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GOOD SOLAR INITIATIVE

Quality Charter

Technical & Service Quality Standards for Accredited Solar Suppliers

Feb 2015 (v1.0)
Final

Developed under the framework of the of the AFD/EU-funded 'Green Microfinance Program', the 'Good Solar Initiative' is the first accreditation and quality control scheme for solar companies and their products in Cambodia. Accredited solar companies commit to promoting only high quality solar products and to providing customer care services - and agree to undergo quality inspection to confirm their compliance. This builds trust among consumers, and the Good Solar Initiative's certification seal becomes a recognized symbol for quality.

Abbreviations

A	Ampere
AC	Alternating current electricity
Ah	Ampere hour
DC	Direct current electricity
DOD	Depth of discharge
ID	Identification
LED	Light-emitting diode
Pmax	Maximum Power
SLK	Solar Lighting Kit
SHS	Solar Home System
S/N	Serial Number
V	Volt
VDC	Voltage direct current
W	Watt
Wh	Watt hour
Wp	Watt peak

Glossary

'Good Solar Initiative'	Quality control and certification scheme to promote high quality solar products and customer services in Cambodia.
Solar Solution	Bundle of goods and services sold by a solar supplier to an end-user to ensure effective supply of electrical power over time. It includes a Solar System and a Services Package.
Services Package	A comprehensive set of intangible benefits delivered to ensure satisfactory usage of a solar system over time.
Solar System	Electrical power system designed to supply usable off-grid power for small electrical DC loads. It consists on an arrangement of several components to generate power (solar panel), store energy (deep-cycle battery), control power generation and usage (charge controller) and additional components required for connection and installation of the system and loads.
Solar Lighting Kit	Plug & play[1] maintenance free solar system designed for indoor installation and to power multiple light points.
Solar Home System	Solar system designed to power various loads at a rated voltage of 12VDC that requires installation by a qualified technician.
Solar Panel	Photovoltaic module that converts light energy from the sun into electricity.
Deep-cycle Battery	Electrochemical cells that can store electrical energy into chemical energy. They are secondary batteries that can be charged and discharged multiple times and allows regular deep discharge using most of its capacity.
Charge Controller / Solar regulator	Electrical device that ensures appropriate charge of a battery form a solar panel and limited discharge of the battery from power loads.
Supplier, Solar supplier	A legally registered business entity existing for the main purpose of selling solar systems and associated services to end-users.
End-User/Consumer/Customer	A person who purchases solar products and services for personal use.
Accreditation/Accredited	Certification of competency, credibility, and compliance against official standards by an accreditation body.

[1] Plug & Play refers to systems that can be installed by the end-users after a basic instruction. End-users do not require electrical qualification or specific tools. Such systems are pre-assembled and just require to the end-user to place the different components and plug them in.

Introduction

Green Microfinance Program/Good Solar Initiative

The AFD/EU-funded 'Green Microfinance Program' aims to broaden access to energy for 25,000 households in off-grid locations in rural Cambodia in the period 2014-2018 - by enabling a sound supply of quality solar products from private solar supply companies, and by triggering demand from households for solar products and solar microcredit.

To ensure that rural households will be satisfied with their Solar Home System for many years to come, the project works only with selected solar suppliers accredited by the program. These suppliers become accredited under the so-called "Good Solar Initiative", the first accreditation and quality control scheme for solar companies and their products in Cambodia.

Accredited solar suppliers commit to promoting only high quality solar products and to providing customer care services - and agree to undergo quality inspection to confirm their compliance. This builds trust in the market, and the Good Solar Initiative's certification seal becomes a recognized symbol for quality.

Quality Standards & Quality Control

In order to promote supply of high quality solar products and associated customer services from solar suppliers operating under the framework of the Green Microfinance Program, the technical and service quality standards in this Quality Charter are established. The Standards follow recommendations from existing national and international solar initiatives and standard setting bodies.[2]

Solar suppliers' compliance with the *system components* and *system design* standards defined in this Quality Charter are to be confirmed by the 'Good Solar Initiative'. Suppliers submit technical documentation for system components and system designs to the Good Solar Initiative for technical review and approval before deploying them in the market place. New system components and designs can be submitted on an on-going basis.

Through a range of quality control tools - such as regular on-site technical audits, documentation review, customer satisfaction surveys, and mystery shoppers - suppliers' on-going compliance with the technical and service standards will be routinely controlled.

[2] Standards are subject to revisions over time to account for technological developments and to preserve the ambitions of the Good Solar Initiative.

1 System Standards for SLKs

*Solar suppliers accredited by the 'Good Solar Initiative' sell only **plug & play** Solar Lighting Kits (SLKs) approved by the 'IFC Lighting Global Program'.*

1.1 Solar Lighting Kits (SLKs)

Eligible Solar Lighting Kits are plug & play systems approved by the 'IFC Lighting Global Program'. A list of approved SLKs is provided at the link below[3]. Eligible IFC Lighting Global approved SLKs are defined as follows:

1.1.1 Core system

1.1.1.1 Eligible SLKs only include products complying with Lighting Global Minimum Quality Standards[4], which certify:

- Truth-in-advertising with accurate technical specifications;
- Lumen Maintenance at 2,000 hours deliver more than 85% of specified light output (L85);
- Safety for AC-DC charger (if included) and hazardous substance ban;
- Product is appropriately protected from water exposure and physical ingress and survives being dropped;
- Product passes a visual wiring and assembly inspection;

1.1.1.2 Additional requirements for SLKs under the program are:

- Only LED technology light points of minimum 75 lumens are included;
- 2 light points minimum are included per kit;
- The minimum run time is 4 hours per day[5] with all light points turned on;
- Minimum 2 year manufacturer warranty;
- An enclosure protects end-users from electrical hazard by direct contact to live wires or connectors;
- Plug & Play system installation and operation can be performed by the end-users without any electrical qualification or specific tools;
- Kits are properly packaged to prevent damage during transport;
- Solar panel rated peak power is less than 20Wp* and its cable length is at least 3m.

* Any system equal or larger than 20Wp is considered as a SHS and complies with the requirements specified in sections 2 and 3 below.

1.1.2 Optional appliances

SLKs can include small DC appliances such as mobile phone charger, radio, fan or TV. The minimum run time available for each appliance included in the system is 2 hours per day[4], in addition to the minimum runtime requirements for all light points. Accredited suppliers also offer a 2-year warranty[6] for any appliance sold as part of a Solar Lighting Kit.

[3] *List of approved Solar Lighting Kits: https://www.lightingglobal.org/products/?filter_product-type=48*
[4] *Lighting Global minimum Quality Standards: https://www.lightingglobal.org/wp-content/uploads/2014/09/MQStandards_Jan2014_V4_3.pdf*
[5] *Run time per day of solar charging as defined in Lighting Global product spec sheets.*
[6] *Manufacturer warranty is not mandatory but accredited solar suppliers offer a 2 years warranty on any appliance included with a SLK.*

2 System Components Standards for SHSs

Accredited suppliers sell only high quality, safe, efficient, user-friendly and long-lasting solar system components for Solar Home Systems (SHSs).

2.1 Key system components

Solar Suppliers submit technical documentation from the manufacturer to the Good Solar Initiative for each of the components used in the Solar Home System to confirm compliance with the technical standards set out in this Quality Charter. Eligible high-quality solar home system components are defined as follows:

2.1.1 Solar Panel

Accredited Solar Home Systems include a certified Solar Photovoltaic Panel with guaranteed output and manufacturer warranty, as defined below:

2.1.1.1 Eligible solar panel technologies include:

- Monocrystalline; or
- Polycrystalline; or
- Thin film / Amorphous;

2.1.1.2 Performance required for solar panels are:

- Minimum amount of 36 cells for crystalline panels and 29 cells for amorphous panels;
- Minimum 10 years product warranty;
- Minimum 25 years performance warranty (90% power output guaranteed for the first 10 years, 80% for 25 years);
- Peak Power between 20Wp and 250Wp.

2.1.1.3 Permanent solar panel label by the manufacturer includes the following information (as rated under Standard Test Conditions):

- Brand and Model;
- Nominal power;
- Rated Voltage and rated Current at Pmax;
- Open Circuit Voltage and Short Circuit current.

2.1.1.4 Documentation for solar panel confirms:

- Factory quality standard compliance: ISO 9001:2008 and ISO 14001:2004;
- Performance testing standard compliance: IEC 61215 (crystalline modules) or IEC 61646 (thin film modules) or equivalent;

2.1.2 Battery

Accredited Solar Home Systems include a certified, safe Deep-cycle Battery with manufacturer warranty, as defined below:

2.1.2.1 Eligible battery technologies include:

- Gel[7] (also including OPzV); or
- Absorbed Glass Mat[4] (AGM); or
- Lithium-ion; or
- Lithium Iron Phosphate (LiFePO4); or
- Nickel–Metal Hydride (Ni-MH).

2.1.2.2 Performance required for batteries are:

- 12 VDC rated voltage;
- Minimum 1 year manufacturer warranty[8];
- Cycle life of minimum 1,000 cycles at 50% DOD, C10 rate, 25°C;
- Maximum self-discharge does not exceed 5% of rated capacity per month.

[7] *Both Gel and AGM batteries are also called Sealed Lead-Acid (SLA) or Valve Regulated Lead-Acid (VRLA).*
[8] *Manufacturer warranty minimum requirement is only 1 year but accredited solar suppliers offer a 2 years warranty on the battery.*

2.1.2.3 Permanent Battery label by the manufacturer includes the following information:

- Brand and Model;
- Rated voltage;
- Capacity[9];
- Terminal polarity.

2.1.2.4 Documentation for batteries confirms:

- Factory quality standard compliance: ISO 9001:2008 and ISO 14001:2004;
- Performance testing standard compliance: IEC 61427-1 or equivalent.

2.1.3 Charge Controller

Accredited Solar Home Systems include a Charge Controller with pre-set or adjustable settings that allow for optimal harvest from the Solar Photovoltaic Panel and optimal charge and discharge of the Battery, as defined below:

2.1.3.1 Eligible Charge Controller technologies include:

- Pulse-Width Modulation (PWM); or
- Maximum Power Point Tracking (MPPT).

2.1.3.2 Performance required for Charge Controller are:

- Protection against:
  - Battery overcharge & over-discharge;
  - System Overcurrent, Overvoltage and Over-temperature;
  - Wrong polarity and short circuit;
- Boost and Floating battery charge available;
- Charging temperature compensation;
- Expected lifetime is greater than 10 years.

2.1.3.3 Permanent Charge Controller label by manufacturer includes the following information:

- Brand and Model;
- Nominal voltage (VDC), Maximum input current (A) and Maximum output current (A);
- Terminals labelled with function and polarity;
- All displays labelled with the meaning of the indication for intuitive reading;
- Characteristic type and value of fuses is written near the fuse holder.

2.1.3.4 Documentation for Charge Controller confirms:

- Factory quality standard compliance: ISO 9001:2008;
- Performance testing standard compliance: IEC 62509 or equivalent.

2.1.4 LED lights

Accredited Solar Home Systems include at least 02 LED Lights with guaranteed output, as defined below:

2.1.4.1 Eligible LED Light technologies include:

- LED bulbs; or
- LED tubes.

2.1.4.2 Performance required for a LED Light fixture are:

- Minimum luminous flux per lighting point of 150 lumens;
- Lumen Maintenance at 2,000 hours deliver more than 85% of specified light output (L85);
- Expected lifetime is greater than 5,000 hours.

2.1.4.3 Permanent LED Light label by manufacturer includes the following information:

- Nominal power.

2.1.4.4 Documentation for LED lights confirms:

- Factory quality standard compliance: ISO 9001:2008;

[9] *For a specified discharge rate down to 1.75V/cell for AGM batteries, down to 1.8V/cell for gel batteries, down to 2.75V/cell for Li-ion batteries, down to 1V/cell for Ni-MH batteries, and down to 2V/cell for LiFePO4 batteries(all measured at 25°C).*

2.1.5 Additional mandatory components

Accredited Solar Home Systems include a set of additional mandatory components to ensure the highest possible level of safety and installation quality, as defined below:

2.1.5.1 Mandatory components for safety reasons include:

- Enclosure/tamperproof for Battery and Charge Controller;
- DC protection for load;
- DC sockets for load connection;

2.1.5.2 Mandatory components for installation reasons include:

- Mounting system for Solar Panel;
- Cables, wiring and soldering to connect components;
- LED light sockets, cables, switches and DC connectors;
- Additional connectors for DC appliances;

2.1.6 Additional optional DC appliances

Accredited suppliers are strongly encouraged to promote bundle offers that include system-appropriate DC appliances (such as TV, DVD player, fan, radio, music system, mobile phone charger, refrigerator, water pump, etc.). DC appliances sold as a part of a bundle require review from the Good Solar Initiative. Accredited suppliers also offer a 2 years warranty[10] on any appliance sold as part of a Solar Home System.

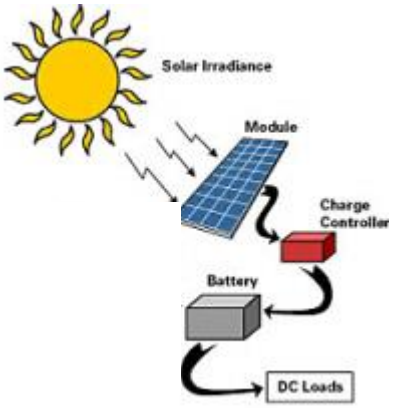
2.1.7 Inverters and AC appliances

To ensure optimal system performance, accredited suppliers discourage the use of AC appliances in combination with inverters and inform end-users about the importance of using DC appliances for higher efficiency. Inverters, AC appliances, and Solar Home Systems with an integrated inverter are not eligible under the Good Solar Initiative.

[10] *Manufacturer warranty is not mandatory but accredited solar suppliers offer a 2 years warranty on any appliance included with a SHS.*

3 System Design Standards for SHSs

For the design of Solar Home Systems, accredited solar companies select only system components and system settings that ensure a high level of energy output while at the same time ensuring a long lifetime of the system.



3.1 Key System Design Standards

Eligible Solar Home System designs are defined as follows:

3.1.1 Overall Performance

- Solar Home Systems (SHSs) power at least 4 appliances (including 2 LED lights) at a rated voltage of 12 VDC and with a total rated peak between 20Wp and 250Wp;
- System designs include all key system components listed in 2.1 above (a deep cycle battery, a solar panel, a charge controller, LED lights, and other mandatory components as listed in 2.1.5 above). System designs omitting one or more components are ineligible.
- System designs guarantee the highest possible level of safety for the end-users at all times.
- Systems are designed to withstand the environmental conditions found in Cambodia[11];
- System designs guarantee a **minimum expected lifespan** of the system of at least 10 years (except for the battery):
  - (a) The minimum expected lifespan is defined as the number of years that the system can operate, delivering the minimum Rated Energy Output (as defined below), and only considering replacement of the battery over time by a similar one;
  - (b) Selection of battery model and of the daily expected depth of discharged ensures a battery lifespan of more than 3 years;
  - (c) Maximum depth of discharge of the battery allowed by the charge controller is not above 80%.
  - (d) System expected lifespan and component replacement requirements are clearly specified on the system and any related promotional material;
- System designs guarantee a **Rated Energy Output** specified for each Solar Home System:
  - (a) Rated **Energy** Output[12] (in Wh) is the minimum energy guaranteed to be available to the customer on a daily basis;
  - (b) Rated **Power** Output[13] (in W) is the maximum power allowed by the system for loads.
  - (c) Rated Power Output ensures that all included appliances can be powered at the same time;
  - (d) Rated Energy Output is available to power appliances for a minimum of 4 hours per day each when their cumulated nominal power is less than the Rated Power Output;
  - (e) Both Rated Energy Output and Rated Power Output are clearly specified on the system and any related promotional material;
  - (f) Rated Energy Output is available for at least 2 days when the battery is fully charged;
  - (g) Solar panel[14] and charge controller ensures daily generation of at least 150%[15] of the daily Rated Energy Output, under 5 full solar equivalent hours, and taking into consideration system losses and component performance degradation overtime.
  - (h) Battery model and maximum depth of discharged allowed by the charge controller ensures at least 240%[16] of the daily Rated Energy Output can be stored;
  - (i) All components and protections are rated to withstand 120% of the expected currents under normal operation;

[11] Temperature range from 0 to 40°C, humidity level up to 90% and wind gusts up to 100 km/h.
[12] Rated Energy Output [Wh] = Battery Capacity [Ah] x Battery Nominal Voltage [V] x maximum DOD [%] / 240%.
[13] Maximum Rated Power Output [W] = Rated Energy Output [Wh] / 4 hours.
[14] Minimum Solar Panel Nominal Power [Wp] = Rated Energy Output [Wh] x 150% / 5 hours.
[15] Takes into consideration charge controller's efficiency (±10%), solar panel's output power reduction of overtime (±10%), additional energy generation requirements when battery is fully discharged (±20%) and other losses related to operating environment and installation (±10%).
[16] Ensures minimum 2 days autonomy and takes into consideration battery's reduction of output overtime (±20%).

3.1.2 Additional requirements for systems

3.1.2.1 Charge Controller and Battery are placed in a sealed enclosure(s)[17] or be otherwise tamper proofed in order to:

- Protect end-users from electrical hazard by direct contact to live wires or connectors;
- Avoid bypass connection of any loads or power generators directly to the battery or to the solar panel;
- Protect the battery and the charge controller from UV, high humidity conditions, corrosion, insects, rodents and dust intrusion;
- Allow reading of charge controller indicators;
- Permit easy connection of DC appliances into sockets fitted into the sealed enclosure;
- Allow access to resettable DC circuit breaker or fuse protecting from overload;
- Control misuses if seal/tamperproof is broken.
- Allow proper ventilation of all enclosed components;

3.1.2.2 Wiring devices and electrical protections ensure safe conduction of energy and adequate installation:

- All cables are insulated conductors with a minimum ingress protection level of IP53, are UV resistant for outdoor installation, and have different wiring colours to clearly identify different polarities;
- All cable lengths and cross-sections ensure reduced power loss[18] with a maximum power loss of 0.5% between the battery(ies) and the charge controller and a maximum power loss of 3% on other cables;
- Sufficient cable length is available to adapt to typical installation situations, with a suggested average of 10m for solar panels and a suggested average of 5m per light as required;
- Appropriate light connections to the sealed enclosure and switches are included for all LED lights;
- Appropriate safe and straightforward DC sockets and connectors are available for DC appliances to prevent reverse-polarity connection and to conduct a minimum current of 5A at 12VDC;
- Solar systems include an overload protection[19] (12 VDC) requiring end-user reactivation, for a maximum rated current in line with the maximum expected output of the designed system;
- All components are connected to the system using either terminal trip, DC sockets and connectors, or soldering, and prevent direct contact from the end-users.

3.1.2.3 The mounting system for the solar panel(s) is resistant to expectable weather conditions in Cambodia, prevents damage to the solar panel, and ensures optimal solar radiation harvesting:

- Frame and associated parts required for mounting are made of non-corroding galvanised metal (aluminium or stainless steel) so as to ensure robust mounting of the Solar Panel on a rooftop or on a pole, and ensure appropriate mounting distance for natural ventilation;
- The use of rivets or tamper-proof (non-removable) screws for theft protection is strongly recommended;
- Selected solar panel tilt and orientation ensures maximum solar radiation harvesting[20].

3.1.2.4 Other appliances

- System design takes into account expected utilisation of additional appliances in terms of consumption, maximum load and connectivity;
- Accredited suppliers offer 2 years warranty on any appliances sold as part of a Solar Home System bundle.

[17] Can be a single enclosure or two separated enclosures.
[18] Formula: Power Loss [%] = (2 x resistivity of material [Ω mm2/m] x length [m] / section [mm2]) x Current [A] / Voltage [V].
[19] Selected technology (single pole DC circuit breaker or fuse) can be included in the charge controller or installed between the charge controller and the sockets for loads.
[20] Mounting system allows installation of solar panel for all solar home systems with the following conditions: facing South ±20 degrees and tilt angle between 10 and 30 degrees from horizontal.

4 Customer Service Standards for SLKs & SHSs

Accredited solar suppliers offer their customers a range of services that ensure customers' full satisfaction with their Solar Lighting Kit and Solar Home System at all times.

4.1 Pre-Sales Services

Pre-sales services ensure customers' full understanding of the benefits of using solar, as well as potential drawbacks, so that they can make an informed decision about the purchase of a system. Pre-sales services are defined as follows:

4.1.1 Promotion

4.1.1.1 Accredited suppliers ensure that prospective customers receive educational information about solar, including:

- Solar system operating principles; key system components; main benefits and potential drawbacks of solar technology;
- Solar system operation requirements and usage limitations;
- Education on the efficiency of appliances;
- Quality principles and key messages of the 'Good Solar Initiative'.

4.1.1.2 Accredited suppliers conduct ethical promotional activities and respect truth-in-advertising standards:

- Provide truthful and transparent information that puts customer interests first;
- Present their accredited SLKs or SHSs and related content in terms of components, design, and customer services, including warranty terms and conditions;
- Refrain from comparative advertising that specifically mentions the name of a competing solar supplier/fellow accredited supplier for the express purpose of showing why the competitor is inferior.

4.1.2 Customer guidance

Accredited suppliers guide prospective customers through the selection of a solar system that best suits the customer's individual circumstances.

4.1.2.1 Accredited suppliers determine the best solar solution together with the customer:

- Assessment of current and future energy requirements;
- Preliminary technical feasibility discussion to review potential constraints for the installation;
- Selection of the most suitable accredited Solar Lighting Kit or Solar Home System.

4.1.2.2 Accredited suppliers explain to the customer performance and limitations to be expected from the selected system:

- Expected usage (appliances that can be powered and daily run-time);
- Requirements and limitations for system operation.

4.1.2.3 Accredited suppliers discuss available payment options with the customer:

- A minimum of two payment options is presented, one of which is cash payment and the other one is a MFI loan.

4.1.2.4 Accredited suppliers provide a written quotation[21] for the selected system to the customer, valid for 30 days, that includes:

- Supplier name and contact information;
- End-user name, village and contact phone number;
- Date of issue;
- Description of selected solar SLK or SHSs;
- List of services included;
- All-inclusive retail price.

[21] The document is written in Khmer language and is read to the customer if the customer is illiterate.

4.2 Sales Services

Once pre-sales activities are concluded, accredited suppliers conduct the sales transaction and subsequently ensure correct installation and end-user training to optimise system operation and prevention of system damage.

4.2.1 Purchase

4.2.1.1 Accredited solar suppliers only conclude a sale when the following conditions are met:

- Customer is fully aware of the specifications and energy generation potential of the selected solar system;
- All components are in stock and available;
- Customer is able to pay using a payment option offered.

4.2.1.2 Accredited solar suppliers document the sale of an accredited system and give to the customer:

- A sales contract[22] with:
  - Unique reference number and date of issue;
  - Supplier name and contact information;
  - Customer name and contact information;
  - Solar system product name and ID number and product description;
  - Comprehensive list of services included;
  - All-inclusive retail price and payment method;
- A warranty contract[21] with:
  - Unique reference number and date of issue;
  - Supplier name and customer name;
  - Solar system product name and ID number;
  - Sales contract number;
  - Terms and conditions[23];
  - Planned dates for preventive maintenance visits (for SHSs only).

4.2.2 Installation, Training and Commissioning

All solar systems go through an acceptance process prior to operation by the customer to evaluate (a) proper operation of the system, and (b) end-user capacity to properly operate the system and to seek for support when required.

4.2.2.1 Installations of SLKs are performed by customers themselves under the following conditions:

- Functioning and content of an accredited SLK is checked by the accredited supplier before the sale;
- Customer receives installation and operation instructions;
- Manual for installation and operation is provided.

4.2.2.2 Installations of SHSs are performed by a qualified technician (see section 4.4) within 10 days from the date of purchase of the system and ensure:

- Optimum solar panel tilt and orientation, robustness of the mounting system, ventilation, and shading avoidance;
- Safe and reliable position, fastening and connection of the system components; Appropriate sealing of all components to prevent intrusion of insects or dust;
- End-user training for system operation and basic trouble-shooting.

4.2.2.3 A label is placed on the system that includes the following information in English:

- Supplier name and hotline phone number;
- Product ID (S/N or product code);
- Quality Label from the 'Good Solar Initiative';
- Daily Rated Energy Output (in Wh), Rated Output Power (in W), Daily rated usage (in hours), rated solar panel peak power (in Wp) and battery capacity (C10 in Ah).

4.2.2.4 A simple and easy to understand[24] Khmer language user manual is provided to the customer and includes:

- Theory of solar system: photovoltaic generation, battery charging; battery low voltage protection and battery overcharge protection, relationship between sunlight conditions, load usage and energy available;
- Simplified system operating instructions (functional block diagram, description of components, status indicators, connection of loads, etc.);
- Basic troubleshooting guide;
- Presentation of services included;
- Summary of key operation instructions on one page.

4.2.2.5 End-User Training delivered during installation for SHS or during the sales for SLKs includes:

- Solar PV principles and benefits;
- System components and expected performance;
- Associated services offered by the solar supplier;
- Limitations of the solar system;
- Limitations of services offered;
- Review of physical installation;
- Safety rules;
- System operations: charge controller indicators reading and connection of loads;
- Basic troubleshooting.

[22] The document is written in Khmer language and is read to the customer if the customer is illiterate.
[23] Documented terms of warranty must explain: how the consumer can access the warranty (return to point of purchase/distributor/service centre; call or SMS to supplier support hotline, etc.); and how the warranty will be executed (repair, replacement, etc.) and in which timeframe;
[24] Considering possible illiteracy of some end-users, sketches and graphics are highly recommended to illustrate the manual.

4.2.2.6 Accredited suppliers perform the commissioning process at the end of installation for SHSs:

- Measurement of solar panel open circuit voltage, short circuit current and maximum power under direct solar radiation in local conditions;
- Verification of all connections and system-wide voltage drop measurements in the sub-circuits;
- Measurement of battery voltage during charge and discharge;
- Testing of loads for proper operation;
- Testing of electrical protection;
- Review of the end-user's capability to perform day-to-day operations and basic troubleshooting;
- Review of labelling and availability of user manual.

4.2.2.7 Accredited suppliers perform and document the commissioning process for SHSs:

- Accredited suppliers and customers sign a Commissioning Form[25] that confirms that the customer was thoroughly guided through the installation, training and commissioning process and that a qualified technician tested the system;

4.3 After-sales services

After a system has been commissioned, accredited solar suppliers continue to assist their customers during regularly scheduled maintenance activities as well as during operation and/or troubleshooting requests as they occur, at no additional charge to the customer during the warranty period.

4.3.1 Warranty

The minimum warranty period offered by the accredited supplier to the end-user covers the whole system for a period of at least two (02) years from the date of purchase. The warranty includes trouble-shooting, repair and replacement services for any problems that are not caused by end-user misuse of the system. Full warranty terms and conditions are stated in a warranty contract.

4.3.2 On-going Support

Accredited suppliers provide on-going after-sales assistance to their customers.

4.3.2.1 Accredited suppliers make a hotline phone number available for end-users of both SHSs and SLKs to contact Khmer speaking trained service staff:

- The hotline service is available at least from Monday to Saturday from 8am to 5pm.
- Local call rates may apply for the hotline.
- Hotline operators are able to:
  - (a) Provide accurate information about solar energy, the company, its products and services;
  - (b) Access and update information in a customer database;
  - (c) Deliver refresher training over the phone;
  - (d) Assist with basic troubleshooting;
  - (e) Launch an on-site intervention when deemed necessary;
  - (f) Fill a hotline support form to record all actions performed and information delivered.

4.3.2.2 A qualified technician performs preventive maintenance activities for SHSs only at least once every 12 months and documents the maintenance visit:

- All system components and labels are visually checked;
- Basic system operations and performance is tested;
- A refresher end-user training is delivered and availability of user manual is ensured;
- An intervention form is filled at each visit.

4.3.2.3 Qualified technicians are available to perform an on-site intervention when deemed necessary within 48 hours from receipt of an intervention request and document it for both SHSs and SLKs:

- A technical diagnosis is conducted on site in order to establish the causes and solution(s) of the problem;
- Any corrective action ensures that the performance of the overall system remains no less than the current state of the system prior to the intervention;
- During the warranty period, repairing or replacement of the system is done at no cost to the end-user;
- For any intervention not covered by the warranty[26], the technician provides an all-inclusive price quotation to be validated by the customer prior to the execution of any corrective action;
- An intervention form is filled at each visit to record all actions performed and testing carried out.

4.3.2.4 The intervention form field during on-site preventive or corrective maintenance includes:

- Product or Customer ID;
- Name of the technician;
- Tasks performed during intervention;
- Component(s) replaced, if any;
- Key measures and tests results;
- Observations on state of the system and customer's utilization to power appliances[27].

[25] The document is written in Khmer language and is read to the customer if the customer is illiterate.
[26] System damaged due to end-user misuse, replacement of component at end of lifetime and maintenance after the warranty period.
[27] Technician reviews what type of appliances are used and for how many hours per day, including potential usage of inverters.

4.4 Staff and Subcontractors qualification

Accredited suppliers employ a sufficient number of qualified staff, subcontractors or distribution partners to ensure the delivery of quality products and associated customer services. Accredited suppliers are responsible to ensure Quality Charter compliance at all level of the distribution network. Accredited suppliers ensure each member of their networks is trained[28] to properly respond to pre-sales, sales and after-sales services requirements.

4.4.1 Installers and After-sales service technicians

4.4.1.1 Technician training curriculum includes:

- Principles of electricity and related hazards;
- Principles of solar PV technology: operation, key system components, main benefits and potential drawbacks of solar technology;
- Presentation of accredited solar system components and design and associated services including warranty terms and conditions;
- Methodology for installation covering:
  - Safety;
  - Tools;
  - Safe and long lasting installation of the solar system;
  - Training for end-user;
  - Testing of the system and reporting;
- Methodology for end-user training (see section 4.2.2.5);
- Methodology for intervention, covering both preventive and corrective maintenance:
  - Comprehensive system check;
  - Review of end-user capacity for operations;
  - Analytical diagnostic;
  - Repairing or replacement when required;
  - Testing of the system and reporting;
- Requirements for filling forms.

4.4.1.2 Technician Manuals include:

- Copy of the user manual;
- List of all system components with associated data sheets, manuals and warranty conditions;
- Complete installation instructions;
- Post-installation commissioning procedure, including all appropriate control points, set points and test procedures;
- End-user training procedure;
- The recommended maintenance schedule with complete maintenance instructions;
- Detailed trouble-shooting guide, including all repairs and diagnostic procedures that can be performed while also instructing which maintenance/repair procedures shall not be attempted by the end-user.

4.4.2 Sales Agents

4.4.2.1 Sales agents[29] training curriculum includes:

- Principles of solar PV technology: key system components, installation basics, operation basics, main benefits and potential drawbacks of solar technology;
- Presentation of accredited solar systems and associated services including warranty terms and conditions;
- Methodology for promotion and customer guidance:
  - Principles of solar PV technology;
  - Quality principles of the Good Solar Initiative presentation;
  - Advantages of quality products versus low cost products (safety, performance, life expectancy, savings);
  - Importance of appliances selection for optimal system performance;
  - Presentation of accredited solar systems and associated services, and optional DC appliances;
  - System operation requirements and usage limitations;
  - Discussion about current and future energy needs of the customer;
  - Presentation of payment options, including MFI loan;
  - Selection of the most suitable solution for the customer and quotation form;
- Methodology for sales:
  - Sales contract and warranty contract;
  - Receiving payment;
  - Planning for delivery and installation;

[28] In-house training or training provided by a specialized training center.
[29] Includes in-house sales agents, franchisees and independent resellers.

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