

VENDOR PARTICIPATION AGREEMENT

Between



UNEP

UNEP Collaborating Centre on Energy and Environment
At Risø National Laboratory
Frederiksborgvej 399
DK-4000 Roskilde, Denmark

And



Selco Solar Light Private Limited
No. 26, BHCS Layout, Bannerghatta Road,
BTM II Stage, Bangalore 560076, INDIA.

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Between

UNEP Collaborating Centre on Energy and Environment

At Risø National Laboratory
Frederiksborgvej 399
DK-4000 Roskilde, Denmark
(Hereinafter referred to as “UCCEE”)

The Centre provides scientific input on energy and climate changes issues to the United Nations Energy Program, and is placed at RISØ, a national laboratory under the Danish Ministry of Science, Technology and Innovation, organised and existing under the laws of Denmark.

and

Selco Solar Light Private Limited

No. 26, BHCS Layout, Bannerghatta Road,
BTM II Stage, Bangalore 560076, INDIA.
Having registered office at;
26, 1st Main, BHCS Layout
Bannerghatta Road, BTM II Stage, Bangalore- 560076.

(Hereinafter referred to as “Vendor”)

a company organized and existing under the laws of India.

(UCCEE and Vendor hereinafter sometimes also referred to individually as “Party” and collectively as “Parties”)

The following

Vendor Participation Agreement
(herein after referred as “the Agreement”)

is made and entered into regarding

Project no. 1215110-04 - PV Solar Home System Financing Project

(hereinafter referred to as “the Project”) with respect to the following facts:

Whereas

- (a) UCCEE proposes to work with one or more banks operating in India and extend financial and technical support to them under the above project for advancing loans at concessional rate of interest to the customer of selected banks (“**Loan Programme**”) against purchase of Solar Home Systems (“SHS”);
- (b) Vendor is primarily engaged in the manufacture, marketing, sale and/or servicing of SHS in India and has expressed a desire to be considered for inclusion of its SHS for the purposes of the Loan Programme and proposes to enter into agreement with UCCEE for the aforesaid purpose;

Now, therefore the Parties have agreed as follows:

Article 1- Definitions

1.1 Definitions.

The following terms when used in this Agreement shall have the following meanings:

“**Bank**” means the bank selected by UCCEE for the purposes of granting loans under the auspices of the Loan Programme, and may be one or more in number.

“**Claims**” has the meaning ascribed thereto in Article 6 of this Agreement.

“**Loan Programme**” the respective meanings ascribed thereto in the preamble to this Agreement and described in Article 3 of this Agreement.

“**Qualified Vendor**” means the Vendor who has contracted with UCCEE under this and any other Agreement to act in the capacity as a vendor of SHS for the purposes of the Loan Programme.

“**Qualifying Criteria**” has the meaning ascribed thereto in Article 2 of this Agreement and described in Schedule 2 hereof.

“**SHS**” means the Solar Home Systems, which has the features and characteristics described in Schedule 1 hereto.

“**Technical Specifications**” has the meaning ascribed thereto in Article 2 of this Agreement and described in Schedule 1 hereof.

“**Term**” has the meaning ascribed thereto in Article 7 of this Agreement.

“**UCCEE/UNEP Representative**” means an employee or authorized representative of UCCEE deputed by UCCEE from time to time to Vendor in accordance with this Agreement.

Article 2- Qualification

2.1 Qualification.

UCCEE hereby qualifies the Vendor to manufacture, market, sell and/or service SHS within the territory of India for the purposes of carrying out the Loan Programme for the Term of this Agreement, and Vendor agrees to act in such capacity in accordance with the terms and conditions of this Agreement. During the term of this Agreement, Vendor will be entitled to describe itself as “Qualified Vendor” for the UNEP Project for the SHS, but shall not hold itself out as UNEP’s agent or representative or as being entitled to, and shall not be entitled to, bind UCCEE in any manner or capacity. Further, such qualification shall not amount to an endorsement, recommendation or acceptance in any manner whatsoever of the SHS manufactured, marketed, sold and/ or serviced by the Vendor.

2.2 Non-exclusivity. The qualification of the Vendor shall be on non-exclusive basis and during the Term of this Agreement, UCCEE may from time to time at its sole discretion, and without prejudice to the remaining provisions of this Agreement appoint any other Person(s) as a Qualified Vendor(s) for the SHS.

2.3 Modifications. The qualification of the Vendor shall be subject to the compliance by the Vendor of the Qualifying Criteria and conformity of its SHS to the Technical Specifications at all times during the term of this Agreement, and UCCEE may from time to time at its sole discretion, by intimating in writing to the Vendor and the Banks, and without prejudice to the remaining provisions of this Agreement:

- (a) Vary, add, modify, delete or otherwise change the Technical Specifications; and
- (b) vary, add, modify, delete or otherwise change the Qualifying Criteria.

2.4 Undertakings.

During the Term of this Agreement, Vendor shall:

- (a) manufacture, market, sell and/or service the SHS in accordance with the conditions stipulated in this Agreement and the Technical Specifications as described in Schedule 1 hereto and as UCCEE may provide to Vendor or modify from time to time;

(b) ensure that it complies with, at all times during the Term of this Agreement, the Qualifying Criteria as described in Schedule 2 hereto and as UCCEE may provide to Vendor or modify from time to time.

Article 3- Loan Programme

3.1 Vendor shall only manufacture, market, sell and service SHS conforming to the Technical Specifications under the auspices of the Loan Programme. The Banks will at their sole discretion provide loans to buyers of SHS. The Banks will follow such loan appraisal criteria as they may decide appropriate in accordance with their internal lending policies and in consonance with the objectives of the Loan Programme. The Banks shall have the right to additional information, documentation or support from the Vendor in respect of any specific or all customers. The Banks will charge commercial rates of interest on loans advanced to buyers of SHS. UCCEE intends to provide financial support to the Banks in order that the financing costs are reduced or other financial incentives are provided to the borrowers. However, the quantum, timing and manner in which such support is made available shall be at the discretion of the UCCEE and the Banks. Neither UCCEE nor the Banks shall be under any obligation to provide any Vendor, specific customer or set of customers the aforesaid financial support. Vendors shall make available details of their SHS price lists, including revisions thereto, to UCCEE and the Banks to indicate the range of sale prices of the products and make the pricing process transparent. However, it will be open to the Banks to extend loan to buyers of SHS at different prices, if required based on their assessment. The loans will be available at selected branches of the Banks in the State of Karnataka or such other areas as the UCCEE and/or Banks may decide at their sole discretion. UCCEE and/ or the Banks may seek the co-operation of the Vendor to participate in initiatives associated with spreading awareness and information about solar photovoltaic technologies, SHS and the Loan Programme.

3.2 Loan Programme may be cancelled, altered, modified or otherwise subject to change from time to time, without reference to the Vendor

Article 4- Covenants

4.1 Vendor Covenants.

During the Term of this Agreement, Vendor shall, at its cost and expense, and at no cost or expense to UCCEE, ensure that the UCCEE Representatives have access to the information relating to the SHS and its compliance with Qualifying Criteria at all times or for any other purpose.

Article 5- Representations And Warranties

5.1 Representations and Warranties by Vendor.

Vendor represents and warrants to and for the benefit of UCCEE that as of the date of this Agreement and as of the Effective Date, each of the statements set out in Clauses 5.1(a) to 5.1(e) below is true and correct:

(a) Corporate Existence. Vendor is duly organised, validly existing and in good standing under the laws of its organisation, and has all requisite power to

own, lease and operate all of its property and to carry on its business as it is now being conducted. No order or petition has been presented or resolution has been passed for the winding-up or liquidation of Vendor and no receiver or manager has been appointed in respect thereof.

(b) Satisfactory Conduct. Vendor or any person connected with senior management of the Vendor is not in default with the Banks or any other bank or has otherwise contravened or failed to discharge its obligations in any manner whatsoever towards the Banks or any other bank; and it has not been blacklisted, prohibited, restrained, barred or otherwise prevented from manufacturing, marketing, selling or servicing its SHS.

(c) Compliance with Laws. Vendor is in compliance with all laws applicable to its business and operations and is not under investigation with respect to and has not been threatened to be charged with or given any notice for any violation of any applicable law, rule, regulation, judgements, injunction, order or decree, including by the Ministry of Non-Conventional Energy Sources of the Government of India or any similar authority, whether under the auspices of the Central or State governments in India.

(d) Litigation. There is no Action pending or, to the knowledge of Vendor, threatened or anticipated with respect to its business and operations or seeking to delay, limit, prevent, hinder or enjoin the transactions contemplated by this Agreement.

(e) Authority. Vendor has the power to execute, deliver and perform its obligations under this Agreement. The execution and delivery by Vendor of this Agreement have been authorised by all necessary corporate action; and this Agreement is and will be, when duly executed and delivered, a valid and binding obligation of Vendor enforceable in accordance with its terms.

5.2 Representations and Warranties by UCCEE.

UCCEE represents and warrants to and for the benefit of Vendor that, as of the date of this Agreement and as of the Effective Date it has all requisite corporate power and authority to execute, deliver, perform and observe its obligations under this Agreement, and to consummate the transactions contemplated herein, and when duly executed and delivered by it, this Agreement shall be binding upon it and enforceable against it in accordance with its terms.

Article 6- Indemnities

6.1 General Indemnity.

Each Party undertakes to indemnify, defend and hold harmless the other Party from and against all actions, proceedings, claims, demands, damages, costs, expenses (including without prejudice the reasonable legal costs of such party) (“**Claims**”) however arising, directly or indirectly, as a result of any breach or non-performance by the non-performing Party of its undertakings, warranties or obligations under this Agreement, to the extent such breach or non-performance is not

cured within 30 days of written notice thereof delivered to the non-performing Party by the other Party.

6.2 Third Party Claims.

Without prejudice to Article 7.1, Vendor shall be liable for and shall indemnify UCCEE against any and all Claims incurred or suffered by UCCEE arising out of any dispute or contractual, tortious or other claims or proceedings brought against UCCEE by a third party claiming relief by reason of the use of any SHS supplied by the Vendor.

Article 7- Effective Date, Term And Termination

7.1 Effective Date.

This Agreement will be effective from the date of execution hereof (“**Effective Date**”), subject to the fulfilment of the following conditions:

(a) Truth of Representations and Warranties. The representations and warranties of Vendor contained in Article 5.1 shall be true and correct on and as of the Effective Date with the same effect as though such representations and warranties had been made on and as of such date.

(b) Performance of Agreements. All of the obligations of Vendor to be performed prior to the Effective Date pursuant to the terms of this Agreement shall have been duly performed in all material respects to the satisfaction of UCCEE.

(c) Consent of the Banks. The Banks have agreed to give effect to the implementation of the Loan Programme and take such steps, actions and measures that are necessary for that purpose.

7.2 Term.

The term of this Agreement shall commence on the Effective Date and shall continue for a period of three years thereafter, unless terminated by UCCEE upon the occurrence of any one of the following events:

- (d) There has been a breach of this Agreement by the Vendor;
- (e) Vendor is declared bankrupt, suffers bankruptcy proceedings or makes an assignment for the benefit of creditors;
- (f) there has been a consolidation or merger of Vendor with or into one or more corporations unless Vendor is the surviving corporation of such consolidation or merger; or
- (g) UCCEE decides, in its sole discretion, to terminate the agreement for any reason whatsoever.

UCCEE shall have the right to terminate this Agreement upon written notice to Vendor and this Agreement shall terminate one month after the date on which UCCEE notifies Vendor as aforesaid and provided further that this Agreement shall

terminate automatically and immediately without notice or other action by UCCEE or Vendor.

7.3 Post-Termination.

Upon termination of this Agreement, Vendor agrees that it shall forthwith cease to refer to itself as a Qualified Vendor for the SHS.

Article 8- Dispute Resolution

8.1 Amicable Settlement.

Any and all disputes, controversies and conflicts between the Parties arising out of or relating to or in connection with this Agreement and the performance or non-performance of the obligations set forth herein (including the validity of this Agreement) (a “**Dispute**”) shall, so far as is possible, be settled amicably between the Parties within thirty (30) days after written notice of such Dispute has been given by one Party to the other Party.

Article 9. Governing Law And Venue

9.1 This Agreement shall be construed and enforced in accordance with the laws of the Kingdom of Denmark and its proper venue for solution of disputes shall be Copenhagen City Court.

Article 10 - Miscellaneous

10.1 Notices.

6.1 Any notice or other communication hereunder must be given in writing to the Party, to which such notice or communication is to be given at the address set forth below:

For the UCCEE;

UNEP Collaborating Centre on Energy and Environment

Risø National Laboratory
Frederiksborgvej 399
DK-4000 Roskilde, Denmark

For the Vendor;

Selco Solar Light Private Limited

No. 26, BHCS Layout, Bannerghatta Road,
BTM II Stage, Bangalore 560076, INDIA.

10.2 Binding Effect; No Assignment; No Third-Party Beneficiaries.

Neither this Agreement, nor any right hereunder, may be assigned by Vendor without the prior written consent of UCCEE. Nothing in this Agreement is intended or shall be construed to give any Person, other than the Parties hereto, any

legal or equitable right, remedy or claim under or in respect of this Agreement or any provision contained herein.

10.3 Compliance with Laws.

Vendor shall comply with all laws and regulations in the jurisdiction in which it manufactures, markets, sells and/or distributes the SHS pertaining to such manufacture, marketing, sale or service of the SHS.

This Agreement is executed by the duly authorised officers of the respective Parties in 2 (two) original copies and each Party has received a copy.

For and on behalf of UCCEE:
Date:

For and on behalf of Vendor
Date:

SCHEDULE 1

TECHNICAL SPECIFICATIONS

The Technical Specifications of the SHS are stipulated herein, and they are subject to review, modification, addition, deletion and change from time to time at the sole discretion of UCCEE/UNEP, by intimation in writing to the Vendor and Banks.

1. Solar Home System Hardware Description

- 1.1. The Solar Home System (“SHS”) is intended to provide the user with a convenient means of supplying power for small electrical loads such as lights, fans, radio/cassette players or TV. A typical SHS operates at a rated voltage of 12 Vdc and provides power for compact fluorescent luminaries (minimum 6W), fans (14W), radio/cassette players, small black and white TV or similar low-power appliance for about three to five hours a day. Each SHS consists of one or more photovoltaic (“PV”) modules with an output of 18Wp or more charging a 12 Vdc lead-acid battery along with luminaires, related electronic and electrical components and mounting hardware. The system should be designed with battery capacity to provide at least for 3 days non-sunshine autonomy. Examples of SHS PV module sizes and the minimum useful energy that can be got from the system provided with 5.5 peak sunlight hours per day are shown below:

<i>Solar Home System</i>	<i>Minimum Useful energy</i>
18 Wp	4.5 Ah/day or 54Wh/day
36 Wp	9 Ah/day or 108Wh/day
50 Wp	12 Ah/day or 144 Wh/day
70 Wp	18 Ah/day or 216 Wh/day

Note: These are representative levels of service assuming 10% module derating and 20% battery round-trip Wh losses. Actual operating hours per day will vary depending on the wattage of the lights and other appliances, number of lights and other appliances switched on at any given time and peak hours of sunlight available on any given day.

- 1.2. The SHS is packaged and pre-wired to provide convenient installation at a remote customer home site by a qualified technician. The system is constructed such that a user can perform routine maintenance such as adding battery water and replacing light bulbs and fuses, and a technician can easily perform system diagnostics or replace components.

2. Component Specifications

- 2.1 Technical specifications of SHS to be financed must meet or exceed the specifications and best practices recommendations stipulated herein or the Ministry of Non-Conventional Energy, Government of India (“MNES”).

- 2.2 The Vendor provides the most appropriate system integration, components, assembly and packaging that meet all the component specifications and the best practices recommendations. Any exceptions and variations to the specifications must be explicitly stated, and the scope and reasons for each listed exception and variation must be fully explained with supporting data.
- 2.3 The Vendor will provide at a minimum a 6-month warranty against manufacturers defects on all system integrated parts and labor excluding fuses. On all major individual components, manufacturers warranties will be passed through to the user. Specifically, the PV modules should be warranted against reduction of output of no more than 10% of rated capacity over a minimum of 10-year period. The charge controller, low voltage disconnect, switches, and charge indicators should be warranted for at least 1 year. The battery should be warranted for at least 3 years. Battery end-of-life will be determined when the battery capacity down to 1.75 V/cell at 25 degrees centigrade drops to less than 80% of the initial rated capacity. All warranties will start from the day the system is installed in the premises of the customer.
- 2.4 Nominal system voltage (rated voltage) shall be 12 Vdc.
- 2.5 The entire SHS system must be designed and constructed so that it requires maintenance and inspection by a technician no more frequently than once every 6 months.
- 2.6 The main components shall be integrated in such a way as to allow replacement (in case of failure) with a similarly functioning component of a newer design or a different brand. This will allow for future component evolution or variability of future component availability.
- 2.7 With the exception of the PV module(s), the Vendor shall deliver the system to the user with as many components pre-assembled and pre-wired as is feasible prior to shipment.
- 2.8 All components, including spares, will undergo quality control testing of the highest standards, to the satisfaction of UCCEE/UNEP, at the Vendor factory or the originating source factory and proper documentation should be available detailing the procedures followed and results thereof.
- 2.9 The following are some of the applicable standards:
- International Electrotechnical Committee (IEC) 61215: 1993 Crystalline Silicon Terrestrial PV Modules – Design Qualification and Type Approval
 - IEC 61646: 1996 Thin Film Silicon Terrestrial PV Modules – Design Qualification and Type Approval
 - IEC 60904-1:1987 Photovoltaic Devices Part 1 – Measurement of PV Current-Voltage Characteristics
 - IEEE 1262: 1995 Recommended Practice for Qualification of Photovoltaic Modules, April 1996

Operating Environment

- 2.10 The entire system shall be designed and built to withstand the environmental conditions found in the area of sale. For design purposes, consider that temperature extremes could range from +5 to +45 degrees Centigrade and humidity levels could reach 95%.
- 2.11 All wiring, enclosures, and fixtures that are mounted indoors must be resistant to high humidity conditions, corrosion and insect and dust intrusion. Use of corrosion-resistant terminals is required. Protection of the electronic circuit boards from corrosion is recommended.

Photovoltaic Array

- 2.12 The photovoltaic array will consist of 1 or more photovoltaic modules. Each module should comprise of no less than 36 series-connected single or polycrystalline silicon solar cells. Flat plate thin-film modules could also be used.
- 2.13 The photovoltaic array should have a peak power output of at least 18 Wp, under Standard Test Conditions (STC) as defined in IEC 60904-1. The peak power output for thin film modules should be the value after light soaking.
- 2.14 The single-crystalline or poly-crystalline modules must be product tested and certified in accordance with IEC 61215 or equivalent specifications. If thin-film photovoltaic modules are used, they must be product tested and certified in accordance with IEC 61646 or equivalent specifications. Crystalline or thin film modules that meet IEEE Specification 1262-1995 will also be acceptable. If more than one module is used, identical models shall be used and they shall be connected in parallel.
- 2.15 Each module must be factory equipped with either (a) weather-proof junction box with terminal strip that allows safe and long lasting wiring connection to the module, or (b) output cable that connects the module via a sealed weather proof termination.
- 2.16 Each module must be labeled indicating at a minimum: Manufacturer, Model Number, Serial Number, Year of Manufacture, Peak Watt Rating, Peak Current, Peak Voltage, Open Circuit Voltage and Short Circuit Current of each module.

PV Module Installation

- 2.17 The modules must be framed in such a way as to allow secure connection to the module mounting structure.
- 2.18 The array mounting structure will hold the PV module(s). The module(s) must be mounted on a support structure made of corrosion resistant material that assures stable and secure attachment.

- 2.19 The PV array and support structure must be able to withstand wind gusts up to 100 km/hour without damage.
- 2.20 The structure must be mounted at a fixed angle and oriented to maximize the useful energy supplied to the user during the design month (i.e., the month with the worst average daily insolation). Array orientation must be adjustable in the field.
- 2.21 The structure will incorporate corrosion resistant hardware for all external connections. These include the modules to structure, structure to pole and pole to building attachments.
- 2.22 The modules can be roof or ground-mounted: Roof-mounting: Minimum clearance between the PV array and the roofing material must be at least 20 cm above the roofing material. It is recommended that the module mounting structure be supported on top of a pole of at least 50 cm length. Anchoring of the mounting structure must be to the building and not to the roofing material. Ground-mounting: A metal, concrete or treated wood pole must be used with the modules attached at the top of the pole. The modules must be at least 4 meters off the ground. The pole must be anchored in concrete or tightly packed soil at least one meter deep in the ground. The pole and mounting structure must be sufficiently rigid to prevent twisting in the wind or if large birds alight on the array.

Battery Storage

- 2.23 Batteries should be selected and sized to offer a 3-year useful life under anticipated operating conditions.
- 2.24 The battery capacity shall be designed to provide for at least 3 days non-sunshine autonomy and the maximum depth of discharge is calculated at 60%. The rated amp-hour capacity is measured at 25 degrees Centigrade at the C/20 discharge rate down to a voltage of 1.75 volts per cell.
- 2.25 The maximum permissible self-discharge rate is 3% of rated capacity per month at 25 degree Centigrade.
- 2.26 Cycle life of the battery (i.e., before its residual life drops below 80% of the rated Ah capacity), at 25 degree Centigrade must exceed 1000 cycles when discharged down to an average depth of discharge (DOD) of 60%.
- 2.27 The battery must be production tested and certified in accordance with IS 1651 of 1991, or better qualification tests.
- 2.28 The Battery should be designed for 3 days of autonomy.
- 2.29 No automobile-type batteries should be used.

Charge Controller

- 2.30 The charge controller must be CE certified. At a minimum, the following requirements must be met:
- 2.31 The charge controller set points must be factory preset with the set points applicable to the specified battery characteristics. It is recommended that circuitry to allow boost charging the battery is provided.
- 2.32 The charge controller must be capable of handling 125% of the array's rated short circuit current for 1-hour duration.
- 2.33 The charge controller must be able to withstand 125% of the array's rated open circuit voltage with the battery removed from the circuit for 1-hour duration.
- 2.34 Maximum current draw of the controller, when no LED's are lit should not exceed 10 mA.
- 2.35 The model number, serial number, rated voltages and currents, and set points should be noted on the charge controller case.

Circuit Protection and Charge Controls

- 2.36 Systems must include a means to protect users and system components from the following:
 - Battery overcharge and excessive water loss.
 - Battery undercharge and excessive deep discharge.
 - Circuit protection against short circuit of any load.
 - Circuit protection against reverse polarity of any load.
 - Circuit protection against reverse polarity of module or battery.
 - Circuit protection against internal shorts in charge controller, inverter or other devices.
 - Circuit protection against damage by the high PV open circuit voltage when it is connected to the controller without battery.
 - Protection of controls against lightning induced transients.
 - Nighttime discharge of the battery due to reverse current through the array.
- 2.37 For most systems this protection will be provided by a charge controller incorporation a high voltage disconnect (HVD), low voltage disconnect (LVD) and circuit protection. Devices that integrate the following into a single device are strongly encouraged for all SHS sizes but alternate approaches will be considered.
- 2.38 A solid state PV charge controller is required for all systems.

System Monitoring

- 2.39 A display to indicate when the battery is in the charging mode must be provided. (Systems without Charge controllers are not allowed)
- 2.40 Some form of a Battery State-of-Charge indicator must be provided on or near the controller or load center.
- 2.41 This device must, at a minimum, indicate when the battery condition is:
 - Suitable to operate loads (e.g. voltage greater than 12.5 Vdc)
 - Energy conservation required (e.g., battery voltage less than 11.5 Vdc)
 - The indicators may be LED's, or analog or digital meters.
- 2.42 The chosen device must come appropriately labeled such that the user does not have to refer to a manual to understand the existing battery condition

Protective Devices

- 2.43 The protective devices must meet appropriate Indian or international standards. These devices should ideally be built into the charge controller. At a minimum, the following requirements must be met:
- 2.44 Reverse current leakage protection is recommended. Blocking diodes or logic-derived methods are both acceptable. If blocking diodes are used they must exhibit a low forward voltage drop.
- 2.45 The SHS must be protected against damage caused by short circuit of the input and output terminals, and reverse polarity of connections. Over-current protection must be provided to prevent peak current to four times the maximum expected continuous current. Lightning induced surge protection is recommended.
- 2.46 Some means must be provided to safely disconnect the battery and the module during servicing or repair by a technician.

Load Control

- 2.47 The load control devices must meet appropriate Indian or international standards. At a minimum, the load must be controlled by a low voltage disconnect (LVD) device. The LVD must be capable of handling at least 150% of the maximum expected continuous load (e.g., assuming all end use devices are simultaneously on). It should be factory preset to disconnect and reconnect voltages corresponding to the safe operation of the battery under ambient temperature conditions.

Fluorescent Luminaire

- 2.48 The luminaire must meet approval of CE or LSDE. At a minimum, the following requirements must be met:

- 2.49 Each fluorescent luminaire should have its own inverter (ballast).
- 2.50 The inverter electrical efficiency must be greater than 80% from 11.0 to 13.3 V when using the fluorescent lamp specified by the luminaire supplier.
- 2.51 The minimum operating voltage when the tube will strike (start) should be at least 85% of the rated input voltage when using the fluorescent lamp specified by the luminaire Vendor.
- 2.52 Maximum continuous operating voltage without damage to the inverter circuit must be at least 125% of the rated voltage.
- 2.53 The minimum operating frequency should be 20 kHz.
- 2.54 The electrical waveform at the fluorescent lamp terminals must be symmetrical in time to within 10% (i.e., 60%/40% waveform maximum difference in symmetry over the voltage range of 11.0 to 12.5 Vdc at an ambient temperature of 25 degree C).
- 2.55 The maximum crest factor (ratio of maximum peak to RMS voltage of the waveform applied to the fluorescent lamp) shall be less than 2.
- 2.56 The input connections to the inverter should prevent the application of voltage with reverse polarity, or the inverter should be protected against damage when the rated voltage is applied with reverse polarity.
- 2.57 The inverter should be protected against damage by the application of voltage under open circuit conditions (e.g., when the light bulb is removed or has failed). The maximum input current draw under open circuit conditions should be no more than 200 mA.
- 2.58 Inverter or the luminaire must be marked with the manufacturer, model number, rated voltage, wattage and date of manufacture or batch number.

Socket Outlet

- 2.59 A 12 Vdc and/or lower voltage socket outlet for a radio/cassette player, TV or similar appliance must be rated to carry the maximum expected DC current. The outlet must be protected from reversing the polarity of the voltage applied to the appliance.

Equipment Enclosure

- 2.60 The equipment enclosure(s) will house the charge controller, charge indicators, low voltage disconnect, and all interconnecting wiring.
- 2.61 The batteries must be housed in a vented or a wooden compartment or should be provided with a stand. All parts of the compartment subject to battery acid contact must be acid resistant. This compartment must be built strong enough

to accommodate the weight of the battery. Access to the battery compartment by children must be prevented.

- 2.62 The remainder of the system components (electronics, switches etc.) must be housed in a separate compartment or enclosures, which prevents the system components being affected, by battery acid spills or fumes. The compartment or enclosure design must allow the internal electronic equipment to operate within acceptable operating temperature limits.

Wiring

- 2.63 Stranded and flexible insulated copper wiring must be used. Minimum acceptable cross-section of the wire in each of the following sub-circuits is as follows:

- From PV module to regulator/controller: 2.5 mm² upto 36Wp system (not exceeding 15 mtrs and 4 mm² above 50Wp systems
- From regulator/controller to battery: 2.5 mm²
- From controller to loads: 2.0 mm² (minimum)

Wherever special circumstances warrant use of different specifications, such specifications should be equivalent to the above standards.

- 2.64 Notwithstanding the above minimum wire size requirements, all wiring must be sized to keep line voltage losses to less than 5% in each sub-circuit and to allow the circuit to operate within the ampacity rating of the wire.
- 2.65 For SHS permanently installed on a structure, all exposed wiring (with the possible exception of the module interconnects) must be in conduits or be firmly fastened to the building structure. Wiring through roofing, walls and other structures must be protected through the use of bushings. Wiring through roofing must form a waterproof seal. Where the wiring is through flammable material (e.g. thatched roofs), they must be in a metal conduit. Adequate fasteners, conduits, bushings and other installation hardware must be supplied.
- 2.66 Field-installed wiring must be joined using terminal strips or screw connectors. Soldering or crimping in the field must be avoided if at all possible. Wire nuts are not allowed. The rated current carrying capacity of the joint must not be less than the circuit current rating. All connections must be made in junction boxes. Fittings for lights, switches, and socket outlets may be used as junction boxes where practical.
- 2.67 All wiring shall be color coded and/or labeled.

3. Documentation

Users Manual

- 3.1 The Vendor must provide a User's Manual intended for the customers and will be included with each of the packaged systems. The manual must be in

English and Kannada language. The User's Manual documentation should be simple and easy to understand. Use of sketches or graphics should be used to make the manual easier to use.

- 3.2 The documentation is to include the following:
- How the SHS works: battery charging by the array, functions, battery low voltage protection, and battery overcharge protection. The relationship between energy available on daily basis and sunlight conditions should be clearly and simply explained.
 - A description of all user interactive hardware including disconnect switches and status indicators.
 - Procedures for proper system operation, including a list of load limitations and any problem loads. These procedures should include suggested operation, including load conservation, during periods of inclement weather, and/or a low voltage disconnect event. The procedures for checking that the PV array is not shaded and how to prevent shading must be explained.
 - Any user maintenance items.
 - Emergency shut down procedures and recommendations for extended periods of system non-use.
 - A user-troubleshooting guide.
 - A block diagram showing the main components.

Technicians Manual

- 3.3 The Vendor must provide a Technician's Installation, Operations and Maintenance Manual to be used by the service technicians. The manual must be in English and Kannada language. The manual will include the specific details on installation, operation and maintenance
- A detailed technical description of the system.
 - A complete copy of the Users Manual.
 - A complete list of all system components, with associated manufacturers literature, specifications, and warranties.
 - Complete installation instructions.
 - Recommended post-installation acceptance test procedures, including all appropriate set points and test procedures. They will include:
 - Verify that the installation of the PV array with regard to position, direction, inclination and shading avoidance will maximize energy generation.
 - Ensure that the battery has received an equalization charge just before installation.
 - To measure the current and voltage from the array under charging conditions to verify the array charging current using a multimeter.
 - Test all of the loads for proper operation.
 - Make system-wide voltage drop measurements in the sub-circuits to verify that connections meet the required maximum allowable voltage drop.
 - Note all measurements in the installation log.
 - Explain to the user the system operating principles, load management requirements, impact of shading of the array and how to check and avoid it, user maintenance checks and how to conduct them.
 - A recommended annual maintenance schedule, with complete maintenance instructions.

- A detailed trouble-shooting guide referencing all the system components. This shall include repairs and diagnostic procedures that can be done by the supplier or a qualified third party. Repairs and procedures not to be attempted by non-electricians and/or electricians unfamiliar with PV systems shall also be identified.
- A functional block diagram, electrical single-line drawing showing the placement of all hardware and ratings of all component and physical layout diagram.
- Emergency shut down procedures.

SCHEDULE II
QUALIFYING CRITERIA

1. Vendor should have sold SHS in India for a minimum period of 2 years as on the date of the Agreement.
2. It should have installed at least 1,000 SHS in India.
3. It should operate in at least 5 districts in the State of Karnataka, and should have its own Sales Offices and Service Centres in the aforesaid districts.
4. It should have ongoing programmes to train local technicians to service SHS, either through special training programmes of its own or by way of adequate arrangements to train local technicians on a continuous basis.
5. Vendor should be a turnkey service provider.
6. It should have adequate experience in installing SHS in houses and small businesses in rural areas.
7. SHS should comply with the Technical Specifications detailed in **Schedule I**. Solar Lanterns are excluded from the definition of SHS.
8. Vendor should provide a certificate to UCCEE and/or the Banks or the branches of the Banks that its SHS complies with Technical Specifications, and such other confirmations that may be requested for
9. Vendor will be required to comply with requests made from time to time by the UCCEE and/or the Banks to subject its SHS to testing, audit and certification by independent agencies.
10. In the event that SHS sold to its customers does not conform to the Technical Specifications, Vendor should make adequate disclosure of such information to the customer and the Bank financing the purchase, stating the deviations therefrom, impact thereof and quantifying the cost increase/reduction therefrom. In such cases, UCCEE and the Bank will extend their support under the Loan Programme at their sole discretion.
11. Vendor should sell only new SHS.
12. The Vendor should provide detailed information including documentation such as invoices in respect of each SHS sold by it, whenever requested for by the UCCEE, and facilitate inspection, audit or certification by UCCEE/UNEP's Representatives.
13. Vendor should supply Product literature / User Manuals with every SHS. User manuals should state clearly:

- Break-up of components supplied
- Details of components supplied
- Standards complied with
- Price at which the complete system is sold
- Maintenance schedule
- Contacts of service centres
- Warranty information

14. Warranty Card should be supplied with every SHS.
15. Vendor should provide after-sales services based on a pre-determined schedule. The maintenance schedule should be disclosed in product literature. Both the customer and the Bank should be apprised of the schedule of maintenance that will be supported by the Vendor during the period of the warranty and the Bank Loan.
16. Warranty should be mandatorily available on all components for the period stipulated below, and in the Technical Specifications. In the event that the manufacturer or supplier of the individual component(s) provides longer periods of warranty, such benefits should be passed on to the customer:
 - Photovoltaic Panel – 10 years
 - Tubular Batteries – 3 years
 - Charge Controllers - 1 year
 - Luminaries – 6 months
17. Contact information on service centres should be available in product literature or User Manual
18. Service Technician should visit SHS location, or a service centre close to the premises of the customer. Visit particulars of Service Technicians should be available for audit and verification.
19. There should be at least one Service Centre within a radius of 100 kms of the location of the SHS. The Bank should be satisfied that the Service Centre is located at reasonably close distance from the customer's premises to provide high level of service, preferably within 24 hours of call. Vendor should provide information on Service Centres established by them, area covered by each and the facilities available in each.
20. Arrangements should be made to train and equip local technicians in each village-location where SHS is installed to take care of minor maintenance tasks for SHS.
21. Fees for after-sales service, including Annual Maintenance Charges, if any, for the full period of the Bank Loan, should be disclosed separately and built into the initial purchase price. No extra charges should be levied on the customer or the Bank during the tenure of the Loan.
22. In the event of premature failure or latent defect during the Warranty period, Vendor should repair/replace within reasonable period at no extra cost. Vendor should make available alternative SHS for the period during which the

repair/replacement is undertaken such that the customer does not suffer any breakdown or dislocation wherever period of dislocation is expected to last 2 days or more.

23. After-sales service support should be made available to the customer for the full period of the Bank Loan.
24. After-sales service support should continue to be available for the original period of the Bank Loan if the Bank repossesses the SHS from defaulters.
25. Vendor should assist Bank in restoring by repair/replacement SHS that is repossessed by the Bank from defaulters, and resold to other customers at a price to be mutually decided upon.
26. Vendor should circulate common Price List in respect of each of its products to the Banks and UCCEE. Price List should detail all common configurations in which the product is or proposed to be sold. Price List should be detailed enough to permit break-up of different components and permit comparisons between different SHS.
27. Revisions to the aforesaid Price List should be intimated to the Banks
28. Vendor will submit periodical reports in formats stipulated by UCCEE to the Banks and/or UCCEE regarding the specifications of SHS, after-sales infrastructure, sale of SHS, etc.
29. In the event that any subsidy, concession, discount or support is available to the Vendor or the customer (other than from UCCEE), in respect of a SHS sold to a customer, the Vendor will be responsible for ensuring that wherever the Vendor or customer have availed such benefit(s), such sale will not be eligible for financial support under the Loan Programme.