

TENDER DOCUMENT

SOLAR HOMES SYSTEMS

(SHS)

Province of Sindh

TENDER NOTICE

For undertaking Solar Homes Program under 'ROSHAN PAKISTAN' this project, tenders are invited from international, national firms for provide quality energy services to remote villages of Sindh through Solar Home Systems. Service providers will be responsible for the supply, installation and operation and maintenance of solar home systems for 1 year after the installation.

2. Registration and tender documents containing details of items and other terms/conditions may be obtained from Alternative Energy Development Board office on any working day at a price of Rs 500. These documents can also be downloaded from AEDB official website (www.aedb.org) and Public Procurement Regulatory Authority (PPRA) official website (www.ppra.org.pk).
3. The tenders should reach the office of Assistant Director (Admn) AEDB Islamabad by 4 September 2006 at 1:00 pm accompanying a Demand Draft equal to 2% of the bid price (refundable).
4. Bid shall comprise a single package clearly indicated "Bid for SHS" containing two separate sealed envelopes of technical and financial proposals. Envelops shall be marked as "Technical Proposal" and "Financial Proposal" in bold and legible letters.
5. The AEDB reserves the right to reject any or all tenders, without assigning any reason. Decision of the Board will be binding and final in all matters.
6. Technical Proposals will be opened on 4 October 2006 at 1:30 pm and evaluated first. Technically short-listed companies will be informed accordingly for opening of financial bids. The financial offers will be opened on 25 October 2006 at 3:00 pm in Conference Room of AEDB in the presence of the short listed bidders who choose to be present.
7. The Bid should be valid for a period of 6 months from the date of the opening of the tender.

Rural electrification of 100 Villages of Sindh through Solar Energy

Introduction

1. General.

This project takes place in the framework of an important rural electrification programme launched by the Government of Pakistan, Roshan Pakistan. Solar home system was selected as the most appropriate technology to electrify remote villages of Sindh and Balochistan that are situated more than 20 km away from the national grid. This project is aimed at providing access to electric lighting and means of communication to rural population.

2. Targeted area

Project is to be executed simultaneously in a number of districts of Sindh. The list of villages is given in Annexe I to this tender document. The total number of homes to be equipped with Solar Home System (SHS) is 4200 (four thousand and two hundred). Each house will be provided with a stand-alone solar home system. Two rooms are equivalent to one Solar Home System. In case a house has 4 rooms, it shall be consisting of 2 solar home systems.

3. Institutional set-up

The project is implemented by the Alternative Energy Development Board (AEDB) that will provide finance and support to service providers. Service providers will be in charge of providing energy services to users during the entire duration of the contract period. At the end of the contract period, Renewable Energy Department, Government of Sindh (RED) will be in charge of operation and maintenance of systems. However, during the contract period, the Renewable Energy Department will finance one local operator per 200 systems that will support the service providers.

General Terms and Conditions

1. Responsibilities of the service provider

The service provider shall be responsible for providing quality energy services to rural households of Sindh. In particular, the service provider shall be responsible for the supply, installation and operation and maintenance of solar home systems.

1.1. User information and training of local technicians

The service provider shall be responsible for informing users of the different SHS options, fee, rights and duties of users, information on the functioning of solar home systems. The service provider shall be responsible for providing on-the-job training during installation to local operators designated by the Renewable Energy Department. The service provider shall pay the services rendered by the local operators at the same rate than its permanent staff during installation (The local technicians will be paid after installation by the Renewable Energy Department). The service provider shall provide technical training to local operators as well as to 5 persons designated by AEDB.

1.2. Supply of equipment and installation of SHS

The service provider shall be responsible of the supply of equipment and installation of Solar Home Systems according to the criteria given in Annexe II and Annexe III. The installation shall be completed not later than 1 year from award of contract.

1.3. Organize a local supply chain mechanism for SHS appliances and consumables

The service provider shall ensure that appliances for SHS are made available on the local markets and if necessary build the capacity of local stakeholders.

1.4. Operation and Maintenance of systems

The service provider shall ensure that all installed systems function according to international standards during one calendar year after installation of the last system and that all failures are fixed within a maximum period of one week from the date of un-serviceability. In particular, the service provider shall organise the operation and maintenance mechanism including:

- supervise local operators (ensure monthly visits to users, ensure record keepings, ensure that maintenance books are properly filled in, ensure fee are collected and handed over to Renewable Energy Department);
- ensure that all systems are checked at least once by a qualified technician around 6 month after installation;
- provide local operators with individual coaching at least twice after the end of installation phase; and
- organise the supply, storage of spare components (at least 2% of all items at any given time) and their installation as required.

The service provider shall ensure the transfer of responsibility to the Renewable Energy Department, Government of Sindh at the end of the contract period.

After the end of the contract period and before the end of the performance guarantee of components, the service provider shall be responsible for the storage and supply of spare components (at least 2% of all items at any given time), in Karachi, to Renewable Energy Department.

1.5. Monitoring and Evaluation

The service provider shall provide required information for monitoring and evaluation purposes for all the contract period as given in Annexe III and VIII. At the end of the warranty period of systems, the service provider shall provide a consolidated report including 1) a technical appraisal of system performance, 2) a report of activities undertaken, 3) a financial analysis 4) recommendations for further operation and maintenance.

2. Number of villages/systems

- 2.1. Individual companies can bid for 30 to 100 villages and/or from 1,250 to 4,200 systems¹. In case the number of villages bided for is less than 100, the selection of villages will be mutually agreed between the service provider and AEDB amongst the list of villages given in Annexe 1. Cluster approach and even degree of difficulty in execution will be duly considered.
- 2.2. The distribution of batches of villages amongst bidders will be at the discretion of AEDB. However, each batch will be not less than 30 villages and not less than 1,250 systems. Batches will consist of clusters of villages/systems.

¹ Systems and options are defined in Annexe II.

Special Terms and Conditions

- 1 Reliable products of international reputation conforming to technical specifications listed in Annexe III would only be acceptable. When no other standard is given, products should meet the national standards whenever existing.
- 2 Reliable execution conforming to technical specifications listed in Annexe III would only be acceptable.
- 3 Technical and financial offers must be submitted separately in sealed envelopes. Only financial offers of technically short-listed proposals will be opened and considered.
- 4 The costs related to preparation of tender proposals and all related documents will be solely borne by bidders.
- 5 Five copies (1 original clearly indicated (ORIGINAL) and 4 additional copies clearly indicated (COPY)) and one soft copy
- 6 of each offer have to be submitted. For each offer, copies will be enclosed in one envelope. The original will be used as reference in case of discrepancy.
- 7 All documentation is to be provided in English.
- 8 2 % of the bid price will be submitted as Bid Security along with the offer in the form of bank guarantee or bank draft / pay-order.
- 9 Documents indicating conformance of firm to all other legal requirements for government procurement like payment of professional tax and sales tax must be attached with the technical offer.
- 10 Details of manufacturing facilities along-with declaration of conformity from the manufacturer regarding the compliance with international standards shall be provided in the technical offer; the same applies to sub-contractors.
- 11 Details of qualification and experience of existing staff (technical and administrative) and similar projects/jobs undertaken previously must be listed in the technical offer.
- 12 Payment to service provider would be made in Pak Rupees as per government procurement procedures. Payment for imported goods could be made in foreign exchange.
- 13 Payment of service providers shall be made as per schedule given below.
 - b. 80% of payment of each batch (consisting of 500 SHS) shall be made on completion and acceptance of each batch of SHS by AEDB and fulfilment of other terms and conditions given in the present tender document and contract agreement.
 - c. 10% of payment shall be made on completion and acceptance by AEDB of the total number of SHS contracted for and fulfilment of other terms and conditions given in the present tender document and contract agreement.
 - d. The remaining 10% of payment shall be made on completion of one calendar year from the commissioning of the last SHS contracted for and fulfilment of all

contractual obligations. An inspection of SHS will be conducted by AEDB and Renewable Energy Department, Government of Sindh before the release of the last payment.

- 14 Mobilisation advance around 20% may be given against bank guarantee.
- 15 Once selected, the service provider shall provide a detailed project management plan including a detailed time schedule of village electrification.
- 16 Special terms for bid documents:
 - a. Correct and verifiable performance and technical parameters must be specified for each item and filled in the forms provided in Annexe V.
 - b. Certificates according to performance and testing standards given in Annexe III from one of the laboratory mentioned in Annexe IV shall be submitted for each item.
- 17 Price of each item and work / job would be mentioned separately and quoted in Pakistani Rupees.
- 18 If during the execution of the contract, the service provider wishes to change an item, the service provider shall request in writing to AEDB the permission to do so. The request shall include the performance and technical parameters of the new item, a certificate from one of the laboratories listed in Annexe IV certifying the item meets the technical specifications given in Annexe III and a report on system performance issued by one of the laboratories listed in Annexe IV. Approval will be at the discretion of AEDB. Any additional cost shall be solely borne by the service provider.
- 19 Performance guarantees specified in Annexe III of this document need to be ensured for each item.
- 20 Supplied items and installation job would be guaranteed for one year against faulty manufacture / material / workmanship.
- 21 Inspection and acceptance would be carried by an inspector or a team co-nominated by Chairman AEDB and Secretary Renewable Energy Department, Government of Sindh (RED,GoS)
- 22 Testing of supplied equipment and installed systems would be carried by AEDB and RED,GoS designated inspectors but testing facilities to check power output of PV Modules, calibrated modules with setup for measuring sun intensity, voltmeter, ammeter, DC power supplies, multi meters, loading facility for charge controller etc would be provided by the service provider.
- 23 During execution, if at any time, a service provider cannot fulfil its obligation as initially planned, the service provider shall immediately (within a week time) notify in writing to AEDB the problem, its expected duration and its possible causes. In any case, the execution delay shall not exceed three months.

- 24 At the end of the planned installation period, if installation has been delayed, a penalty of 2% per month of the uncompleted part of the contract will be retained from the remaining payment.
- 25 In case of delay in execution, if AEDB authorizes the service provider to complete the contract in a longer timeframe than initially planned, all additional expenses related to delay in execution will be solely borne by the service provider.
- 26 The contract can be terminated at any time under the condition of mutual consent of AEDB and the service provider.
- 27 The contract can be terminated totally or partially at any time by AEDB in any of the following cases:
- b. The service provider does not provide the services he has been contracted for;
 - c. The service provider does not fulfil the conditions of the contract;
 - d. The service provider of has been involved in corruption or fraud in matters related to the execution of the contract.
- If the contract is partially broken, the service provider shall fulfil his contractual obligations for the part that is not withdrawn.
- 28 In case of controversy between AEDB and a service provider, if no mutual agreement is reached after 30 days, a third party mutually agreed upon can be chosen as arbitrator. Otherwise, the controversy should be solved in court.
- 29 Qualification and evaluation criteria are given in Annexe VI.
- 30 In case of acceptance of the bid, the service provider shall provide an affidavit along with the agreement in accordance with the “Integrity Pact” mentioned under Rule 7 of Public Procurement Rules 2004. The content of the Integrity Pact certificate are mentioned in Annexe VII.
- 31 Interested parties may contact AEDB for any clarification before submission of bids.
- 32 All components used in the proposed systems are exempted from custom duties in accordance with clause 13 of SRO (575)(1)2005 of CBR. The service provider shall request and obtain a certificate in this respect issued by the Senior Officer in charge of Projects for Sindh, AEDB, at the time of claiming exemption by the importer.

ANNEXE

ANNEXE I
LIST OF VILLAGES

District Tharparkar						
Proposed Solar Energy Villages List						
	Taluka	Name of Uc	S.NO	Name of Village	No of H.H	Population
	Chachro	Chachro	1	Bhadasandha	136	990
	Chachro	Chachro	2	Laplo	116	850
	Chachro	Chachro	3	Chachi	127	925
	Chachro	Chachro	4	Khohano	81	590
	Chachro	M Charan	5	Nakrayo	81	591
	Chachro	Chachro	6	Ranchi Jo Tar	80	450
	Chachro	M Charan	7	Mithrio Charan	318	2,325
	Chachro	M Charan	8	Mithrio Suthar	210	1,535
	Chachro	Chachro	9	Dabhi Juneja	84	610
	Chachro	Saranghiar	10	Charnore	255	1,913
	Chachro	Veejhiar	11	Bhagtani	45	330
	Chachro	Veejhiar	12	Hanjital	85	620
	Chachro	Veejhiar	13	Uge Jo Par	18	130
	Chachro	Veejhiar	14	Jhamirisar	53	390
	Chachro	Kantio	15	Mevo Rind	55	401
	Chachro	Chelhar	16	Mehar	164	1,197
	Chachro	Chelhar	17	Janjhyar	139	1,013
	Chachro	M Charan	18	Chapar DinShah	227	1,658
	Chachro	M Charan	19	Rohiraro	54	395
	Nangar Parkar	Veerawah	20	Sakri	33	244
	Nangar Parkar	Veerawah	21	Dano Dandhal	102	746
	Nangar Parkar	Veerawah	22	Bhalwa	137	1,000
	Nangar Parkar	Veerawah	23	Qabool Ji Dhani	41	296
	Nangar Parkar	Veerawah	24	Chanesar Ji Dhani	62	456
	Nangar Parkar	Piloo	25	Soondar	271	1,831
	Nangar Parkar	Piloo	26	Dabhi Bheel	65	460
	Nangar Parkar	Piloo	27	Gori	133	1,058
	Nangar Parkar	Piloo	28	Chabhiriko	47	322
	Nangar Parkar	Piloo	29	Arniaro	97	630
	Nangar Parkar	Piloo	30	Antri	27	190
	Nangar Parkar	Nangarparkar	31	Bhodesar	80	600
	Nangar Parkar	Nangarparkar	32	Goongri	22	163
	Nangar Parkar	Nangarparkar	33	Choncha	49	355
	Nangar Parkar	Nangarparkar	34	Kubri	53	389
	Nangar	Nangarparkar	35	Kot Bandho	65	473

	Parkar					
	Mithi	Manjthi	36	Okiraro	82	600
	Mithi	Manjthi	37	Dharm	164	1,200
	Mithi	Manjthi	38	Godhangari	116	850
	Mithi	Manjthi	39	Dongh	62	450
	Mithi	Manjthi	40	Chabhrial	82	600
	Mithi	Manjthi	41	Mandhakar	41	300
	Mithi	Manjthi	42	Sooja Veri	48	350
	Mithi	Manjthi	43	Sonyath	38	375
	Mithi	Islamkot	44	Mithrio Soomra	106	773
	Mithi	Islamkot	45	Borli Mose Pota	152	1,106
	Mithi	Kehri	46	Kehri	114	730
	Mithi	Kehri	47	Morano	80	500
	Mithi	Kehri	48	Jhanpo	70	500
	Mithi	Kehri	49	Kattan	115	800
	Mithi	Kehri	50	Kuran	60	420
	Mithi	Kehri	51	Gorano	185	1,073
	Mithi	Kehri	52	Gawaran	140	910
	Mithi	Kehri	53	Pilooro	90	650
	Mithi	M Bhatti	54	Mithrio Dal	137	100
	Mithi	M Bhatti	55	Mukhi Jo Tar	41	300
	Mithi	M Bhatti	56	Depiar	88	645
	Mithi	M Bhatti	57	Tabho Meghwar	58	425
	Mithi	M Bhatti	58	Godhyar	162	1,180
	Mithi	M Bhatti	59	Rangelo	33	240
	Mithi	M Bhatti	60	Khekno	57	415
	Mithi	M Bhatti	61	Veesaser	115	840
	Mithi	M Bhatti	62	Akheraj	89	650
	Mithi	Bhakuo	63	Nakino	166	1,210
	Mithi	Bhakuo	64	Chownhar	129	940
	Mithi	Bhakuo	65	Hothi Jo Tar	103	750
	Mithi	Bhakuo	66	Senhar Nanger	142	1,035
	Mithi	Bhakuo	67	Somji je Dhani	18	130
	Mithi	Bhakuo	68	Monghat	101	740
	Mithi	Bhakuo	69	Bapuhar	222	1,620
	Diplo	Jhirimirio	70	Verhar	121	885
	Diplo	Jhirimirio	71	Dedhsarh	77	559
	Diplo	Jhirimirio	72	Gangolus	63	459
	Diplo	Jhirimirio	73	Aklo	63	459
	Diplo	Jhirimirio	74	Kounralio	59	428
	Diplo	Jhirimirio	75	Jhirimiyo Parha	14	102
	Diplo	Jhirimirio	76	Konral	98	715
	Diplo	Jhirimirio	77	Jhimiriyo Thakur	38	278
	Diplo	Jhirimirio	78	Jhimiriyo Bheel	102	742
	Diplo	Jhirimirio	79	Nerhori	40	295
	Diplo	Jhirimirio	80	Jaga Veri	91	667
	Diplo	Jhirimirio	81	Lakooro	16	119
	Diplo	Jhirimirio	82	Lakooro Sungal	17	126
	Diplo	Jhirimirio	83	Ladki	21	152
	Diplo	Jhirimirio	84	Rohal	72	527
	Diplo	Jhirimirio	85	Chahee Chapro	154	1,123
	Diplo	Saro	86	Dondri	30	219
	Diplo	Saro	87	Dondio	35	257
	Diplo	Saro	88	Pabuhar	59	429
	Diplo	Saro	89	Balihari	55	402
	Diplo	Saro	90	Talo Tamachi	93	677
	Diplo	Saro	91	Oermoon	43	314
	Diplo	Saro	92	Kaharyari	38	274
	Diplo	Saro	93	Dohar	95	691

Diplo	Saro	94	Bitri	16	114
Diplo	Saro	95	Padmori	38	276
Diplo	Saro	96	Mehro Khawaria	35	257
Diplo	Saro	97	Soondook	58	421
Diplo	Saro	98	Pharharo Nohri	39	285
Diplo	Saro	99	Sodhoi	100	729
Diplo	Saro	100	Amernoo	116	848

ANNEXE II

Solar Home Systems: composition

The service provider shall provide to user the following minimum quantity of electricity (available for consumption) at 12 V DC per day: (Option 1) 6 Ah, (Option 2) 11Ah, (Option3) 17 Ah, (Option 4) 22 Ah, (Option 5) 28 Ah and (Option 6) 44 Ah. For each quantity, one day reserved has to be catered.

The minimum requirements for each option are as follow:

Components	Minimum size/ Characteristics	Quantity
Solar Panel	20 wp (Option 1) 40 wp (Option 2) 60 wp (Option 3) 80 wp (Option 4) 100 wp (Option 5) 120 wp (Option 6)	1 or 2 (Additional panels must be possible to add.)
Charge controller	12 V nominal	1
Battery (Vented-type, tubular, lead-acid battery)	25 Ah (Option 1) 50 Ah (Option 2) 75 Ah (Option 3) 100 Ah (Option 4) 125 Ah (Option 5) 150 Ah (Option 6)	1 (2 maximum)
CFL Lamps with matching holders	13 watts maximum	1 minimum (Option 1) 2 minimum (Option 2) 3 minimum (Option 3) 4 minimum (Option 4) 5 minimum (Option 5) 6 minimum (Option 6)
LED Lamps with matching holder	1.5 watt maximum	1 minimum (Option 1) 1 minimum (Option 2) 2 minimum (Option 3) 2 minimum (Option 4) 3 minimum (Option 5) 3 minimum (Option 6)
Solar Panel mounting structure on a 4 inch diameter pole with base		1
Switches with base – 3 Amps		As per number of lamp holders and sockets.
Sockets (DC) with base – 3 Amps or additional lamp holders		As per system capacity and user requirement (User will

(as per user requirement)		self-finance additional lamps and/or other DC appliances) ²
Multi-strand electric Wire for 12V DC System		Depending of system capacity
PVC conduit / Strip for wiring		As required
Battery terminals, clips, junction boxes and connectors etc		As required
Battery box		1
Maintenance log for local operators		1 set
Information material for users and local operators in local languages		1 set

The subsidies from the Federal Government and monthly fee paid by users will be as follows:

Option n ^o	Criteria (minimum)	Subsidy on capital investment	Monthly fee for O&M (paid by user, collected by RED)
1	1 room Number of household members >1	100%	Rs 60
2	1 room, Number of household members >1	100%	Rs 120
2	Criteria of Option 3 to 6 and preference of user	100%	Rs 120
3	2 rooms Number of household members >6	100%	Rs 180
3	1 room Number of household members >5	100%	Rs 180
3	Criteria of Option 4 to 6 and preference of user	100%	Rs 180
4	3 rooms Number of household members >9	100%	Rs 240
4	2 rooms Number of household members >10	100%	Rs 240
4	Criteria of Option 5 and 6 and preference of user	100%	Rs 240
5	4 rooms Number of household members >12	100%	Rs 300
5	3 room Number of household member > 15	100%	Rs 300
5	Criteria of Option 6 and preference of user	100%	Rs 300
6	5 rooms Number of household members > 15	100%	Rs 360
6	4 rooms Number of household members > 20	100%	Rs 360

² The service provider shall inform the user of the capacity of the installed system and the options he has to select between lamps and other appliances. The service provider shall ensure the system is sized according to users' preference.

The criteria given in the table above are minimum criterion, an user can choose to have a smaller system than the one he/she is entitled to. The service provider can provide system of higher capacity to a user than the one he/she is entitled to. However, in this case, the user will finance the additional costs only. The service provider shall offer such possibility to users

** The service provider shall use the percentage given in the table below for preparing its bid document.

Option n°	Percentage of systems
1	10%
2	15%
3	20%
4	30%
5	20%
6	5%

Example: If one service provider quotes for 30 villages (or 1250 systems): the distribution of systems will as follow:

Option n°	Percentage of systems
1	10% * 1250
2	15% * 1250
3	20% * 1250
4	30% * 1250
5	20% * 1250
6	5% * 1250

The final payment to service providers will be made on submission of a Bill Of Quantity since estimation may differ from on-ground situation.

** The %ages could be changed by the AEDB with corresponding change in prices. There fore the prices must be quoted for each option explicitly.

ANNEXE III

TECHNICAL SPECIFICATIONS

1. Solar Photovoltaic Modules

Technical Specifications

1. The Solar Panels shall meet the requirements set in IEC 61215:2005.
2. If thin film silicon modules are used, they shall meet the requirements set in IEC 61646: Thin Film Silicon Terrestrial PV Modules Design Qualification and Type Approval.
3. Each module must be labeled indicating at a minimum: Manufacturer, Model Number, Serial Number, Peak Watt Rating, Voltage and Current at peak power, Open Circuit Voltage and Short Circuit Current of each module.
4. Solar panels shall have framed module with type A junction box (rain tight) accepting PG 13.5 conduit/cable fitting.
5. Freight/Insurance as well as taxes and clearance charges must be quoted separately (FOR QUOTE).
6. Manufacturer of solar panels along with date of manufacture must be stated in current production.
7. Solar panels have to be packaged for safe transportation on non-metallic roads.
8. The solar panel shall have a certificate of compliances, issued by any of the laboratories listed in Annexe IV with IEC 61215:2005, (IEC 61646 if appropriate). The certificate shall also certify the compliances with the additional technical specifications mentioned in point 1 of Annexe III .
9. Performance guarantee has to cover at least 20 years of operation.

2. Photovoltaic Charge / System Controller

Technical Specifications

General: all specifications below are defined for systems with a nominal voltage of 12 V

1. The regulator or charge controller must protect the battery against overcharge and excessive discharge, besides giving information to users on the general state of the system.
2. The charge controller must ensure safe and reliable operation in the whole range of ambient temperatures from -5° C to + 40° C.
3. The “load voltage disconnect” (LVD) must respect the established limits for the maximum discharge depth (PDmax) of the battery (70%). Regardless of this condition, it should never be lower than 10.4 V.
4. Load disconnection must take between 5 and 30 seconds as from the moment on which the disconnection voltage is achieved.
5. The “load voltage reconnect” must be between 0.9 and 1.2 V higher than the

- “disconnection voltage” referred to in the previous specification.
6. The “alarm voltage” must be 0.2 V higher than the “disconnection voltage”.
 7. The disconnection, reconnection and alarm voltages must have a precision of at least $\pm 0.5\%$ (± 60 mV), and must remain constant in the whole range of possible operation temperature.
 8. The “final charge voltage” (high voltage disconnect, HVD) must be 14.4 V for tubular battery. These values are to be interpreted at 25° C. The thresholds must be compensated in temperature, at the rate of between -18 to -24 mV/°C
 9. The final load and replacement voltages must have a precision of at least $\pm 0.5\%$ (± 60 mV)
 10. In the case of ON-OFF regulators, the “reconnect voltage” must be between 13 to 13.5 V. These values are to be interpreted at 25° C.
 11. The improved algorithms of load regulation (for example of controlled overcharge followed by a flotation phase) are accepted if they are time controlled. .
 12. The charge controller shall not use electro mechanic relays
 13. The charge controller shall use a pulse with modulation (PWM) strategy to control the charging current.
 14. Maximum current draw of the controller, when no LEDs are lit, should not exceed 5 mA
 15. The connection terminal must easily admit cables with a section of minimum 6 mm². In case the current to be managed is higher than 10 A, the corresponding terminal must easily admit cables with a section of 10 mm².
 16. The charge controller boxes must offer a protection of at least IP 22.
 17. The regulator must be protected from polarity inversions in the lines of the generator and of the battery.
 18. The charge controller must prevent reverse current into the PV module during night
 19. The regulator must resist, without any damages, any possible condition related to operation of the battery. In particular, it must resist when there is no consumption in the load and the voltage in the generator terminals reaches 26 V.
 20. The regulator must protect the loads against damaging related to operation without a battery.
 21. The regulator must be protected from excessive tensions induced by atmospheric discharges through transitory suppression devices. .
 22. The acoustic noise coming from the regulator must be lower than 35 dbA, as measured at a distance of one meter.
 23. The regulator should not produce any interference, either radiated or conducted, in the radio frequencies: AM 530kHz – 1600 kHz; SW1: 2.3 MHz – 7 MHz; SW2: 7 MHz – 22 MHz, and in any operating condition.
 24. The regulator must include, as a minimum, the following signs:
 - a) Charging mode
 - b) State of battery: charged, half full and empty
 - c) Alarms: short circuit, excessive current, excessive voltage and load disconnect.
 25. The model number, serial number, rated voltages and currents should be noted on the charge controller case
 26. The load regulator must have a certificate of compliance, issued by any of the laboratories listed in ANNEXE III, with one of the following standards:
 - a) Recommended Specifications PVRS 6/6A of the Photovoltaic Global Approval Program-PVGAP.
 - b) Universal Technical Standard for Solar Home Systems - Thermie B: SUP 995-96, ECDGXVII, 1998. Version 2, revised 2001.
 - c) The technical specification mentioned under point 2 of Annexe II of this document.

27. The performance guarantee shall cover at least 3 years of operation

3. Rechargeable Deep Cycle Battery

Technical Specifications

1. The battery should be a vented-type “heavy duty” tubular lead acid battery of nominal value 12V.
2. The battery shall meet the requirements and recommendations given in IEC 61427: 2005.
3. The battery must ensure safe and reliable operation in the whole range of ambient temperatures from -5° C to + 35° C.
4. Technical specifications of the battery including the nominal capacity at a certain current (e.g. I₁₀, I₂₀, I₁₀₀), the number of cycles at different dept of discharge and maximum depth of discharge shall be clearly indicated.
5. Cycle life of the battery (i.e., before its residual life drops below 80 percent of the rated Ah capacity), at I₁₀ must exceed 1500 cycles when discharged down to an average depth of discharge (DOD) of 50 percent at the discharge rate of 10 hours.
6. The maximum permissible self-discharge rate is 5 percent of rated capacity per month at 25 C.
7. A detailed calculation shall be provided to explain the sizing of the battery, realistic system losses shall be taken into consideration. (at least 6-8 hours of operation of the specified load)
8. The battery shall have a certificate of compliances, issued by any of the laboratories listed in Annexe IV with IEC 61427: 2005. The certificate shall also certify the compliances with the additional technical specifications mentioned in point 3 of Annexe III .
9. Batteries should be packaged in order to withstand transportation on non-metallic road.
10. The performance guarantee shall cover at least 2 years.

4. LED Lamp with matching holder

Technical Specifications

1. LED lamps shall have a nominal input voltage of 12V.
2. The LED lamps must ensure safe and reliable operation in the whole voltage range of - 10% to + 25% of the nominal voltage (10.8 V to 15 V), and in the whole range of temperatures from -5° C to +40° C.
3. The power consumption shall range from 1.4 to 3.6W
4. The LED lamps must deliver at minimum a luminous flux of 35 lm to 90 lm respectively a luminous efficacy of at least 25 lm/W (at 25 °C ambient temperature)
5. The LED lamp must be protected against reversed polarity of the operation voltage
6. Base shall be an E27 European screw base.
7. The emitted light shall be cool or warm white.
8. The wide angle shall be between 120° to 125°.
9. LED lamps shall be installed at a place in accordance with user’s preference and habits.
10. Lamps should be marked with the manufacturer model number, rated voltage, wattage and date of manufacture or batch number

11. The performance guarantee shall cover at least 3 years.

5. Compact Fluorescent Light Lamp with matching holder

Technical Specifications

1. The CFL shall have a nominal input voltage of 12V
2. Every lamp is composed of a fluorescent light bulb and the corresponding ballast, for operation of the tube with constant current.
3. The power consumption shall range from 11/13 W.
4. Power consumption should range between 90% to 110% of the nominal value.
5. The ballast must ensure safe, flicker free and stable operation of the light bulb in the whole voltage range of -10% to + 25% of the nominal voltage (10.8 V to 15 V), and in the whole range of temperatures from -5° C to +40° C. The tube must ignite at the lowest temperature and lowest operation voltage without problems.
6. Under 10.8 to 15 V operation, lamps must provide a minimum tube life time of 5,000 hours.
7. The switching lifetime must be at least 10,000 cycles (at nominal voltage and a switching cycle of 60 sec. on and 150 sec. off).
8. Lamps should be protected against damage when operating under open circuit conditions. Current draw when operated with a failed or removed tube should be limited to less than 20% minimum current consumption.
9. Lamp and ballast should be protected against reversed polarity.
10. Luminous efficiency requirements:
 - a) Under rated voltage the luminous efficacy should not be less than 45 lm/W without cover and reflector, after 100 hours of conditioning and at ambient temperature of 25°C.
 - b) Luminous efficacy should be not less than 80% of this rated value throughout a voltage range of 10.8 to 15 V.
11. Minimum operating frequency should be 20kHz.
12. The lamp current must not contain a DC component. The lamp current must be a pure AC current.
13. The maximum crest factor not more than 2.0.
14. The lamps should be able to withstand shocks and vibration due to shipping and transport.
15. Lamps should be marked with the manufacturer model number, rated voltage, wattage and date of manufacture or batch number.
16. Lamps shall be installed at a place in accordance with user's preference and habits.
17. The lamps should not produce interference, either radiated or conducted, in the following radio frequencies: AM 530kHz – 1600 kHz; SW1: 2.3 MHz – 7 MHz; SW2: 7 MHz – 22 MHz, and in any operating condition.
18. The lamps must have a certificate of compliance, issued by any of the laboratories listed in Annexe IV, with any of the following standards:
 - a) Recommended specifications PVRS 7/7A of the Photovoltaic Global Approval Program – PVGAP.
 - b) Universal Technical Standard for Solar Home Systems - Thermie B: SUP 995-96, ECDGXVII, 1998. Version 2, revised 2001.
 - c) The technical specifications contained in point 5.of Annexe III.
19. The performance guarantee shall cover at least 3 year.

6. Installation/Cables/Wires

Technical Specifications

20. Installation including wiring shall meet the requirements and recommendations given in 8.3 of IEC 62124 ed 1.
 21. The commissioning and acceptance will be subject to the fulfilment of all requirements specified in the above mentioned paragraphs of IEC 62124 ed.1 and additional requirements as detailed below.
 22. Stranded and flexible insulated copper wires and cables must be used for all outdoor and indoor installations. Indoor installation of the lighting distribution system might be performed with solid wires, if appropriate and common practice.
 23. The wiring that leads into the building shall be protected in a conduit.
 24. External cables should be specifically adapted to outdoor exposure (see IEC 60811). Especially the outer insulation must be sunlight (UV)-resistant, weatherproof and designed for underground installation. Preferably rubber-coated and PE-coated cables shall be used.
 25. The temperature resistance of all interconnecting wires and cables should be $> 75^{\circ} \text{C}$. The minimum acceptable cross-section of the wire in each of the following sub-circuits is as follows:
 - c. . From PV generator to charge regulator: 2.5 mm² (American AWG 13)
 - d. From charge regulator to battery: 4 mm² (American AWG 11)
 - e. From charge regulator to each loads: 1.5 mm² (American AWG 15)
- Notwithstanding the above minimum wire-size requirements, all wiring must be sized to keep line voltage losses to less than 3% between PV generator and battery, less than 1% between battery and charge regulator, and less than 3% between battery and load, all of them at the maximum current conditions. The minimum cross-section must also allow the circuit to operate within the ampacity rating of the wire.
26. All wiring shall be colour-coded and/or labelled. The following conventions shall be followed for two-conductor DC wiring:
 - a) Positive : Red or brown
 - b) Negative : Black or blue
 27. Earth conductors, either separate or as a third wire in 3-core cables, if present, must be green-yellow.
 28. All exposed wiring must be in UV-resistant conduits or be firmly fastened to the building and/or support structure. Cable binders, clamps and other fixing material must also be UV-resistant, preferably made of polyethylene.
 29. Wiring through roofing, walls and other structures must be protected through the use of bushings. Wiring through roofing must be sealed (waterproof).
 30. Holes through roofing materials should be avoided wherever possible. Cables through roofing shall be contained in purpose-made roof-entry boxes, or proper UV-resistant glands, which shall form a weatherproof seal to prevent leakages. In corrugated roofs, holes for cables are to be drilled at the top of corrugations. All holes in roofing shall be thoroughly sealed and made waterproof with UV-resistant silicone sealant or an equivalent method.
 31. Fittings need to be fastened to suitable supports, which may need to be provided if not already present. No conduit or fitting shall be attached directly to thatch or any other non-supportive surface.
 32. Holes that penetrate external walls shall slope slightly upward to prevent the ingress of water and be suitably sealed.

33. Conduits to battery boxes or battery enclosures shall not provide a route through which hydrogen gas may escape, leading to any area or device (relays, etc.) where there is a danger of sparks.
34. Cables must be joined by the use of junction boxes, screw-connectors, block-connectors. All stranded wires must be terminated with proper end-sleeves. Soldering in the field and the use of wire nuts are not allowed. The rated current-carrying capacity of each joint must not be less than the circuit current rating.
35. Junction boxes or enclosures must be dust- and waterproof, non-corrosive and electrically insulated (no metal boxes). Interior junction boxes shall have an IP protection of at least IP 32, and external junction boxes a minimum of IP 55 according to IEC 60529.
36. Careful attention shall be given to entries into enclosures and junction boxes, to provide good sealing, proper strain relief to ensure that the wiring connections themselves are not under tension and to prevent chafing and damage to the insulation.
37. Surface-mounted cabling shall be installed using appropriate fasteners at suitable intervals (15 to 20 cm) to prevent sagging.
38. Visible interior cabling or conduits shall be aesthetically tidy, and should not slant from the vertical or horizontal unless essential.
39. Suspended cables shall be mounted so that the lowest point is at least 2.8 m above ground level. The cable shall be held in position by suitable brackets and strain relief to prevent mechanical wear and any strain on the electrical connections.
40. Mains (230VAC) sockets and plugs are not to be used under any circumstances. Any 12 V appliance with a mains-type plug attached constitutes an unacceptable safety risk to the user if the appliance is used in a 230 VAC outlet.

7. Installation/Switches /Fuses

Technical Specifications

41. Connectors, fuses and circuit-breakers shall meet the specifications given in 8.4 and 8.5 of IEC 61214 ed.1.
42. Fuses and circuit-breakers shall
 - a) be rated for DC service
 - b) have voltage ratings greater than the maximum circuit voltage
 - c) have current ratings between 125% and 150% of the maximum design current for the circuit
 - d) be marked with the rated capacity and circuit voltage.
43. Fuses or any other components which can cause sparking shall not be installed in a battery enclosure where there is a chance of explosion of hydrogen. No fuses or circuit breakers shall be installed in a grounded conductor.
44. Light switches shall be installed next to the entrance door of each room at approximately 1.2 m above finished floor level.
45. Only special DC switches are allowed. They shall be rated for the current and voltage of the circuit they disconnect.
46. All switches should include a clear visual indication of their state (ON/OFF or I/O). However, suitable pull switches may be acceptable for overhead light fittings.
47. Every current circuit connected to the battery shall be equipped with a melting fuse or a circuit breaker to protect it against short circuit and overload.
48. In a grounded two-conductor system, the fuses should be installed in the not-grounded path as close as possible to the battery. However, they must not be installed in places where hydrogen escapes, due to the risk of arcing or sparking.

49. Fuses have to be suitable for direct current and must be designed for the maximum occurring operating voltage; they shall trigger between 125% and 150% of the maximum operating current that occurs.
50. Switches shall be installed at a place in accordance with user's preference

8. Installation /Sockets **Technical Specifications**

51. Sockets have to be designed for DC and have to be safe against reverse polarity. The direct current (DC) and the voltage should be clearly indicated in writing on the device.
52. Sockets shall be installed at a place in accordance with user's preference.

9. Installation /Panel Mounting Structure **Technical Specifications**

The PV Solar Panel Mounting Structure should comprise of;

53. Three inch diameter galvanized pipe of twelve feet length. Two to four feet (the depth shall depend upon the type of ground and local wind conditions) will be buried in the ground while ten feet height will be provided for solar module. The base of the pole should be anchored in concrete.
54. Pipe rotation in the foundation will be prevented through "BARAS" of ¾ inch iron rod welded with the base of the pipe.
55. A sleeve of 9 inches, carrying the frame for solar module along with the solar module will be installed on the pipe. It should be free to rotate in 360 degrees and should be able to be fixed through two side nuts/bolt arrangements, in any position.
56. Vertical angle to the frame should be through hinges on one side and two sliding plates on both sides.
57. Bolts should be tightened at the required angle.
58. Module should be fixed with the frame through bolt.
59. The entire mechanical structure should be powdered painted for longer life of the structure.
60. The orientation and tilt angle of module shall be optimized to the place of installation.
61. Shading shall be avoided the all year around from 90mn after sunrise to 90mn before sunset.
62. To allow for regular cleaning of the solar module, they should be accessible for personnel.
63. The module and support structures should be able to withstand 120 km/h.
64. The array frame and structure should be connected by the shortest practical route to an adequate earth contact, using an uninterrupted conductor of at least 16 mm² cross-section. Grounding can reduce the risks of damage from lightning-induced surges.

10. Installation /Battery box

Technical specifications

65. The battery should be housed in a vented compartment that prevents users from coming in contact with battery terminals. This compartment should be strong enough to accommodate the weight of the battery. A mechanism to prevent opening and entry of the battery enclosure by children shall be provided.
66. The entire enclosure must be constructed to last at least twenty years without maintenance and protected against corrosion. The battery enclosure should have a clean and neat appearance.
67. Battery should be installed at a place in accordance with user's preference.

11. Installation /Documentation

Technical specifications

68. In accordance with the standards IEC 62124, documentation for technicians and user shall be provided. The documentation shall be provided as follows:
 - a) For 2,000 systems 3 copies of the technician manual (1 copy in English, 1 copy in Urdu, 1 copy in Balochi or Pachtu as appropriate)
 - b) For 200 systems 2 copies of the technician manual (1 copy in Urdu, 1 copy in Balochi or Pachtu as appropriate)
 - c) For each system, 1 copy in Urdu or Balochi or Pachtu as appropriate of the user manual. The user manual shall be illustrated in order to be understandable by illiterate user. The text shall be understandable by technically unqualified user.
 - d) For each village, 2 additional copies of the user manual (1copy in Urdu, 1 copy in Balochi or Pachtu as appropriate) shall be provided.
69. Maintenance log book for each village/system will be provided to designated supervisors/CCBs. The first page will include the name of the user, as-built system plan, specifications and brands of components, date of installation and contact number of the installation company (see Annexe 6 for example). Each book will consist of a minimum of 100 pages. The logbook has to be filled by operators under the supervision of the service provider during throughout the contract period.
70. For each village an electronic copy of the first page of the maintenance books will be provided to AEDB.
71. For each village a database sheet will be provided after completion. An electronic format will be given on request.
72. An update of these data will be provided every three months during one calendar year after completion of the last village (warranty period of systems).

11. Complete Solar Home System

Technical specifications

73. The system performance of the whole SHS shall be tested either directly or by computer simulation. A system performance report from one of the laboratories mentioned in Annexe IV shall be provided within two month after the award of contract and before the physical mobilization of items.

ANNEXE IV

List of Approved Laboratories

Name	Address	Phones / Fax / contact info	e-mail / website
Pakistan Council for Renewable Energy Technologies Laboratory (PCRET)	25, Sector H9, Islamabad Pakistan	+92 519257473-74	
Fraunhofer ISE	Heidenhofstr.2D-79110 Freiburg Germany	Norbert Pfanner / Georg Bopp T:+ 49 (0) 761 4588-5224 F:+49 (0) 761 45 88 9000	norbert.pfanner@ise.fhg.de www.ise.fhg.de
European Solar Test Installation Renewables Energies Unit Institute for Environmental and Sustainability -JRC	Via E. Fermi 1 Ispra (VA) 21020 Italy	T: +39 0 332 78 9172 F: + 39 0332 78 9268/5561	esti.services@jrc.it www.iames.jrc.it
NREL - National Renewable Energy Laboratory	1617 Cole Blvd. Golden, CO 80401-3393 USA	T: +1 (303) 275-3000	www.nrel.gov
Arizona State University Photovoltaic Testing Laboratory	PTL 7349E, Unity Avenue, MESA, Arizona, 85212 USA		
Centro de Investigaciones Energéticas, medio ambientales y tecnológicas Centro de la Moncloa	Avda. Complutense 22-28040 Madrid España	Tel: + 91 346 6000 Fax + 91 346 6005	cav@ciemat.es
TÜV Rheinland Product Safety GmbH	Am Grauen Stein D-51105 Cologne Germany	Tel.+ 49 221 / 806 - 0 Fax + 49 221 / 806 - 114	www.de.tuv.com energie@de.tuv.com

Name	Address	Phones / Fax / contact info	e-mail / website
Post and Telecommunications Industry Products Quality Surveillance and Inspection Center PTPIC	No. 28 Xinjiekou-wai 1000 88 Beijing	Tel. + 86 10 8205 1479 Fax + 86 10 8205 1479	ptpic@263.net www.ptpic.com.cn
BUET Bangladesh University of Engineering Technology	Dept. of Electrical Electronic Engineering Dhaka-1000 Bangladesh	Prof. Mohammed Rezwan Khan Tel. ++88 02 9665650-80, Ext.7105, 7473	rezwanm@ee-buet-ac.bd

ANNEXE V

Forms for SHS's components

1. Photovoltaic module

Manufacturer / Model	
Type (monocrystalline, polycrystalline)	
Model number	
Nominal Capacity (Pmax @ Standard Testing Conditions, STC) in wp	
Open circuit voltage Voc in V	
Short circuit current Isc in A	
V max	
I max	
Weight in kg	
Dimensions in cm (Height, width, length)	
Operating temperature range in °C	
Certificate (Yes/No)	
Name of the laboratory issuing the certificate	

2. Panel Mounting Structure

Material of the mounting structure	
Dimensions of the mounting structure	
Type of anti-corrosion protection	
Diameter of the pole	
Maximum wind speed that the structure is able to withstand in km/h	

3. Charge regulator

Manufacturer / Model	
Nominal voltage in V	
Working principle (On-Off or PWM)	
Type of connexion (series o parallel)	
High-charge voltage of disconnection and reconnection in V (i) High charge disconnect (ii) High charge reconnect	
Indicator of a battery charge?	
Maximum charge current in A	
Maximum discharge current in A	
Voltage drop between panel and regulator in V	
Voltage drop between regulator and battery in V	
Temperature compensation	
Low-charge voltage of disconnection and reconnection in V (i) Low-charge disconnect	

(ii) Low-charge reconnect	
Maximum own power consumption in mA	
Short-circuit protection?	
Protection against reverse polarity	
Operating temperature range in °C	
Service life (years)	
Guarantee (years)	
Certificate (Yes/No)	
Name of the laboratory issuing the certificate	

4. Battery

Manufacturer / Model	
Type of battery (Tubular, Gel, Flat Plate)	
Nominal Voltage in V	
Structure and material of positive plate	
Battery capacity at °20C in Ah	
Maximum depth of discharge in %	
Life cycle at 75% of discharge	
Type of electrolyte	
Volume of electrolyte (in litre)	
Density of electrolyte at full charge in gram/centilitre	
Is the terminals' polarity indicated?	
Is the serial number visible?	
Operating temperature range in °C	
Service life	
Guarantee	
Certificate (Yes/No)	
Name of the laboratory issuing the certificate	

5. Lamps (lamps and holder)

Lamps:	
Manufacturer / Model	
Power in W	
Lighting efficiency Lm/W	
Operating voltage range	
Life cycles	
Switching cycles	
Colour of light	
Guarantee	
Ballast:	
Operating voltage range in V	
Maximum crest factor	
Does protection exist against: Open circuit? (ii) Extraction of the lamp during operation? (iii) Operation without lamp?	

(v) Reverse polarity?	
Certificate (Yes/No)	
Name of the laboratory issuing the certificate	

6. Cables

Conductor	
Sections:	
Diameter of conductor between panel and charge regulator in mm ²	
Diameter of conductor between charge regulator and battery in mm ²	
Diameter of conductor between charge regulator and appliances in mm ²	
Are the cables clearly colour-coded?	

7. Exceptions and deviations from standards

1.	
2.	
3.	
4.	

9. Documentation for each item and installation:

1.	
2.	
3.	
4.	

ANNEXE VI

Qualification criteria

1. Only companies with previous experience of similar projects are qualified for tendering. Documents specified in paragraphs 9 and 10 of Special Terms and Conditions will be taken into account.

Evaluation criteria

2. The two following criteria shall be fulfilled in order for the bidder to qualify for evaluation of technical proposal:
 - a. Submission of Bid Security
 - b. Submission of separately enclosed Financial and Technical proposals
3. The technical scrutiny of accepted offer will be based on the following:
 - a. Technical proposals have to fulfil the technical specifications listed in Annexe III
 - b. Technical proposals have to include certificates of items as specified in Annexe III
 - c. Technical proposals have to fulfil all the terms and conditions given in the tender notice including the Annexe.
4. Companies that have qualified installation teams (including electricians) and qualified staff will be given preference.

ANNEXE VII

Integrity Pact

[The Seller/Supplier] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing, [The Seller/Supplier] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultation fee or otherwise, with the object of obtaining or including the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[The Seller/Supplier] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[The Seller/Supplier] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [The Seller/Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by [The Seller/Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege, or other obligation or benefit in whatsoever form from GoP.

ANNEXE VIII
Installation book

User Name and Address	Number of adults (male/female)	Number of children under 18 (male/female)	Type of House 1. Pacca 2. Kacha	Number of rooms, size of rooms	Veranda size	Separate kitchen size if any	Separate toilet size if any	Remarks	

As-built system plan including location of pole, charge controller, battery and appliances and distances between them:

Details of utilized material:

Item	Number or Length	Brand	Item	Number or Length	Brand
PVC Pipe			Cable 2 Diam....		
PVC Bend			Cable 3 Diam...		
PVC Box 3W			Lamp holder		
PVC Box 4W			LED holder		
Junction Box (01)			Socket		
Junction Box (02)			Switches		
Junction Box (03)			Charge Controller		
Junction Box (04)			Battery		
Cable 1 Diam			Panel		

Date of Installation (completion)	Installation team	Company	Signature of user