

EARTH PIT DETAILS:

Copper earth rod of 35/50 sq. mm x 1000 mm buried in specifically prepared earth pit of 1.2 meters below ground level with **20 kg charcoal & salt** with alternate layers of charcoal & salt with 2 number of **50 mm dia. C class GI pipe** with **funnel** with wire mesh for watering &**brick masonry block** cover, heavy duty **cast iron cover** complete as per IS : 3043.

Necessary connections shall be done using **copper wire of 25 sq. mm** copper wire as per instructions of inspector connected to nearest switch gears as directed & duly tested by earth tester.

Pipe electrode shall be of 1.5 M long 50 mm dia. class C GI pipe. The GI pipes shall be provided with holes at regular intervals as per IS : 3043.

Each array structure and all metal casings of the panel etc. shall be earthed properly. And connected to ground hole including pure copper rod 50 sq.mm and adding salts and carbon.

RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1.0 ohm.

MATERIALS:

Item	Quantity
Copper earth rod of 35/50 sq. mm	**1 meter**
Charcoal & salt	**20Kg**
Copper wire of 25 sq. mm	**As per system requirement.**
C class GI pipe50 mm dia.	**2 × 1.5 meter**
Funnel	**1**
Cast Iron cover	**1**
Brick Masonry Block	**Suitable for earth pit**

General Description

ON/OFF Grid Photovoltaic power system with backup battery consists of PV array, module mounting structure, Inverter with built-in MPPT Controller/s, Backup Batteries & Protections, Cables and Switches etc.

PV array is mounted on a suitable structure. ON/OFF Grid Solar PV system is working with/without batteries (Grid-Tie with backup battery) and should be designed with necessary features to supply directly the power generated by PV to the load grid and charge the batteries to be used in night.

All components and parts used in the PV power systems should conform to the IEC standards.

Scope of Works:

- Design, supply, installation, commissioning and comprehensive maintenance for number of Solar Photovoltaic Systems power solutions with battery backup.
- Carry out all civil works for PV array and distribution line.
- Carry out all civil and electrical works for SPV compatible electrical systems and distribution line.
- Ensure each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors.
- Ensure all electrical equipment, except those operating at extra low voltages will be provided with an earth terminal.
- Supply of the complete systems, including all necessary components, subcomponents, spares, and tools etc. as per technical specifications given elsewhere in this document.
- Erection and commissioning of the supplied systems on the specified site and do any other work urgently required as per site conditions.
- The bidder must also provide a detailed operation and maintenance manual specific to the installed systems.
- Fabrications, supply and the installation of suitable support for the PV panels and other components whichever is required with the accessories.
- Civil work for mounting the panel.
- Any additional works not covered above, but necessary for the functioning of the system and required as per specification incorporated. The works of minor nature, which are not mentioned, shall be incorporated by the bidder.
- Any tender not containing sufficient descriptive material to describe the proposed equipment / components of the system may be treated as incomplete and hence may be rejected. Such descriptive materials and specifications submitted will be retained. Any big deviations from these will not be accepted.
- Detailed implementation plan should be submitted along with the offer.
- The bidder is responsible for arranging all accessories and measuring instruments required to smoothly commission the system.
- Regarding actual work to be carried out at the site bidder needs to execute the work in consultation with the inspector.
- Locations: Supply of solar systems, transportation, installation and commissioning in schools as per the following Quantities & Delivery locations:

Table of Quantities & Delivery Locations

Gov.	District	Activity	Location Name	10 Kwp	13 Kwp	15 Kwp	LED Bulbs
Hadramawt		SCHOOLS	JEFEL GIRLS ELEMENTARY	1	0	0	49
		SCHOOLS	JEFEL BOYS ELEMENTARY	1	0	0	30
		SCHOOLS	AL SABBAN SECONDARY	1	0	0	0
		SCHOOLS	ALHAWATAH GIRLS ELEMENTARY	0	1	0	52
		COLLEGE	WOMEN'SCOLLEGE	0	1	0	0
		SCHOOLS	ALHAWATAH BOYS ELEMENTARY	0	0	1	61
		SCHOOLS	SHIBAM SECONDARY	0	0	1	0
Total				3	2	2	192

Technical Requirements

Solar PV system shall consists of following equipment/components:

- Solar PV modules consisting of required number of Crystalline PV modules;
- ON/OFF Grid (Grid-tied with backup battery) solar inverter (with built in MPPT controller);
- Storage Batteries consisting of required capacity of AH;
- Mounting structures suitable for number of PV panels;
- Junction Boxes (PV array JB/DC JB, AC JB);
- Earthing, short-circuit, surge and lightning protections ;
- IR/UV protected cables, pipes and accessories;
- Interconnects, connectors and protection devices;
- Box/Rack or container for inverter and batteries.
- Light bulbs (W-LED Lamps).

Warranty:

The PV modules will be warranted for a minimum period of 25 years from the date of supply. (Output wattage should not be less than 90% at the end of 10 years and 80% at the end of 25 years).

Necessary maintenance spares for five years trouble free operation shall also be supplied with the system.

The mechanical structures, electrical components including inverter and overall workmanship of the Solar System must be warranted for a minimum of 5 years except the batteries should be warranted for 2 years. All these items must be as per IEC (or equivalent) specifications and standards.

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

The supplier may provide his own design for the solar system in proportion to the equipment that he will provide in his offer, provided that it ensures that the system meets the required performance and the equipment/components should be comply with the main specifications and standards mentioned in this document.

LOT 2

13 Kwp Solar PV Power Solution with Battery Backup

Detail specification for one complete system of 13KWatt

No.	Technical Specification		
1	**Photovoltaic modules:** - Solar Panel Wattage at STC: Shall be ≥ **250Wp** (Bigger watt size Solar PV module will be **preferred**). - Type of PV Module: Higher cell efficiency **Poly Crystalline.** - Module efficiency:**≥16%.** - Open Circuit Voltage of each panel: **≥42Vdc.** - Max MPPT Voltage of each panel:**≥30Vdc.** - Short Circuit Current (A): **≥8.5 Amp.** - Max. Power Current (A): **≥ 8 Amp.** - No of cells in each panel:**60/72 per panel.** - Total No of panels: **as required.** - Total Wattage:**13,000 Watt p.** - Preferred Arrangement of solar panels: **3 or4 Series, ≥10 parallel of series** - Module frame: **Aluminum anodized or corrosion resistant material.** The anodizing Thickness shall be **15 micron or better.** - Conform to **IEC 61215, IEC 61730** and **CE.** or equivalent - PV modules to be used in a highly corrosive atmosphere (Coastal area etc.) must qualify salt mist corrosion testing IEC **61701/ IS 61701.** - Tolerance of maximum power rating: **±3%.** - High transmittance glass: **minimum thickness of 3/4.0 mm.** - Min. system voltage: **≥1000V.** - PV junction box: **IP65** with sufficient at least **3/4 bypass diodes.** Highly heat-resistant bypass diode. - Warranty : **Nominal power output 90% for 10 years, 80% for 25years** - **Weather proof DC rated MC4** connector. Easier and secure, not allowing for any loose connections. - Lead cable coming out as a part of the module: **≥ 4mm², length 1000mm& weather proofed** - **Temperature coefficient: Less than -0.42%/°C.** - Thermal coefficient of voltage: **Less than-0.3/ C⁰.** - With Normal operating temperature coefficient (NOTC): **45 ±2°C.** - **Operational Temperature: -40 ~ +85°C** - Easy to install, easier to grip frame. - Good tab thickness, heavy duty frame. - Resistant of **water, abrasion, hail impact, humidity**& other environment factor for the worst situation at site and **water drainage** structure. Suitable encapsulation and sealing arrangements to protect the silicon cells from the harsh environment.		
2	**Mounting structure For PV Panels** The PV modules shall be mounted on fixed metallic structures having adequate strength		

	and appropriate design, which can withstand the load of the modules and high wind velocities. The support structure shall be hot dip galvanized steel or aluminum. - Angle of orientation: When installation Panel tilt angle **South – South West** orientation with a fixed tilt **angle 20 - 30 degrees.** - Structural material: **hot dip galvanized steel** or **aluminum** alloy. - Hot dip galvanized: **≥ 80 micron galvanization thickness** - Minimum **clearance** of the structure from the roof level should be **300 mm.** - Wind velocity withstanding capacity: **180 km / hour.** - Bolts, nuts, fasteners, panel mounting clamps: **Stainless steel SS 304** - Mounting arrangement for elevated structures: The elevated structure has to be Securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted. - Installation: The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site. - Access for panel cleaning and maintenance All solar panels must be accessible from the top for cleaning and from the bottom for access to the module-junction box. - The prospective Installer shall specify installation details of the solar PV modules and the support structures with lay-out drawings and array connection diagrams. The work shall be carried out as per the designs approved by the Inspector.	
3	**DC Junction boxes / PV Combiner boxes** These combiner boxes are equipped with touch DC fuse-holders, DC fuses, reverse protection diodes, lightning induced DC surge arresters and load disconnect switches. Combiner boxes are installed near their PV arrays (that is, in the weather), and require appropriate outdoor ratings. Installations are expected to last at least the lifetime warranty of PV modules (about 25 years), so installing durable, long-lived equipment that will stand up to the environment in which it is placed is critical. Combiner boxes should be Corrosion resistance, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door, Longer service life, Sun shields (Available for top, sides, and door). - Solar Combiner Box with Circuit Breakers - **16-String PV Enclosure - 10A Breakers.** - **16 String** Solar Power Combiner with **10 Amp Circuit Breakers.** - Each String Continuous Duty Rated at 250 - 600Vdc. - Photovoltaic High-Voltage Protection: Each String with **high-voltage fuses, over-voltage & over-current protection.** - **Lightning arrester** for both poles. - Anti-backflow **diodes,** anti-backflow & anti-reverse protection.(Can be equipped with modularized and encapsulated prevent-reverse diode) - **Circuit breaker output control, short-circuit fault protection, safe and reliable.** - Protection **class IP65** for **outdoor** with **waterproof, dustproof, rustproof, salt fog proof,** can be used outdoors.	

	- Installation requirements. - Touch-safe Circuit Breakers& Non-conductive Box. - All UL Compliant Components Used. - Includes Output cable Glands &**Safety Labels**. - Includes **Lightning/Surge** Protection Module (**1000V**). - Max Total DC Output Current: **100A** - Max Input Voltage Rating: **250 -600Vdc**. - Max Output Voltage Rating: **250 -600Vdc**. - Operational Environment Temperature: **-30 C° ~ +75C°**. - Relative Humidity: **0-95%**. - Cooling Method: **Natural Cooling**. - Dimension: **At least 600*700*120mm.** - Double Flanged Door Opening, Rain Drip Lip, Back Panel and Mounting Tab ...etc.	
4	**ON/OFF GRID Hybrid Solar Inverter** - Type: **ON/Off Grid hybrid Solar Inverter 1/3 Phase with isolated transformer/High frequency output (If it 3ph type, the Unbalancing Tamper feature shall be not required).** - **Built-in MPPT solar controller.** - Solar Inverter modular design, with **parallel connection** to easy capacity expansion. - Rated Continuous Output power: **10KVA with** Power factor: **>0.8 lag. &**THD: **<3%.** Safe and stable. - Output Wave Form: **Pure Sine wave.** - Inverter Efficiency: **>85%.** - Output Voltage: 2line (230VAc±5%) / 4 line **(380VAc±5%).** - Output Frequency: **50Hz±3.** - Inverter Overload Capacity: for load **≥150% 1 Min, for** load **≥ 125% for 2Min** - Battery System Voltage: **As system design required / a suitable Batteries Voltage System with same capacity of batteries in WH that mentioned below in batteries Bank Item.** - Solar charge Controller Type: **- MPPT smart charging** with **temperature sensor** for batteries. **- MPPT. Boost and Float, Smart Charger multi stage (plus) Suitable for AGM battery/ OPZV.** - V_{mpp} Range: **As system design required. (more than 150Vdc Preferred).** - Solar Charge Current: **1/ 2/3 Built-in MPPT solar controller each one of a range from 60 to 100 Amp as system required.** - AC Charge Current: **adjustable from 20A to 80Amp / As system design required.**	

- Max Open circuit Voltage (Vdc) : **As system design required.**
- Max solar PV panels array capacity (Wp): **Not less than14,000W.**
- No-load losses : **less than 1% of rated power.**
- System Operating Modes/Priority: **Solar>Grid>Battery by default (Auto mode). Can be configured to set priority rates of charging from solar panel.**
- Grid input voltage: **165-265Vac/ 380-420Vac.**
- Grid frequency range: **47-53Hz.**
- Ambient temperature considered : **-20°C to 50°C or better.**
- Relative Humidity: **>90% Non-Condensing.**
- Operation Temperature Range: **- 20C°≈ 50C°.**
- Protection of Enclosure (Body): Indoor with **IP20.**
- Cooling: **Heat sinks, Fins (extended surfaces) and Fans with temperature sensors. Intelligent Variable Speed Fan Operation.**
- The inverter/s will be protected against grid voltage and frequency anomalies.
- Programmable multiple operation mode: **OFF-Grid, ON-Grid (Grid-Tie), ON-Grid (Grid-Tie) with backup battery.**
- Battery type setup to get the best charge voltage and node feature.
- Hybrid Support main/generator input.
- Directly power from PV to loads.
- Programmable supply priority for **PV, Battery** or **Load Grid.**
- Intelligent battery management and temperature compensation function.
- System should be reliable environmentally friendly, high intelligence and other characteristics.
- Perfect Protection: DC&AC overload, Under-voltage, SPD, Short-Circuit, Overcharge, Over discharge, Over-temperature, etc.
- Display: LCD display + LED status indicator.
- Display content: PV status, battery capacity, AC input voltage, AC output voltage, Load, running status, etc.
- Comply with applicable **IEC** standard **IEC 61683** and with the safety standard **IEC 62109.**

If the design used **Parallel Connection feature** (more than one solar inverter connected together to perform the output power capacity), the following item should be taken:

1- The **output power** should be **not less than 10 KVA with ≥ 0.8 power factor.**
2- The **overall capacity of MPPTs** should be **not less than 14,000W.**
3- The **overall capacity of batteries bank** should be **not less than 19,000WH.**
4- The **parallel connection** of solar inverters must be **safe** and **stable.**
5- The **output voltage** may **1ph (230Vac)** or **3ph (380Vac without phase unbalancing tampering).**
6- The solar input capacity, output power capacity, batteries system voltage, interfacing, display, etc of the inverters must be selected to achieve the

	overall function and performance of system and must be selected accordance to **related international standards and specifications.**	
5	**Batteries Bank :** - Normal range voltage of batteries bank (V): **48Vdc to 200Vdc.** - Capacity of batteries bank (**WH**): **at least 19,000WH.** - Number of batteries: **Suitable for solar system design.** **Specifications for each battery:** - Sealed construction. - Matching and Balancing **1 cell / 3 cells / 6 cells in series** with nominal cell voltage **2 volt.** - Peak voltage for cells: **2.40V to 2.45V/cell.** - Maintenance- Free Operation (**VRLA**). - **Heavy-Duty Grids, lead plates thick.** - Weight: heavier batteries. - Production Date: must be newer than **10/2016.** - Wide Operating Temperature Range **(-20C⁰ ≈ +60C⁰).** - Suitable **Charging / Discharging Current rate** according to solar **PV array & loads (Inverter capacity) / system design.** - Low self-discharge less than **5% per month.** - Low internal resistance less than **4 to 7 mΩ (m Ohm)** - High specific power/energy (**30-50Wh/Kg**), capable of high discharge currents. - Outstanding performance and **long battery life.** - **Deep-Cycle, AGM** batteries feature Or **OPZV.** - Cycle performance: **not less 1500 Cycle @ 50 % DOD.** - Terminations: **Screw Type.** - Applications: **solar system applications.** - Temperature coefficient less than **(-3mV/C⁰/Cell), 25C⁰.** - Conforms to **IEC 60896 (part 1&2), IEC 60079, CE,** and all standards & certificates &**Success stories** (or previous projects where this product was used) which related. - Service life (**Long shelf life**): **not less than 4 years.** - Container & Cover: **Acid-resistant ABS resin.** - The gelled (**AGM**) electrolyte is a proprietary formulation that delivers consistent performance and dramatically extends the battery's cycle life. - Battery cell designed for maximum capacity. Power density may be compromised.	
6	**Inverter & Battery Rack:** - Should be **closed type** cabinets to use for placing batteries and solar inverter in an efficient manner. - Provide adequate ceiling clearance for ventilation and maintenance. - Should be **Convenient, Easy to clean, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door (Key lock), Longer service life, Sturdy and**	

	Rigid design, excellent in finishing and smooth edges. - Battery Rack should be **smooth finishing** standards and is available in **suitable sizes** as per the system requirements (solar inverter & batteries). - Consist of shelves, **ventilation fans** available in **24V**, and **48V DC/220V AC.** - Ventilation fans **(24Vdc / 48Vdc)** must be connected to the battery bank **(24Vdc / 48Vdc)** to be operated by an external controller to ensure that they operate even when the inverter is switched off. - Standard **ventilation holes** are punctured on all sides including floors of shelves. - The clearance of place **floor and ceiling** of first shelve should not be **less than 20 cm.** - Stable base: The weight should be **distributed** on all loading substrates. - Enclosure Dimensions - Overall: **at least (H) 1.8 m x (W) 2m x (D) 1m or suitable for batteries and solar inverter.**	

7 **AC Distribution Board (ACDB)**

The inverter output will be connected to the existing AC Distribution Board (DB). The contractor will verify the compliance of the existing AC DB with EU standards and if needed adapt the ACDB for integration of the solar system.

All switches and the circuit breakers, connectors should conform to **IEC 60947, part I, II and III.** All **indoor** equipment will have protection of **IP52 or better.** All **outdoor** panels will have protection of **IP65** or better.

All the devices / equipment like change over, circuit breakers, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under harsh environmental conditions.

The AC Distribution board shall consist of the following items:

Item	Description	Quantity
AC Circuit Breaker	- **MCB** type. - Voltage:**220 VSC or380 VAC – 420VAC.** - Rated frequency: **50 Hz** - Cutoff Current: It must be cutoff at **10,000VA** within less than **3 seconds.** - Opening Time: 40-60 ms - Closing Time: 60-80 ms - Suitable Isolation: Yes - Utilization Category: **B** - No. of Poles: **2/3/4 poles.** - Mechanical Life: at least **15000.** - Rated duration of Short Circuit Current: less than 3Sec. - Ambient Temperature: **50C°**	1
Manual Change Over	- **MCB** type. - Voltage: **220VAC / 380 VAC – 420VAC.** - Cutoff Current: **at least 100 Amp.** - Rated frequency: **50 Hz.** - No. of Poles: at least: **6 poles.2poles for load output, 2 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 1PH.**	1

		12 poles.4poles for load output, 4 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 3PH. - Ambient Temperature: **50C°** - Mechanical Life: at least **15000.**	

Circuit Breakers shall be provided for circuit protection. They shall be suitable for over load and short circuit protection of the feeders.

The insulating case and cover shall be made of high strength, heat resistant, flame retardant material.

The MCB shall be provided with a quick make- quick break type of switching mechanism which a definite speed of travel of moving contacts is ensured.

All internal wiring shall be carried out with PVC insulated, stranded copper conductor, single core, **6-10 sq. mm.** or larger stranded copper wires.

The enclosure shall be dust & vermin proof, Rust proof and Corrosion resistance with a degree of protection of **IP-52.**

8

Cables.

Sections of cables between **array interconnections**, **array to combiner boxes**, **combiner boxes to inverter**, **inverter to batteries**, **batteries interconnections**, **inverter to ACDB**, etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum:

- For DC cables, the maximum drop shall be limited to **3%**;
- For AC cables, the maximum drop shall be limited to **2%.**

Cables of appropriate size to be used in the system shall have the following characteristics:

- **Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards.**
- **Temp. Range: –10°C to +80°C;**
- **Voltage rating 600/1000V;**
- **Excellent resistance to heat, cold, water, oil, abrasion, UV radiation;**
- **Flexible;**
- **All conductors shall be copper;**

The outside cables :

- Should be **specific solar cables, insulated** with a **special grade PVC compound formulated** for **outdoor** use **(UV, weather protection)**.

Cable routing/ marking:

- All cable/wires are to be routed in pipes and suitably **tagged** and **marked** with proper manner so that the cable **easily identified**.

Life Time:

- The cable should be so selected that it should be compatible **up to the life of the solar PV panels**, i.e. 20 years.
- Calculations of the current rating of the cables should be according to **IEC 60287**.

Cables to comply with :

- **IEC 60228 Conductors of insulated cables;**
- **IEC 60502 Power cables with extruded insulation;**

Sizing and length of Cables:

1) Cables between array interconnections:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.** • **Multi-stranded flexible copper.** • **Outdoor.** • **Weather proof.**	**single core/ Multi-core Colored**	**10 meters** per System	**10 sq. mm**

2) Array to combiner boxes:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.**	**Multi-core Colored**	**20 meters** per System	**2×10 sq. mm**

• Multi-stranded flexible copper. • Outdoor. • Weather proof.			

3) Combiner boxes to inverter:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	Multi-core Colored	20 meters per System	4×25 sq. mm

4) Inverter to batteries:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated. • Multi-stranded flexible copper. • Indoor. • Heat resist.	Single – core Black color	3 meters per System	50 sq. mm
	Single – core Red color	3 meters per System	

5) Batteries interconnections:

Description	Type	Length	Size
DC cabling; • PVC. • Insulated. • Multi-stranded flexible copper. • Indoor. • Heat resist.	Single – core colored	1 meters per System	50 sq. mm

6) Inverter to ACDB:

Description	Type	Length	Size
AC cabling; • PVC. • Insulated and sheathed. • UV-stabilized. • Multi-stranded flexible copper. • Outdoor. • Weather proof.	Multi-core Colored	20 meters per System	4×10 sq. mm

9	**Wiring Pipes.** PVC pipe minimum 50mm diameter (or as required) and above depending on No. of wires to be drawn, HMS grade (1 - 2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non-inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring. - Pipe type: **Rigid PVC conduits.** - Thickness: 1.3mm to 2.0mm. - Color: **white.** - Size: **50 /70mm dia.** as required. - Smooth inner surface for easy wiring. - Flexibility for long radius bending. - Long lasting life. - Non Conductor of Electricity and prevent Electrical shocks. - High mechanical strength for buried and open application. - Non corrosive in nature and are immune to Chemical and Galvanic corrosion. - Do not support combustion and are self-extinguishing. - Light weight to handle, install and Transport.	
10	**Earthing & Grounding System:** The contractor shall provide the complete bonding & earthling of the neutral point of power system & non-current carrying metal parts of all electrical equipment & apparatus. Each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors. All electrical equipment, except those operating at extra low voltages shall be provided with an earth terminal. EARTH PIT DETAILS: **Copper earth rod of 35/50 sq. mm x 1000 mm** buried in specifically prepared earth pit of 1.2 meters below ground level with **20 kg charcoal & salt** with alternate layers of charcoal & salt with 2 number of **50 mm dia. C class GI pipe** with **funnel** with wire mesh for watering &**brick masonry block** cover, heavy duty **cast iron cover** complete as per IS : 3043. Necessary connections shall be done using **copper wire of 25 sq. mm** copper wire as per instructions of inspector connected to nearest switch gears as directed & duly tested by earth tester. Pipe electrode shall be of 1.5 M long 50 mm dia. class C GI pipe. The GI pipes shall be provided with holes at regular intervals as per IS : 3043. Each array structure and all metal casings of the panel etc. shall be earthed properly. And connected to ground hole including pure copper rod 50 sq.mm and adding salts and carbon. RESISTANCE TO EARTH The resistance of earthing system shall not exceed 1.0 ohm. MATERIALS:	

Item	Quantity
Copper earth rod of 35/50 sq. mm	1 meter
Charcoal & salt	20Kg
Copper wire of 25 sq. mm	As per system requirement.
C class GI pipe50 mm dia.	2 × 1.5 meter
Funnel	1
Cast Iron cover	1
Brick Masonry Block	Suitable for earth pit

General Description

ON/OFF Grid Photovoltaic power system with backup battery consists of PV array, module mounting structure, Inverter with built-in MPPT Controller/s, Backup Batteries & Protections, Cables and Switches etc.

PV array is mounted on a suitable structure. ON/OFF Grid Solar PV system is working with/without batteries (Grid-Tie with backup battery) and should be designed with necessary features to supply directly the power generated by PV to the load grid and charge the batteries to be used in night.

All components and parts used in the PV power systems should conform to the IEC standards.

Scope of Works:

- Design, supply, installation, commissioning and comprehensive maintenance for number of Solar Photovoltaic Systems power solutions with battery backup.
- Carry out all civil works for PV array and distribution line.
- Carry out all civil and electrical works for SPV compatible electrical systems and distribution line.
- Ensure each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors.
- Ensure all electrical equipment, except those operating at extra low voltages will be provided with an earth terminal.
- Supply of the complete systems, including all necessary components, subcomponents, spares, and tools etc. as per technical specifications given elsewhere in this document.
- Erection and commissioning of the supplied systems on the specified site and do any other work urgently required as per site conditions.
- The bidder must also provide a detailed operation and maintenance manual specific to the installed systems.
- Fabrications, supply and the installation of suitable support for the PV panels and other components whichever is required with the accessories.

- Civil work for mounting the panel.
- Any additional works not covered above, but necessary for the functioning of the system and required as per specification incorporated. The works of minor nature, which are not mentioned, shall be incorporated by the bidder.
- Any tender not containing sufficient descriptive material to describe the proposed equipment / components of the system may be treated as incomplete and hence may be rejected. Such descriptive materials and specifications submitted will be retained. Any big deviations from these will not be accepted.
- Detailed implementation plan should be submitted along with the offer.
- The bidder is responsible for arranging all accessories and measuring instruments required to smoothly commission the system.
- Regarding actual work to be carried out at the site bidder needs to execute the work in consultation with the inspector.
- Locations: Supply of solar systems, transportation, installation and commissioning in schools as per the following Quantities & Delivery locations:

Table of Quantities & Delivery Locations

Gov.	District	Activity	Location Name	10 Kwp	13 Kwp	15 Kwp	LED Bulbs
Hadramawt		SCHOOLS	JEFEL GIRLS ELEMENTARY	1	0	0	49
		SCHOOLS	JEFEL BOYS ELEMENTARY	1	0	0	30
		SCHOOLS	AL SABBAN SECONDARY	1	0	0	0
		SCHOOLS	ALHAWATAH GIRLS ELEMENTARY	0	1	0	52
		COLLEGE	WOMEN'SCOLLEGE	0	1	0	0
		SCHOOLS	ALHAWATAH BOYS ELEMENTARY	0	0	1	61
		SCHOOLS	SHIBAM SECONDARY	0	0	1	0
Total				3	2	2	192

Technical Requirements

Solar PV system shall consists of following equipment/components:

- Solar PV modules consisting of required number of Crystalline PV modules;
- ON/OFF Grid (Grid-tied with backup battery) solar inverter (with built in MPPT controller);
- Storage Batteries consisting of required capacity of AH;

- Mounting structures suitable for number of PV panels;
- Junction Boxes (PV array JB/DC JB, AC JB);
- Earthing, short-circuit, surge and lightning protections ;
- IR/UV protected cables, pipes and accessories;
- Interconnects, connectors and protection devices;
- Box/Rack or container for inverter and batteries.
- Light bulbs (W-LED Lamps).

Warranty:

The PV modules will be warranted for a minimum period of 25 years from the date of supply. (Output wattage should not be less than 90% at the end of 10 years and 80% at the end of 25 years).

Necessary maintenance spares for five years trouble free operation shall also be supplied with the system.

The mechanical structures, electrical components including inverter and overall workmanship of the Solar System must be warranted for a minimum of 5 years except the batteries should be warranted for 2 years. All these items must be as per IEC (or equivalent) specifications and standards.

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

The supplier may provide his own design for the solar system in proportion to the equipment that he will provide in his offer, provided that it ensures that the system meets the required performance and the equipment/components should be comply with the main specifications and standards mentioned in this document.

LOT 3

15Kwp Solar PV Power Solution with Battery Backup

Detail specification for one complete system of 15KWatt

No.	Technical Specification		
1	**Photovoltaic modules:** - Solar Panel Wattage at STC: Shall be ≥ **250Wp** (Bigger watt size Solar PV module will be **preferred**). - Type of PV Module: Higher cell efficiency **Poly Crystalline.** - Module efficiency:**≥16%.** - Open Circuit Voltage of each panel: **≥42Vdc.** - Max MPPT Voltage of each panel:**≥30Vdc.** - Short Circuit Current (A): **≥8.5 Amp.** - Max. Power Current (A): **≥ 8 Amp.** - No of cells in each panel:**60/72 per panel.** - Total No of panels: **as required.** - Total Wattage:**15,000 Watt p.** - Preferred Arrangement of solar panels: **3 or4 Series, ≥10 parallel of series** - Module frame: **Aluminum anodized** or **corrosion resistant material**. The anodizing Thickness shall be **15 micron or better**. - Conform to **IEC 61215, IEC 61730** and **CE**. or equivalent - PV modules to be used in a highly corrosive atmosphere (Coastal area etc.) must qualify salt mist corrosion testing IEC **61701/ IS 61701.** - Tolerance of maximum power rating: **±3%.** - High transmittance glass: **minimum thickness of 3/4.0 mm.** - Min. system voltage: **≥1000V**. - PV junction box: **IP65** with sufficient at least **3/4 bypass diodes**. Highly heat-resistant bypass diode. - Warranty :**Nominal power output 90% for 10 years, 80% for 25years** - **Weather proof DC rated MC4** connector. Easier and secure, not allowing for any loose connections. - Lead cable coming out as a part of the module: **≥ 4mm², length 1000mm& weather proofed** - **Temperature coefficient: Less than -0.42%/°C.** - Thermal coefficient of voltage: **Less than-0.3/ C⁰.** - With Normal operating temperature coefficient (NOTC): **45 ±2°C.** - **Operational Temperature: -40 ~ +85°C** - Easy to install, easier to grip frame. - Good tab thickness, heavy duty frame. - Resistant of **water, abrasion, hail impact, humidity**& other environment factor for the worst situation at site and **water drainage** structure. Suitable encapsulation and sealing arrangements to protect the silicon cells from the		

	harsh environment.	
2	**Mounting structure For PV Panels** The PV modules shall be mounted on fixed metallic structures having adequate strength and appropriate design, which can withstand the load of the modules and high wind velocities. The support structure shall be hot dip galvanized steel or aluminum. - Angle of orientation: When installation Panel tilt angle **South – South West** orientation with a fixed tilt **angle 20 - 30 degrees**. - Structural material: **hot dip galvanized steel** or **aluminum** alloy. - Hot dip galvanized: **≥ 80 micron galvanization thickness** - Minimum **clearance** of the structure from the roof level should be **300 mm.** - Wind velocity withstanding capacity: **180 km / hour.** - Bolts, nuts, fasteners, panel mounting clamps: **Stainless steel SS 304** - Mounting arrangement for elevated structures: The elevated structure has to be Securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted. - Installation: The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site. - Access for panel cleaning and maintenance All solar panels must be accessible from the top for cleaning and from the bottom for access to the module-junction box. - The prospective Installer shall specify installation details of the solar PV modules and the support structures with lay-out drawings and array connection diagrams. The work shall be carried out as per the designs approved by the Inspector.	
3	**DC Junction boxes / PV Combiner boxes** These combiner boxes are equipped with touch DC fuse-holders, DC fuses, reverse protection diodes, lightning induced DC surge arresters and load disconnect switches. Combiner boxes are installed near their PV arrays (that is, in the weather), and require appropriate outdoor ratings. Installations are expected to last at least the lifetime warranty of PV modules (about 25 years), so installing durable, long-lived equipment that will stand up to the environment in which it is placed is critical. Combiner boxes should be Corrosion resistance, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door, Longer service life, Sun shields (Available for top, sides, and door). - Solar Combiner Box with Circuit Breakers - **16-String PV Enclosure - 10A Breakers.** - **16 String** Solar Power Combiner with **10 Amp Circuit Breakers**. - Each String Continuous Duty Rated at 250 - 600Vdc. - Photovoltaic High-Voltage Protection: Each String with **high-voltage fuses, over-voltage & over-current protection**. - **Lightning arrester** for both poles. - Anti-backflow **diodes**, anti-backflow & anti-reverse protection.(Can be equipped with modularized and encapsulated prevent-reverse diode)	

	- **Circuit breaker output control, short-circuit fault protection, safe and reliable.** - Protection **class IP65** for **outdoor** with **waterproof, dustproof, rustproof, salt fog proof**, can be used outdoors. - Installation requirements. - Touch-safe Circuit Breakers& Non-conductive Box. - All UL Compliant Components Used. - Includes Output cable Glands &**Safety Labels.** - Includes **Lightning/Surge** Protection Module **(1000V).** - Max Total DC Output Current: **100A**	
	- Max Input Voltage Rating: **250 -600Vdc.** - Max Output Voltage Rating: **250 -600Vdc.** - Operational Environment Temperature: **-30 C° ~ +75C°.** - Relative Humidity: **0-95%.** - Cooling Method: **Natural Cooling.** - Dimension: **At least 600*700*120mm.** - Double Flanged Door Opening, Rain Drip Lip, Back Panel and Mounting Tab ...etc.	
4	**ON/OFF GRID Hybrid Solar Inverter** - Type: **ON/Off Grid hybrid Solar Inverter 1/3 Phase with isolated transformer/High frequency output (If it 3ph type, the Unbalancing Tamper feature shall be not required).** - **Built-in MPPT solar controller.** - Solar Inverter modular design, with **parallel connection** to easy capacity expansion. - Rated Continuous Output power: **10KVA with** Power factor: **>0.8 lag.** **&THD: <3%.** Safe and stable. - Output Wave Form: **Pure Sine wave.** - Inverter Efficiency: **>85%.** - Output Voltage: 2line (230VAc±5%) / 4 line **(380VAc±5%).** - Output Frequency: **50Hz±3.** - Inverter Overload Capacity: for load **≥150% 1 Min,** for load **≥ 125% for 2Min** - Battery System Voltage: **As system design required / a suitable Batteries Voltage System with same capacity of batteries in WH that mentioned below in batteries Bank Item.** - Solar charge Controller Type: **- MPPT smart charging** with **temperature sensor** for batteries. **- MPPT. Boost and Float, Smart Charger multi stage (plus) Suitable for AGM battery/ OPZV.** - V_{mpp} Range: **As system design required. (more than 150Vdc Preferred).**	

- Solar Charge Current: **1/ 2/3 Built-in MPPT solar controller each one of a range from 60 to 100 Amp as system required.**
- AC Charge Current: **adjustable from 20A to 80Amp / As system design required.**
- Max Open circuit Voltage (Vdc) : **As system design required.**
- Max solar PV panels array capacity (Wp): **Not less than16,000W.**
- No-load losses : **less than 1% of rated power.**
- System Operating Modes/Priority: **Solar>Grid>Battery by default (Auto mode). Can be configured to set priority rates of charging from solar panel.**
- Grid input voltage: **165-265Vac/ 380-420Vac.**
- Grid frequency range: **47-53Hz.**
- Ambient temperature considered : **-20°C to 50°C or better.**
- Relative Humidity: **>90% Non-Condensing.**
- Operation Temperature Range: **- 20C°≈ 50C°.**
- Protection of Enclosure (Body): Indoor with **IP20.**
- Cooling: **Heat sinks, Fins (extended surfaces) and Fans with temperature sensors. Intelligent Variable Speed Fan Operation.**
- The inverter/s will be protected against grid voltage and frequency anomalies.
- Programmable multiple operation mode: **OFF-Grid, ON-Grid (Grid-Tie), ON-Grid (Grid-Tie) with backup battery.**
- Battery type setup to get the best charge voltage and node feature.
- Hybrid Support main/generator input.
- Directly power from PV to loads.
- Programmable supply priority for **PV**, **Battery** or **Load Grid**.
- Intelligent battery management and temperature compensation function.
- System should be reliable environmentally friendly, high intelligence and other characteristics.
- Perfect Protection: DC&AC overload, Under-voltage, SPD, Short-Circuit, Overcharge, Over discharge, Over-temperature, etc.
- Display: LCD display + LED status indicator.
- Display content: PV status, battery capacity, AC input voltage, AC output voltage, Load, running status, etc.
- Comply with applicable **IEC** standard **IEC 61683** and with the safety standard **IEC 62109**.

If the design used **Parallel Connection feature** (more than one solar inverter connected together to perform the output power capacity), the following item should be taken:

1- The **output power** should be **not less than 10 KVA with ≥ 0.8 power factor.**
2- The **overall capacity of MPPTs** should be **not less than 16,000W.**
3- The **overall capacity of batteries bank** should be **not less than 19,000WH.**
4- The **parallel connection** of solar inverters must be **safe** and **stable.**

	5- The **output voltage** may **1ph (230Vac)** or **3ph (380Vac without phase unbalancing tampering).** 6- The solar input capacity, output power capacity, batteries system voltage, interfacing, display, etc of the inverters must be selected to achieve the **overall function and performance** of system and must be selected accordance to **related international standards and specifications.**	
5	**Batteries Bank :** - Normal range voltage of batteries bank (**V**): **48Vdc to 200Vdc.** - Capacity of batteries bank (**WH**): **at least 19,000WH.** - Number of batteries: **Suitable for solar system design.** **Specifications for each battery:** - Sealed construction. - Matching and Balancing **1 cell / 3 cells / 6 cells in series** with nominal cell voltage **2 volt.** - Peak voltage for cells: **2.40V to 2.45V/cell.** - Maintenance- Free Operation (**VRLA**). - **Heavy-Duty Grids, lead plates thick.** - Weight: heavier batteries. - Production Date: must be newer than **10/2016.** - Wide Operating Temperature Range **(-20C^0 ≈ +60C^0).** - Suitable **Charging / Discharging Current rate** according to solar **PV array & loads (Inverter capacity) / system design.** - Low self-discharge less than **5% per month.** - Low internal resistance less than **4 to 7 mΩ (m Ohm)** - High specific power/energy (**30-50Wh/Kg**), capable of high discharge currents. - Outstanding performance and **long battery life.** - **Deep-Cycle, AGM** batteries feature Or **OPZV.** - Cycle performance: **not less 1500 Cycle @ 50 % DOD.** - Terminations: **Screw Type.** - Applications: **solar system applications.** - Temperature coefficient less than **(-3mV/C^0/Cell), 25C^0.** - Conforms to **IEC 60896 (part 1&2), IEC 60079, CE,** and all standards & certificates &**Success stories** (or previous projects where this product was used) which related. - Service life (**Long shelf life**): **not less than 4 years.** - Container & Cover: **Acid-resistant ABS resin.** - The gelled (**AGM**) electrolyte is a proprietary formulation that delivers consistent performance and dramatically extends the battery's cycle life. - Battery cell designed for maximum capacity. Power density may be compromised.	
6	**Inverter & Battery Rack:** - Should be **closed type** cabinets to use for placing batteries and solar inverter in an	

efficient manner.

- Provide adequate ceiling clearance for ventilation and maintenance.
- Should be **Convenient, Easy to clean, Durable, Rust proof, Abrasion resistant, durability, reliability, lockable door (Key lock), Longer service life, Sturdy and Rigid design, excellent in finishing and smooth edges.**
- Battery Rack should be **smooth finishing** standards and is available in **suitable sizes** as per the system requirements (solar inverter & batteries).
- Consist of shelves, **ventilation fans** available in **24V**, and **48V DC/220V AC.**
- Ventilation fans (**24Vdc / 48Vdc**) must be connected to the battery bank (**24Vdc / 48Vdc**) to be operated by an external controller to ensure that they operate even when the inverter is switched off.
- Standard **ventilation holes** are punctured on all sides including floors of shelves.
- The clearance of place **floor and ceiling** of first shelve should not be **less than 20 cm.**
- Stable base: The weight should be **distributed** on all loading substrates.
- Enclosure Dimensions
  - Overall: **at least (H) 1.8 m x (W) 2m x (D) 1m or suitable for batteries and solar inverter.**

7 **AC Distribution Board (ACDB)**

The inverter output will be connected to the existing AC Distribution Board (DB). The contractor will verify the compliance of the existing AC DB with EU standards and if needed adapt the ACDB for integration of the solar system.

All switches and the circuit breakers, connectors should conform to **IEC 60947, part I, II and III.** All **indoor** equipment will have protection of **IP52 or better.** All **outdoor** panels will have protection of **IP65** or better.

All the devices / equipment like change over, circuit breakers, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under harsh environmental conditions.

The AC Distribution board shall consist of the following items:

Item	Description	Quantity
AC Circuit Breaker	- **MCB** type. - Voltage:**220 VSC or380 VAC – 420VAC.** - Rated frequency: **50 Hz** - Cutoff Current: It must be cutoff at **10,000VA** within less than **3 seconds.** - Opening Time: 40-60 ms - Closing Time: 60-80 ms - Suitable Isolation: Yes - Utilization Category: **B** - No. of Poles: **2/3/4 poles.** - Mechanical Life: at least **15000.** - Rated duration of Short Circuit Current: less than **3Sec.** - Ambient Temperature: **50C°**	1
Manual Change Over	- **MCB** type. - Voltage: **220VAC / 380 VAC – 420VAC.** - Cutoff Current: **at least 100 Amp.** - Rated frequency: **50 Hz.**	1

		- No. of Poles: at least: **6 poles.2poles for load output, 2 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 1PH.** **12 poles.4poles for load output, 4 poles for 1st input (Solar System) and last 4 poles for 2nd input (Generator/Main network). For 3PH.** - Ambient Temperature: **50C°** - Mechanical Life: at least **15000.**	

Circuit Breakers shall be provided for circuit protection. They shall be suitable for over load and short circuit protection of the feeders.

The insulating case and cover shall be made of high strength, heat resistant, flame retardant material.

The MCB shall be provided with a quick make- quick break type of switching mechanism which a definite speed of travel of moving contacts is ensured.

All internal wiring shall be carried out with PVC insulated, stranded copper conductor, single core, **6-10 sq. mm.** or larger stranded copper wires.

The enclosure shall be dust & vermin proof, Rust proof and Corrosion resistance with a degree of protection of **IP-52.**

8 Cables.

Sections of cables between **array interconnections**, **array to combiner boxes**, **combiner boxes to inverter**, **inverter to batteries**, **batteries interconnections**, **inverter to ACDB**, etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum:

- For DC cables, the maximum drop shall be limited to **3%**;
- For AC cables, the maximum drop shall be limited to **2%.**

Cables of appropriate size to be used in the system shall have the following characteristics:

- **Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards.**
- **Temp. Range: –10°C to +80°C;**
- **Voltage rating 600/1000V;**
- **Excellent resistance to heat, cold, water, oil, abrasion, UV radiation;**
- **Flexible;**
- **All conductors shall be copper;**

The outside cables :

- Should be **specific solar cables, insulated** with a **special grade PVC compound formulated for outdoor** use **(UV, weather protection).**

Cable routing/ marking:

- All cable/wires are to be routed in pipes and suitably **tagged** and **marked** with proper manner so that the cable **easily identified.**

Life Time:

- The cable should be so selected that it should be compatible **up to the life of the solar PV panels**, i.e. 20 years.
- Calculations of the current rating of the cables should be according to **IEC 60287.**

Cables to comply with :

- **IEC 60228 Conductors of insulated cables;**
- **IEC 60502 Power cables with extruded insulation;**

Sizing and length of Cables:

1) Cables between array interconnections:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.** • **Multi-stranded flexible copper.** • **Outdoor.** • **Weather proof.**	**single core/ Multi-core Colored**	**10 meters** per System	**10 sq. mm**

2) Array to combiner boxes:

Description	Type	Length	Size

DC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.** • **Multi-stranded flexible copper.** • **Outdoor.** • **Weather proof.**	**Multi-core Colored**	**20 meters** per System	**2×10 sq. mm**

3) Combiner boxes to inverter:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.** • **Multi-stranded flexible copper.** • **Outdoor.** • **Weather proof.**	**Multi-core Colored**	**20 meters** per System	**4×25 sq. mm**

4) Inverter to batteries:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated.** • **Multi-stranded flexible copper.** • **Indoor.** • **Heat resist.**	**Single – core Black color**	**3 meters** per System	**50 sq. mm**
	Single – core Red color	**3 meters** per System	

5) Batteries interconnections:

Description	Type	Length	Size
DC cabling; • **PVC.** • **Insulated.** • **Multi-stranded flexible copper.** • **Indoor.** • **Heat resist.**	**Single – core colored**	**1 meters** per System	**50 sq. mm**

6) Inverter to ACDB:

Description	Type	Length	Size
AC cabling; • **PVC.** • **Insulated and sheathed.** • **UV-stabilized.** • **Multi-stranded flexible copper.** • **Outdoor.** • **Weather proof.**	**Multi-core Colored**	**20 meters** per System	**4×10 sq. mm**

9	<u>Wiring Pipes.</u> PVC pipe minimum 50mm diameter (or as required) and above depending on No. of wires to be drawn, HMS grade (1 - 2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non-inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring. - Pipe type: **Rigid PVC conduits.** - Thickness: 1.3mm to 2.0mm. - Color: **white.** - Size: **50 /70mm dia.** as required. - Smooth inner surface for easy wiring. - Flexibility for long radius bending. - Long lasting life. - Non Conductor of Electricity and prevent Electrical shocks. - High mechanical strength for buried and open application. - Non corrosive in nature and are immune to Chemical and Galvanic corrosion. - Do not support combustion and are self-extinguishing. - Light weight to handle, install and Transport.	
10	**<u>Earthing & Grounding System:</u>** The contractor shall provide the complete bonding & earthling of the neutral point of power system & non-current carrying metal parts of all electrical equipment & apparatus. Each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors. All electrical equipment, except those operating at extra low voltages shall be provided with an earth terminal. <u>EARTH PIT DETAILS:</u> **Copper earth rod of 35/50 sq. mm x 1000 mm** buried in specifically prepared earth pit of 1.2 meters below ground level with **20 kg charcoal & salt** with alternate layers of charcoal & salt with 2 number of **50 mm dia. C class GI pipe** with **funnel** with wire mesh for watering &**brick masonry block** cover, heavy duty **cast iron cover** complete as per IS : 3043. Necessary connections shall be done using **copper wire of 25 sq. mm** copper wire as per instructions of inspector connected to nearest switch gears as directed & duly tested by earth tester. Pipe electrode shall be of 1.5 M long 50 mm dia. class C GI pipe. The GI pipes shall be provided with holes at regular intervals as per IS : 3043. Each array structure and all metal casings of the panel etc. shall be earthed properly. And connected to ground hole including pure copper rod 50 sq.mm and adding salts and carbon. <u>RESISTANCE TO EARTH</u> The resistance of earthing system shall not exceed 1.0 ohm. <u>MATERIALS:</u>	

Item	Quantity
Copper earth rod of 35/50 sq. mm	1 meter
Charcoal & salt	20Kg
Copper wire of 25 sq. mm	As per system requirement.
C class GI pipe50 mm dia.	2 × 1.5 meter
Funnel	1
Cast Iron cover	1
Brick Masonry Block	Suitable for earth pit

General Description

ON/OFF Grid Photovoltaic power system with backup battery consists of PV array, module mounting structure, Inverter with built-in MPPT Controller/s, Backup Batteries & Protections, Cables and Switches etc.

PV array is mounted on a suitable structure. ON/OFF Grid Solar PV system is working with/without batteries (Grid-Tie with backup battery) and should be designed with necessary features to supply directly the power generated by PV to the load grid and charge the batteries to be used in night.

All components and parts used in the PV power systems should conform to the IEC standards.

Scope of Works:

- Design, supply, installation, commissioning and comprehensive maintenance for number of Solar Photovoltaic Systems power solutions with battery backup.
- Carry out all civil works for PV array and distribution line.
- Carry out all civil and electrical works for SPV compatible electrical systems and distribution line.
- Ensure each & every piece of electrical equipment & apparatus shall be connected to the main earth bus by means of branch main connection of earth continuity conductors.
- Ensure all electrical equipment, except those operating at extra low voltages will be provided with an earth terminal.
- Supply of the complete systems, including all necessary components, subcomponents, spares, and tools etc. as per technical specifications given elsewhere in this document.
- Erection and commissioning of the supplied systems on the specified site and do any other work urgently required as per site conditions.

- The bidder must also provide a detailed operation and maintenance manual specific to the installed systems.
- Fabrications, supply and the installation of suitable support for the PV panels and other components whichever is required with the accessories.
- Civil work for mounting the panel.
- Any additional works not covered above, but necessary for the functioning of the system and required as per specification incorporated. The works of minor nature, which are not mentioned, shall be incorporated by the bidder.
- Any tender not containing sufficient descriptive material to describe the proposed equipment / components of the system may be treated as incomplete and hence may be rejected. Such descriptive materials and specifications submitted will be retained. Any big deviations from these will not be accepted.
- Detailed implementation plan should be submitted along with the offer.
- The bidder is responsible for arranging all accessories and measuring instruments required to smoothly commission the system.
- Regarding actual work to be carried out at the site bidder needs to execute the work in consultation with the inspector.
- Locations: Supply of solar systems, transportation, installation and commissioning in schools, as per the following Quantities & Deliverylocations:

Table of Quantities & Delivery Locations

Gov.	District	Activity	Location Name	10 Kwp	13 Kwp	15 Kwp	LED Bulbs
Hadramawt		SCHOOLS	JEFEL GIRLS ELEMENTARY	1	0	0	49
		SCHOOLS	JEFEL BOYS ELEMENTARY	1	0	0	30
		SCHOOLS	AL SABBAN SECONDARY	1	0	0	0
		SCHOOLS	ALHAWATAH GIRLS ELEMENTARY	0	1	0	52
		COLLEGE	WOMEN'SCOLLEGE	0	1	0	0
		SCHOOLS	ALHAWATAH BOYS ELEMENTARY	0	0	1	61
		SCHOOLS	SHIBAM SECONDARY	0	0	1	0
Total				3	2	2	192

Technical Requirements

Solar PV system shall consists of following equipment/components:

- Solar PV modules consisting of required number of Crystalline PV modules;
- ON/OFF Grid (Grid-tied with backup battery) solar inverter (with built in MPPT controller);
- Storage Batteries consisting of required capacity of AH;
- Mounting structures suitable for number of PV panels;
- Junction Boxes (PV array JB/DC JB, AC JB);
- Earthing, short-circuit, surge and lightning protections ;
- IR/UV protected cables, pipes and accessories;
- Interconnects, connectors and protection devices;
- Box/Rack or container for inverter and batteries.
- Light bulbs (W-LED Lamps).

Warranty:

The PV modules will be warranted for a minimum period of 25 years from the date of supply. (Output wattage should not be less than 90% at the end of 10 years and 80% at the end of 25 years).

Necessary maintenance spares for five years trouble free operation shall also be supplied with the system.

The mechanical structures, electrical components including inverter and overall workmanship of the Solar System must be warranted for a minimum of 5 years except the batteries should be warranted for 2 years. All these items must be as per IEC (or equivalent) specifications and standards.

The contractor shall make arrangementto maintain a sufficient stock of essential spares and consumable spare parts to ensure proper maintenance of the system promptly.

The supplier may provide his own design for the solar system in proportion to the equipment that he will provide in his offer, provided that it ensures that the system meets the required performance and the equipment/components should be comply with the main specifications and standards mentioned in this document.