VeraSol

COMPONENT-BASED OFF-GRID SOLAR ENERGY SYSTEMS

June 2022

Quality Assurance Framework Overview for Component-based Off-grid Solar Energy Systems

LIGHTING GLOBAL
Catalyzing markets for modern off-grid energy

AN INNOVATION OF WORLD BANK GROUP
THE WORLD BANK IFC International Finance Corporation

ESMAP
Energy Sector Management Assistance Program

Acknowledgement

This Quality Assurance Framework for Component-Based Solar Home Systems was adapted from guidance documents initially developed by Global Sustainable Energy Solutions Pty Ltd (GSES) for the Government of Uganda. These documents were edited by staff at the Schatz Energy Research Center and Kevin Gauna of Sunbrothers to produce a more widely applicable framework across multiple countries, and programs with funds gratefully acknowledged from the Energy Sector Management Assistance Program (ESMAP). The development of the original document was funded through the Energy for Rural Transformation Phase III (ERT III) Project, a World Bank project implemented by the Rural Electrification Agency of Uganda.

About Lighting Global

Lighting Global is the World Bank Group's initiative to rapidly increase access to off-grid solar energy for the 789 million people living without electricity worldwide. Managed by the Energy Sector Management Assistance Program (ESMAP), we work with governments, the private sector, development partners, and end-users, continually innovating to unlock key market barriers and enable access and affordability to those that would otherwise be left behind. Our support has expanded to technologies that go far beyond lighting, including systems to power the needs of households, businesses, schools, and health centres. We operate with funding gratefully acknowledged from ESMAP and their donors.

About Schatz Energy Research Center

Schatz Energy Research Center's mission is to promote clean and renewable energy use. The center accomplishes this by designing, demonstrating, and deploying clean and renewable energy technologies; implementing collaborative programs that support the deployment of clean energy systems; performing lab and field research; engaging in scientific and policy analysis; providing graduate fellowships and work opportunities for student engineers and scientists; and educating the public about clean and renewable energy.

About Global Sustainable Energy Solutions

GSES® leads Australia in renewable energy engineering, training and consultancy. We specialise in photovoltaic design, solar training, publications and PV system audits. Established in 1998, GSES has a diverse portfolio, executing projects in Australia, New Zealand, Asia, Africa and the Pacific Islands for both government and private enterprise regarding Renewable Energy engineering, consultancy, design, audit and education.

While all care has been taken to ensure this guideline is free from omission and error, no responsibility can be taken for the use of this information in the design and installation of any off-grid solar energy system.

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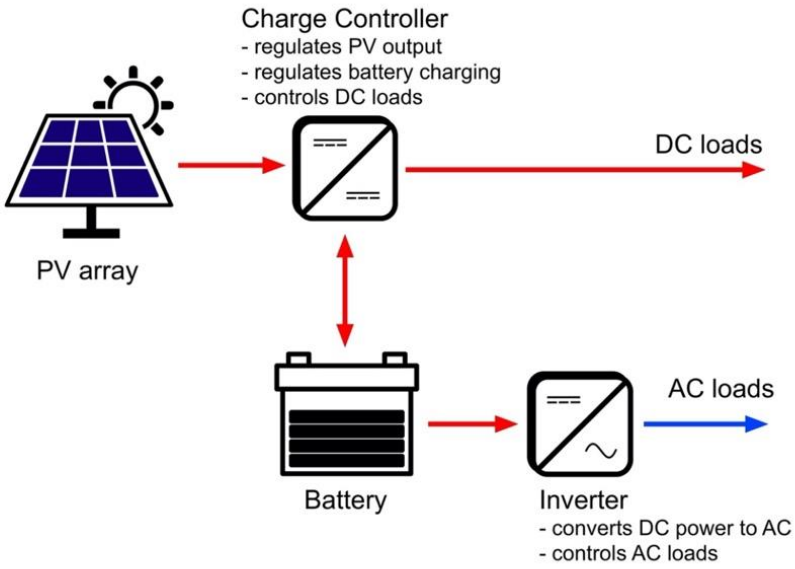
1. Introduction

This Quality Assurance Framework (QAF) for component-based off-grid solar energy systems outlines procedures and requirements that a host country can implement to support the design, procurement, and construction of renewable energy electrical installations. The QAF contains detailed compliance requirements for the system's design, the equipment selection, and the installation/construction of the electrical facility. The QAF provides a host country with current industry-accepted best practices, international certification standards, and comprehensive system performance metrics that can form the basis for renewable energy electrification programs.

The Quality Assurance Framework is applicable for most component-based solar energy systems.

A component-based solar energy system is a system (as shown in Figure 1) where the individual components—solar module, solar array frame, solar charge controller, battery, inverter (optional), and all balance-of-system-equipment (cables, switches, protection devices)—are all sourced as individual products or pre-wired combinations of products. A company typically arranges the installation of the system for a client. Plug-and-play solar home systems, defined as a complete PV system that can be self-installed by the client, are not covered by this framework.

FIGURE 1: EXAMPLE OF A SIMPLE COMPONENT-BASED SOLAR ENERGY SYSTEM



This document includes the following:

- QAF program structure and oversight recommendations
- Contractor requirements
- products standards
- installer requirements
- complaints and sanctioning procedures

The complete Quality Assurance Framework includes two guidelines that must be followed when designing and installing solar home systems. The documents in this series, including this document, are titled:

- *Component-based Off-Grid Solar Energy Systems – Quality Assurance Framework Overview*
- *Component-based Off-Grid Solar Energy Systems – System Design Guidelines*
- *Component-based Off-Grid Solar Energy Systems – System Installation Guidelines*

2. Terms and Definitions

Regulatory Agency (RA)

The regulatory agency or agencies of a QAF program are those government authorities with management or oversight responsibilities related to the accrediting, licensing, and regulation of off-grid and hybrid electrical power installations.

Administering agency

The organisation or entity responsible for managing or administering an element of a QAF program. Administering agencies will typically be government bodies, but other non-government entities may be given program responsibilities deemed appropriate by the host country.

Standards Organization (SO)

The standards organisation of a QAF program is the government authority, bureau, or body responsible for developing and organisation of the host country's national technical standards relevant to off-grid and hybrid electric power equipment and components.

Contracting entity

The organisation, general contractor, installer or persons entrusted to manage or perform work (which may include system design) in a QAF program or have this work performed pursuant to a general specification, possibly through one or more subcontractors. Contracting entities may be of several different types and can fill one or more specific roles in a QAF project. Most QAF installations will have a primary contracting entity that is ultimately responsible for fulfilling all the requirements set forth by the QAF project.

2.1 Abbreviations and symbols

RA	Regulatory Agency
QAF	Quality Assurance Framework
SO	Standards Organization

3. QAF Program structure and oversight

3.1 Introduction

The host country's responsibilities in administering the QAF are subdivided into two primary areas of oversight and management: equipment/component oversight and installation/building oversight. The components used in QAF installations must meet specific individual component standards. Physical constructions and installation of the electrical infrastructure are required to meet host country building codes and standards. In the absence of established country standards for installing PV systems, international standards may be used. Key international standards for component safety and installation are listed in Annex 1 and referenced throughout this document and the two associated design and installation guidelines.

The Quality Assurance Framework (QAF) for Component-Based Off-grid Solar Energy Systems will require administration according to the authorities and jurisdictions of the host country. The QAF program has two distinct aspects in this regard:

- Component testing and standards – The individual components and materials used in a PV system will be required to meet specific international and local standards. International standards are listed in this QAF, while local standards, where present, will be particular to the host country.
- Installations and local builders – The physical assembly and installation of PV systems will be performed by contracting entities and workers in the host country. Local building codes and construction standards, where they exist, shall be followed in addition to the standards and details provided here.

The QAF should be jointly administered by the following:

- host country regulatory agencies responsible for design and construction standards for electrical installations referred to here as Regulatory Agency (RA)
- host country agency or organisation responsible for overseeing product standards referred to here as Standards Organization (SO)

The host country should choose the RA and SO entities according to the host country's specific regulatory and organisational structures. It may be appropriate for an RA or SO to perform the particular management work called for by the QAF. At the same time, in other cases, an RA or SO may delegate these responsibilities to another administrating agency or entity. These administrating agencies will typically be host country government agencies. Still, no requirement would prohibit the host country from assigning non-government administrators for parts of the program. However, clear pathways of responsibility should be firmly established so that host country government RA's and SO's hold the primary responsibility and decision-making power for all parts of the program.

This QAF assigns various responsibilities to RA's or SO's according to the nature of the responsibility. Components are assigned to SOs, while installation and building responsibilities are assigned to RA's. Design verification responsibilities are typically assigned to the SO but may be given to another appropriate agency. These assignments can be flexible if the program elements are accounted for and properly managed. RAs, SOs, and all administrating agencies should be carefully chosen to

establish strong accountability. It is also recommended that the responsibilities be assigned to a few different agencies to simplify communications and maintain a transparent chain of command within the program.

The QAF requires that:

- the contracting entities providing the systems are accredited or otherwise recognised by the host country RA(s) as having the skills needed to install component-based off-grid solar energy systems
- the individual components within the component-based off-grid solar energy system are approved or certified by the host country SO(s)
- the systems are designed in accordance with the *Off-Grid Solar Energy Systems – System Design Guidelines*
- the installation of systems shall be undertaken by the host country's relevant codes of practice or other nationally recognised local building codes.
- all system installer(s) should meet a minimum education/training requirement and have a minimum level of experience installing component-based off-grid solar systems (section 3.2.2 below)

The QAF also includes complaint and sanctioning procedures that should be administered by the RA and/or other administrating agencies.

In summary, the RA will oversee and manage system design and infrastructure construction, while the SO will ensure the system components meet required standards. Table 1 summarises the general division of responsibilities between the RA and SO.

TABLE 1. TYPICAL DIVISION OF MANAGEMENT AND OVERSIGHT RESPONSIBILITIES BETWEEN RA AND SO (MAY VARY BY COUNTRY)

Responsibility		Regulatory Agency (RA)	Standards Organization (SO)
Adopt standards			x
Establish permits and accreditations		x	
Establish training programs for contracting entities	General requirements for systems and installations	x	
	Documentation requirements for components		x
	Installer qualification requirements	x	
Accredit contracting entities and installers		x	
Certify components			x
Handle complaints	Complaints about installations	x	
	Complaints about components		x
Design verification			x
Inspections	Lead	x	
	Support		x
Quarterly reports	List of companies, complaints, installations	x	
	List of products		x

Modifications to these responsibility assignments may be made according to the regulatory structure of the host country. The RA should take the lead in identifying the host country regulatory systems that will be involved in the QAF effort and matching the various program responsibilities to the appropriate host country organizations.

3.2 Regulatory Agency (RA) management responsibilities

3.2.1 QAF program management

The RA shall be responsible for managing and processing the business applications and forms for QAF programs (an example program application is detailed in Section 9). It is recommended that contracting entities pay an annual fee which is determined by the RA in line with the host country's current fee structures for permits and accreditations.

3.2.2 Company Registrations and Licenses

Systems installed under the QAF are expected to be safe, reliable, and meet the performance expectations of the project sponsors, end users, and other stakeholders involved in the installation. This requires that contracting entities (general contractors, installers, and other companies involved with building/installing the system) have adequate training and experience with off-grid solar energy systems.

The RA should manage or establish, if none exists, a regulatory structure in the host country to facilitate accreditations or licenses to companies to supply and install component-based solar energy systems. This regulatory structure may already be in place, or the RA may need to implement additional qualification guidelines, business licenses, and permit classifications. The regulatory structure aims to ensure that contracting entities have the necessary expertise and competency to deliver the specific performance objectives of off-grid energy system designs.

The RA shall manage the host country requirements for contracting entities performing work under the QAF. Suggestions for qualifications include:

- Installers should be properly registered or accredited and/or otherwise have the necessary licensing to perform electrical and/or structural work, as applicable, within the host country.
- Companies may have private, public, or partnership structures appropriate to the host country's business management structure.
- Companies should have a minimum amount of time experience as determined appropriate by the host country, for example, two years of operation or another time requirement.
- Contracting entities should have a minimum amount of project experience as determined appropriate by the host country; for example, the business may be required to have previously installed energy systems similar in size or performance to systems that will be installed under the QAF.

The RA shall put in place or delegate a system to manage, process, and record the business applications and forms for QAF programs (an example program application is detailed in Section 9), ensuring all the above information has been provided. It is recommended that companies pay an annual fee in line with the Host Country's current fee structure for permits. This should include the maintenance of a database of all registered, accredited, or otherwise licensed companies approved to perform work under the QAF.

3.2.3 Installer permits

It is recommended that a new class of permit(s) is developed to cover component-based solar energy systems in host countries that do not already have targeted accreditation, permitting, and training courses specific to off-grid solar technologies. These permits and training programs will help ensure that the QAF can proceed with a minimum number of problems or interruptions that delay or disrupt the successful deployment of fully compliant system installations.

The permitting structure for contracting entities should include the following:

- Contracting entities must have the competency, experience, and the capability to deliver properly functioning off-grid solar energy systems to fulfil end-user energy needs.
- Minimum demonstrated business requirements to exclude contracting entities that are not capable of undertaking the necessary technical and logistical tasks called for by the specific off-grid solar energy system designs.

The appropriate permits required by an off-grid solar energy design and installation should be created to address the following considerations:

- The safety of an energy system is a primary concern, and permits should be formulated to require a thorough and detailed procedure of checks to prevent injury to system installers and end-users.
- Permits should include traceable verification that contracting entities have fulfilled the requirements regarding project deliverables, system performance, and component qualifications.
- A certificate of completion, or other similar documents, should be established by the host country to verify that the solar energy system has been installed according to the design and installation requirements in the QAF.

3.2.4 RA-Sponsored Training Programs (QAF General Requirements)

Training programs are critical to the success of the QAF program. Experience has shown that a properly targeted series of training programs can prevent many administration problems early in implementing the QAF. These training courses can lower administrative costs and program delays and are recommended to include training courses to educate contracting entities on the general requirements for system designs and installations.

3.2.5 System Inspections

A process should be implemented whereby at least one system of each installer is inspected each year. The inspection check sheet (Annex 2) based on the *System Installation Guidelines* shall be completed during the inspection.

The RA shall undertake the planning of the inspectors; however, the actual inspections could be conducted by staff from the RA or SO, another administrating agency, or a team of specialised regional inspectors could be trained and appointed. The selection of the system to be inspected can

be based on certificates of completion provided by the installers or other QAF program records that allow for tracking inspection locations and schedules.

3.2.6 Complaints Investigation

The RA shall administer the complaints and sanctioning procedure as detailed in Section 7 of the QAF.

3.3 Standards Organization (SO) Activities in Implementing the QAF

3.3.1 Component Verification

The SO shall establish an approval mechanism for the individual components that can be used in a QAF solar energy system. The SO or another administrative agency can manage this. The host country determines the structure of this approval process according to the testing and certification processes used by that country. It is anticipated that the SO will be primarily responsible for designing and implementing these efforts.

Each individual component within a solar energy system shall

- have adequate performance capabilities for the QAF design in which it is employed
- have been tested and certified against the required standards; and
- meet the product performance requirements that are specified in Section 4.

The role of the SO is to ensure verification of:

- the test certificates, reports, or other approved compliance documents provided for each individual component; and
- system components' abilities to meet all specified performance requirements.

The SO or an appropriate administrating agency shall maintain component records for QAF installations indicating that the components used in a particular project are appropriately approved and meet all requirements. An example application checklist is provided in Annex 4.

The SO should also ensure that programs are available for ongoing training to ensure the SO staff and other administering agencies can undertake the verification of the certificates as provided in the initial training courses.

3.3.2 SO-Sponsored Training Programs for Component Documentation Requirements

Experience has shown that substantial delays can occur because a contracting entity does not provide the correct certificates as required and/or instead submits extraneous documentation that is not requested or approved. It is recommended that the host country develop a product standards checklist (refer to Annex 3) that needs to be completed by the contracting entity when submitting the

component standards certificates. Submission of this checklist can be instituted as a requirement before further reviews are undertaken.

It is further recommended that as the QAF is implemented, the SO works with industry stakeholders to develop and conduct training sessions for companies on what must be submitted concerning the test certificates when applying for a product to be approved. This will reduce the time that SO staff spend on reviewing applications.

3.4 Design Verification

The QAF requires that the component-based solar energy systems be designed per the *System Design Guidelines* and the host country local building codes or relevant local codes of practice.

If a complaint or an inspection reveals that the design does not meet the above requirement, the SO should establish an investigation to determine what corrective actions need to be taken. The investigation should be performed by individuals recommended by the QAF Technical Committee or other industry representatives with expertise in the relevant fields.

3.5 System Inspections

SO staff should be trained to support the RA in inspecting systems as per section 3.3.

3.6 QAF Technical Committee

Though the SO and the RA will administer the QAF, it is recommended that a QAF Technical Committee be responsible for overseeing the implementation of the QAF in the long term. This committee would comprise representatives from the SO and RA and other host country organisations, as deemed appropriate by the SO and RA, working in the energy, solar, and electrical sectors. Examples of these types of host country organisations include:

- Government ministries
- Renewable energy associations
- Electrical equipment and electrician associations
- Solar energy associations
- Building and construction organisations
- Off-grid equipment and component manufacturers

The chair of the committee shall be from the host country RA.

The remainder of the QAF Technical Committee shall be chosen by the RA and SO to participate in the implementation of the QAF.

3.7 QAF Technical Committee Objectives

The objectives of the QAF Technical Committee are to:

a) Monitor the implementation of the QAF to ensure it continues to meet the initial objective of quality component-based off-grid solar systems being installed as per the requirements of the QAF.

b) Recommend improvements to the QAF and/or changes to the implementation of the QAF.

3.8 QAF Technical Committee Meetings

In the first two years, the QAF Technical Committee should meet quarterly to ensure that the QAF is established and operating successfully. However, the committee can determine whether the meetings should be more regular, especially in the initial few months.

After two years, the committee can decide whether quarterly meetings are still required or less frequent meetings would be sufficient.

3.9 RA and SO Responsibility to QAF Technical Committee

The QAF Technical Committee should require quarterly reports from the RA and SO. These should be provided two weeks before the quarterly meeting. The information to be provided in these reports is detailed in sections 3.9.1 and 3.9.2.

3.9.1 RA Reports

As a minimum, the reports by RA to the QAF Technical Committee should include:

a) List of the companies that have been accredited.

b) List of the individual installers indicating those who have successfully completed the required training courses and those who have received relevant permits.

c) Summary of any system inspections undertaken and any key findings concerning the installations not meeting the requirements of the *Off-grid Solar Energy Systems – System Design Guidelines*.

d) List any complaints that have been received and the outcome of the investigation of each complaint.

e) Any issues identified in implementing the QAF and recommendations for overcoming these issues.

f) Any recommended changes to the QAF.

3.9.2 SO Reports

As a minimum, the reports by SO to the QAF Technical Committee should include:

a) List of the products that have been approved.

b) List of products that were submitted and not approved.

c) List any specific product standards that should be included in or removed from the QAF.

d) Any issues identified in implementing the QAF and recommendations for overcoming these issues.

e) Any recommended changes to the QAF.

3.10 QAF Technical Committee Responsibilities

The specific responsibility of the QAF Technical Committee is to:

a) Review the reports provided by RA and SO.

b) Identify and recommend possible changes to the QAF and its implementation based on the reports.

c) Deliberate on all the recommendations and decide to accept or ignore any recommended changes.

d) Update the QAF based on the changes.

3.11 Financial Sustainability of QAF

3.11.1 Company Registration

The company registration and licensing process outlined in Section 3.2.2 should include annual fees or other fee structures deemed appropriate by the host country RA to help cover the administrative costs of implementing the QAF program.

3.11.2 Installer Permits fee structures

In addition to company registrations, the RA should also develop a permit fee structure consistent with the host country fee structures already in place for other types of electrical system installations.

3.11.3 Product Approval

The SO may consider charging fees for reviewing submitted components and maintaining any product approval databases established in the QAF program. The fees could be charged per test certificate provided or structured to cover multiple submissions. In developing these fees, it is recommended that the SO should determine a reasonable time estimate and staffing requirements for verifying certificates and base the fee structure on these estimates. Allowance should be made for certificate rejections when components are submitted without required certifications and documentation.

3.11.4 System Inspections

The annual system inspections outlined in Section 3.2.5 should include a fee to cover the inspection. This fee may be included in other yearly fees established to support the QAF program.

3.11.5 Investigating Complaints

Over the first 12 months, the cost of processing complaints should be recorded. The objective is to determine whether this cost is covered by the fees charged for company registrations and permits and any fines that might be levied.

If not, the company registration fees and permit fees might need to be increased to cover the complaint investigation costs.

3.12 Promotion of the QAF

The QAF must be promoted to stakeholder companies (contacting entities, product manufacturers etc.) and the end-users of the systems.

A solar industry representative can promote the QAF to prospective contracting entities; however, the RA, with the support of all stakeholders (RA, SO, and other solar industry representatives), should also develop a marketing campaign to promote the QAF to end-users to encourage demand for QAF projects.

Reaching and educating end-users is typically more complicated than reaching and certifying contracting entities and product manufacturers. The cost to reach and educate end users may only be justified for large, well-funded "projects". Meanwhile, general commercial sales and installation of component-based off-grid PV systems may already be occurring, and consideration should be given to introducing the QAF into this environment and the effect it might have on marketing and outreach efforts.

4. Component Standards Requirements

The individual system components to be used in component-based solar home systems must comply with the specific component standards listed in this document.

Contracting entities overseeing and implementing QAF projects must provide verifiable test certificates to the SO, confirming that the major components used in the system comply with the relevant specified standards. The SO will confirm that the laboratory is accredited to perform the test(s).

4.1 Component (Equipment) Standards (Informative)

Quality system components in the solar energy industry are typically tested and certified against standards developed by the International Electrotechnical Commission (IEC), Underwriters Laboratories (UL), or, in some cases, European Standards (EN). Many products such as solar modules, batteries, inverters, and controllers are tested and certified to one or more sets of standards. For example, some USA-manufactured inverters are tested against the UL standard for the USA versions and have the CE marking, meaning they conform to European requirements. As the industry has been progressing very quickly, there are instances when some of the balance-of-system equipment used in the industry do not have IEC or UL standards available. Still, they do meet national or regional standards such as European Standards (EN).

4.2 Testing Laboratories

Quality system components in the solar energy industry are typically tested and certified by qualified test laboratories. In this QAF, testing and verification that the system components have met the relevant standard(s) shall be undertaken by a testing laboratory accredited to ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories.

The test laboratory shall have ISO/IEC 17025 accreditation for the standard/test method used.

Copies of all the relevant ISO/IEC 17025 accreditation certificates and other supporting documentation from the test laboratory may be required if there is any doubt by the SO or RA regarding the credibility of a specific test laboratory.

4.3 Verification of Test Certificates

The primary contracting entity in charge of a QAF project must provide verifiable test certificates, test reports, or other evidence of conformity to the SO confirming that the primary components used in the system comply with the relevant specified standards. The SO will confirm that the laboratory has ISO/IEC 17025 accreditation and that the test certificates are genuine and applicable to the specified components. Where compliance is achieved by a safety mark such as the CE mark, documentation of the mark's validity shall be provided.

4.4 Photovoltaic Modules

4.4.1 For solar energy systems with an array peak watt rating greater than 100Wp

Solar modules shall meet either of the relevant following design qualifications and type approval standards:

- IEC standards:
    - IEC 61215 Terrestrial photovoltaic (PV) modules - Design qualification and type approval
        - IEC 61215-1 Part 1: Test requirements
        - IEC 61215-2 Part 2: Test Procedures

    and

    - IEC 61730 Photovoltaic (PV) module safety qualification
        - IEC61730-1 Part 1: Requirements for construction
        - IEC61730-2 Part 2: Requirements for testing

or

- UL 1703: Flat Plat Photovoltaic Modules and Panels

Note: IEC 61215 and IEC 61730 are also available as European Standards (EN) and UL standards.

Modules tested according to IEC 61730 that will be installed in systems where the maximum open-circuit voltage of the array is greater than 35V d.c. must be certified as Class II per IEC 61730 or application class A per IEC 61730:2004.

Note: Maximum open circuit voltage is the open-circuit voltage corrected for the lowest expected operating temperature as detailed in IEC 62548: Photovoltaic (PV) Arrays-Design Requirements.

Modules tested according to IEC 61730 that will be installed in systems where the maximum open-circuit voltage of the array is equal to or less than 35V d.c. can be certified as Class II or Class III per IEC 61730 (application class A or C per IEC 61730:2004).

Each module shall be marked with a serial number to provide traceability to the manufacturer's name, factory, and date of manufacture.

The module label must show the correct Certifier Mark (logo) corresponding to the test certificate supplied at approval.

Suppose the certificate on which the listing was based becomes invalid. In that case, the relevant contracting entity must supply a new certificate to the SO for the module or cease using that module.

Suppose a host country contracting entity wishes to sell modules manufactured by an international module manufacturer but are supplied with the contracting entity's company name or a specified brand name. In that case, the contracting entity could obtain an IEC test certificate from the international manufacturer, which lists the host country company's name and model numbers or brand name and model numbers as applicable. In cases where this is overly difficult or impractical, consideration may be given to a process that allows a module manufacturer to submit a certification letter or other documentation matching a 'rebranded' PV module to one IEC certified. This would match the module model number on the IEC certificate with the same module that has been sold and rebranded for sale in the host country (and thus no longer carries the IEC-certified model number).

4.4.2 For Solar Energy Systems with an array peak watt rating equal to or less than 100Wp with a maximum array open-circuit voltage less than 35V d.c.

Modules that are not tested and certified by the IEC and UL standards specified in section 4.4.1 will be accepted if they comply with the following requirements:

1. **Prior to 31 December 2020,** the modules were tested per the solar module test requirements specified in IEC TS 62257-9-5:2018: Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated systems - Laboratory evaluation of stand-alone renewable energy products for rural electrification.
    - The test results must show that the solar module meets the relevant requirements specified in the Lighting Global SHS Kit Quality Standards.

- The validity of the test is for two years, so modules that meet the above requirements will be accepted until July 2023.

or

2. The modules have been tested per the solar module test requirements specified in IEC TS 62257-9-5:2018 and IEC TS 62257-9-8:2020: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W. These modules shall meet the relevant solar module test requirements specified in IEC TS 62257-9-8 (refer to https://verasol.org/).

4.5 Batteries

4.5.1 Lead-Acid battery banks with an energy rating greater than 1,000 Watt-hours (Wh) at C_{10}

Lead-acid batteries used in a battery bank with an energy rating greater than 1,000Wh (C_{10}) shall meet one of the following standards:

- IEC 61427-1 Secondary Cells and Batteries for Renewable Energy Storage – General Requirements and Methods of Test – Part 1: Photovoltaic Off-grid Application
- IEC 60896 Stationary lead-acid batteries (series)
- UL 1973 Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications
- UL 1989 Standby Batteries, or
- A standard submitted by an Applying Company approved by consensus between SO and the RA.

In addition to meeting the requirements of the above-referenced standards, lead-acid batteries shall:

- have a minimum cycle life of 1100 cycles down to 50% depth of discharge: and
- be marked with a serial number to provide traceability to the manufacturer name, factory and date of manufacture.

Note: End of life is when the battery can only retain 80% of its original capacity.

4.5.2 Lead-Acid battery banks with an energy rating of 1,000 Watt-hours (Wh) or less at C_{10}

Batteries with an energy rating of 1,000 Wh or less at C_{10} that are not tested and certified per the IEC and UL standards specified in section 4.5.1 will be accepted if they:

a) have a minimum cycle life of 1100 cycles down to 50% depth of discharge, or

b) **Prior to 31st December 2020,** have been tested per the battery durability tests specified in IEC TS 62257-9-5:2018: Recommendations for renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated systems - Laboratory evaluation of stand-alone renewable energy products for rural electrification.

   - The test results must show that the battery meets the relevant requirements specified in the Lighting Global SHS Kit Quality Standards (available at https://verasol.org/publications/shs-kits-quality-standards.
   - The validity of the test is for two years, so batteries that meet the above requirements will be accepted until July 2023, or

c) have been tested per the battery durability tests specified in IEC TS 62257-9-5:2018 and complete the relevant battery durability test requirements specified in IEC TS 62257-9-8:2020: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W. (Refer to https://verasol.org)

4.5.3 Lithium-Ion battery banks for stationary applications

The individual cells and the assembled battery pack for lithium-ion batteries included in a system battery bank designed for a stationary application shall meet either:

- IEC 62619 Secondary cells and batteries containing alkaline or other non-acid electrolytes—Safety requirements for secondary lithium cells and batteries for industrial applications.

or

- UL 1973 Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications

or

- A safety standard submitted by an Applying Company that is approved by consensus between SO and the RA.

Suppose the solar home system battery has been tested and approved per IEC 62619, and the battery's transportable mass is less than 18 kg. In that case, the individual cells and the assembled battery pack shall also meet:

- IEC 62281 Safety of Primary and Secondary Lithium Cells and Batteries during Transport

or

- UN 38.3 United Nations Manual of Tests and Criteria: Lithium Battery Testing Requirements.

In addition to meeting the requirements of the above-referenced standards, lithium-ion batteries shall be:

- supplied with a manufacturer's approved battery management system (BMS); and
- marked with a serial number to provide traceability to the manufacturer name, factory and date of manufacture.

4.5.4 Lithium-ion battery banks for portable applications

The individual cells and the assembled battery pack for lithium-ion batteries included in a system battery bank for systems designed to be portable (i.e., easily hand-carried) shall meet either the requirements of Section 4.5.3 or:

- IEC 62133-2 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary lithium cells and for batteries made from them for use in portable applications - Part 2: Lithium systems.

or

- UL 1642 Standard for Lithium Batteries; and
- UL 2054 Safety standard for household and commercial batteries.

4.6 Solar Controllers

The controllers shall either meet one of the standards listed below or carry one of the markings listed below.

Standards include:

- IEC 62109 Safety of power converters for use in photovoltaic power systems.
    - IEC 62109-1 Part 1: General requirements
- IEC 62509 Battery charge controllers for photovoltaic systems - Performance and functioning
- IEC 60335-1 (Household and similar electrical appliances - Safety - Part 1: General requirements) and IEC 60335-2-29 (Household and similar electrical appliances - Safety - Part 2-29: Particular requirements for battery chargers).
- UL 1741: Standard for Inverter, converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources.

or

- A safety standard submitted by an applying company that is approved by consensus between SO and the RA.

Markings include:

- Underwriters Laboratories (UL) Listing and Classification Mark.
- CE mark.

In addition to meeting the requirements of the above-referenced standards, each controller shall be marked with a serial number to provide traceability to the manufacturer name, factory and date of manufacture.

4.7 Inverters

The inverters shall meet one of the following standards:

- IEC 62109 Safety of Power Converters for use in Photovoltaic Power Systems
    - IEC 62109-1 Part 1: General requirements.
    - IEC 62109-2 Part 2: Particular requirements for inverters.
- UL 1741: Standard for Inverter, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources.

or

- A safety standard submitted by an applying company that is approved by consensus between SO and the RA.

Note: Some inverters manufactured in accordance with the UL standards will have the CE mark for their European (230V, 50Hz) models.

The inverters shall be rated to provide an a.c. voltage and frequency typical for a.c. systems in the local area and compatible with the intended loads. If supplied with a socket outlet, it should be a type commonly used in the host country. It is strongly recommended that inverters have pure sine wave (or true sine wave) output as opposed to a modified sine wave output unless there is a specific and documented reason for choosing a modified sine wave output.

In addition to meeting the requirements of the above-referenced standards, each inverter shall be marked with a serial number to provide traceability to the manufacturer name, factory and date of manufacture.

5. Warranty

The minimum warranty acceptable should be two years on the complete system installation and each of the individual components.

The photovoltaic modules shall be warranted to provide their rated output at standard conditions within ±10% for a minimum of 10 years under the operating conditions at the sites. The modules shall be warranted against physical defects for at least five years following installation.

The battery, solar controller (PWM or MPPT) and inverter shall each have a minimum two-year warranty.

The primary contracting entity in charge of the QAF project bears the responsibility to carry and honour these warranty provisions. It applies even if the product manufacturer fails to honour the warranty and/or the company manufacturing the product no longer exists. It is also common for end-users to experience considerable difficulty making warranty claims. These common problems should be stressed and clarified in training and outreach programs as they represent a substantial cost risk

to the contracting entity responsible for ensuring that warranty claims are properly processed and honoured.

6. Installer Requirements

The contracting entity's employed or sub-contracted installers responsible for installing component-based solar home systems must comply with the requirements listed in this section.

6.1 Installer Qualification Requirements

The host country RA shall establish qualification requirements for contracting entities installing solar energy systems in the QAF. Some of these qualifications may already be in place in the host country, while others specific to solar energy systems may need to be introduced.

Training courses and assessment testing can be used to qualify installers. These tests and courses should be developed under the guidance of the RA in collaboration with the SO and other appropriate industry representatives.

Example installer requirements for Uganda:

All installers, as a minimum, must have successfully completed the *Short Course in Solar Photovoltaic Technology (Stand-Alone Systems) Level 1* as detailed in the "Assessment and Training Package for Solar Photovoltaic Electrician" that was developed by the Directorate of Industrial Training (DIT) in conjunction with the Nakawa Vocational Training Institute under Business, Technical, Vocational Education and Training (BTVET) programme under the Ministry of Education and Sports.

Experienced installers should still either complete this course or be assessed by a training centre that they have all the skills identified in this course. Within quality training programs, this process is often called Recognition of Prior Learning or RPL.

After two years' experience, all installers shall apply and obtain their Z Class Permit provided by the Electricity Regulatory Authority.

In addition, all installers shall complete and achieve a pass mark of 75% in a written multiple-choice assessment based on the *Off-Grid Solar Energy Systems – System Installation Guidelines*.

7. Complaints and Sanctioning Procedure

A Quality Assurance Framework for any industry needs to have a procedure to process any complaint made against companies that agree to abide by that framework but fail to meet all or part of the framework requirements.

The typical outcome of a company that fails to meet the requirements of the QAF is that the owner of a solar energy system, purchased from the company, is not happy with the system or service from the company. This could be a result of:

- A system not performing as per the expectations of the customer (refer to next paragraph); or
- Equipment failing due to a manufacturer/equipment defect; or
- Substandard equipment used (using equipment not approved through the framework); or
- Substandard system design (not following the *System Design Guidelines*); or
- Substandard system installation (not following the *System Installation Guidelines*); or
- Substandard customer service (not following the customer service best practice guidelines in section 8); or
- a combination of two or more of the above reasons.

There is the possibility that the solar energy system does not perform to the owner's expectations or the installer's stated performance. In this case, the system owner will be required to provide evidence that they followed the prescribed usage procedures as stipulated in the supply agreement.

In the case of a manufacturer/equipment defect, the company should confirm it is a defect and fix or replace the defective equipment under warranty (assuming the defect is found within the warranty period) so that it does not become a complaint under this procedure. If the defect is not rectified, then this would be classified as substandard customer service.

Before any disciplinary action (e.g., a fine) against the company, the company should be allowed to provide evidence that they took the necessary measures to address the owner's reports of a poor service from the system supplied.

This section contains:

- submitting complaints procedure (section 7.1)
- complaints and sanctioning procedure (section 7.2)

These procedures are intended as examples and may be modified as appropriate to suit the host country's needs or practices. The RA is generally responsible for complaints about installations and shall develop detailed procedures for these submissions and the subsequent investigation and resolution. The SO is responsible for complaints about components and shall develop detailed procedures for submitting and resolving these complaints.

7.1 Complaints Submission

Complaints against a company could be raised by:

- the SO after inspections of the systems have been undertaken; or
- a customer who purchased a solar energy system from the company; or

- another company.

An example complaint submission form is included in Section 10. This should be completed either by the complainant or a third party. When the complainant is an end-user who contacts RA by phone, the form should be completed by the person who takes the complaint.

7.1.1 Complaint Raised by SO

- The complaint must be submitted to the RA in writing with the following information:
    - the exact nature of the complaint, details of the system, location and date of installation and date from which the system is malfunctioning
    - the name of the company
    - the full name and contact details of the person making the complaint; and
    - what, if anything, has been undertaken to resolve the complaint with the company.
- The RA shall notify the SO complainant that the complaint has been received.
- The RA shall investigate the complaint within two weeks and determine if the complaint is justified or if no further action is required.
- Suppose no further action is to be taken. In that case, the RA shall inform the SO complainant stating the complaint has been investigated and notify them about the outcome of the investigation.
- If the complaint is justified, the RA shall follow the complaints procedure as detailed in section 7.2.

7.1.2 Complaint Submitted by Solar Energy System Owner

- The complaint must be submitted to the RA either verbally or in writing, and during this process, the following information is required to be obtained and recorded:
    - the exact nature of the complaint, details of the system, location and date of installation and date from which the system is malfunctioning
    - the name of the company
    - the full name and contact details of the person making the complaint; and
    - what, if anything, has been undertaken to resolve the complaint with the Company.
- The RA may specify alternative methods of complaint submission, such as email or SMS.
- Depending on how the complaint is received, the RA shall notify the complainant, using the most convenient communication tool available, that the complaint has been received.
- The RA shall investigate the complaint within two weeks and determine if the complaint is justified or if no further action is required.

- Suppose no further action is to be taken. In that case, the RA shall inform the complainant stating the complaint has been investigated and notify them about the outcome of the investigation.
- If the complaint is justified, the RA shall follow the complaints procedure as detailed in section 7.2.

7.1.3 Complaint Submitted by Another Company or Other Entity Involved in the Industry

- Suppose another company or other entity involved in the industry wants to complain about a system that has been installed by a company or complain about the business practices of a company. In that case, the complaint must be submitted to the RA, preferably in writing, specifying:
    - the exact nature of the complaint and (as applicable) the details of the system, location and owners of the system, system owner contact details, date of installation, and date from which the system is malfunctioning
    - the name of the company that installed the system
    - the full name and contact details of the person making the complaint; and
    - consent from the owner/ user of the system.
- Upon receiving the complaint, the RA should try to ascertain within two weeks if the complaint is justified and that it is not just a case of a competitor making comments about the other company for their commercial gain.
- Suppose a company submits the complaint and it is not correct and/or justified. In that case, a letter should be sent to the complainant informing them that they are in breach of the best practices guidelines and that the company must explain why they should not be sanctioned. The RA shall follow the complaints procedure against the complainant company as detailed in section 7.2.
- If the complaint is justified, the RA shall follow the complaints procedure as detailed in section 7.2.

7.2 Complaints and Sanctioning Procedure

- When the RA has a legitimate complaint with a contracting entity, the RA shall write to the company specifying:
    - the exact nature of the complaint; and
    - that the company has two weeks to respond to the complaint in writing.
- If the company fails to respond, the RA shall attempt to contact the company by phone and/or electronically to determine why there has not been a response.

- If, after contact has been made with the company and the company still fails to respond within two weeks of being notified, then the RA should fine the company and the company should be suspended from selling and installing SHS.
- If the company does respond, then the RA shall form a committee comprising representatives from RA and industry stakeholders. The committee shall assign a member as an investigator, who shall review the response within two weeks and report the findings to the committee. If necessary, the review can include contacting the company directly in writing to clarify any issues.
- The committee shall decide based on the report of the investigator. The decision could be to:
    - Continue the investigation because further information is required
    - Dismiss the complaint against the company; or
    - Uphold the original complaint and require the company to rectify the complaint within a period of a month.
- The RA shall notify the complainant and company in writing about the outcome of the investigation.
- Suppose the company never rectifies the complaint to the satisfaction of the RA. In that case, the company should be suspended from selling and installing QAF off-grid systems until the complaint is adequately resolved.

8. Customer Service Best Practice Guidelines

These best practice guidelines detail the actions, activities and procedures that a company shall apply to provide customers with quality service. These include:

1. When a person or company enquires about potential services to be provided, the company shall respond professionally and as quickly as practically possible.
2. If a site visit is undertaken, the company's staff or installer should undertake a thorough site visit per the requirements detailed in the *System Design Guidelines*.
3. When providing a quotation to a potential customer, the company should provide (as a minimum) the following information:
    - Full specifications of the system equipment being offered, including quantity, make (manufacturer), and model number,
    - The relevant warranty information relating to each of the items of equipment,
    - The expected output (daily, monthly or yearly) of the system and how it meets the electrical energy requirements of the customer (e.g., a completed load assessment form).

- Firm quotations, including all equipment, installation and commissioning charges.

4. When a potential customer agrees to purchase a system from the company, the company should have a simple contract for the system's supply, installation and commissioning. The customer shall sign the contract before proceeding. The Company shall also sign the contract, and each party (Company and customer) keeps a copy of the contract.

5. The company's designer shall follow the System Design Guidelines when designing a system.

6. The company's installer shall follow the System Installation Guidelines when installing a system.

7. For system installation, the company shall provide the customer with a minimum of 2 years' warranty on the installation workmanship.

8. The company shall support the customer when a product underperforms or fails under warranty. This support will include liaising with the manufacturer or equipment agent on behalf of the client.

9. The company shall keep, as a minimum, the documentation relating to the system installed as specified in the relevant technical guidelines.

10. If a customer complains to a company that the system has failed:

- If the failure occurs within the two-year installation workmanship warranty period, the company:
    - Should respond to the complaint within one week
    - If it is a fault arising from the installation workmanship, it is the company's responsibility to rectify the problem by correcting, repairing or replacing the faulty components or installation.
    - If it is an equipment fault, the Company should liaise with the equipment manufacturer to rectify the issue as soon as possible.
- If the failure is after the two-year installation warranty period:
    - The company shall still provide backup service to the customer and must respond to the complaint in a timely manner.
    - This response should initially involve attempting to determine the fault remotely and then, if required, organising a visit to the system to determine the fault and then rectifying the fault as soon as possible. A reasonable price shall be quoted to the customer for the call-out; that is, the price should be reflective of the price quoted for other work and not be higher than standard pricing because the customer has a problem with their system and needs help.
    - If it is a fault in the installation's workmanship, the company shall provide the customer with a quotation for repairs, re-installation or replacement of smaller items or accessories.

- If it is faulty equipment, the company shall liaise with the equipment manufacturer to fix the product as soon as possible. The cost of providing the repairs will be quoted to the customer. If the equipment is still under warranty, the cost should be for the time spent travelling to/from site and onsite while undertaking the replacement (or repairs) of equipment unless the manufacturer will pay this.

11. Suppose a customer complains to a company that they believe the system is not performing as stated in the quotation. In that case, the company shall request from the customer the evidence as to why they have reached this conclusion. If it appears that it is not performing as anticipated, then the company shall investigate why promptly and professionally.

12. The company shall attempt to solve all complaints professionally and directly with the customer.

13. A company shall not criticise the work of another company. The company should follow the complaints procedure.

14. If a system inspection is undertaken of a company's work, the company shall respond to any reasonable request by the inspector to fulfil their duties.

9. Example Company Application Form

COMPANY APPLICATION FORM				
Part 1: General Information on Company				
Name of Company				
Physical Address of Main Office/Shop				
Postal Address (if different)				
Website				
Name of Contact				
Position				
E-mail				
Phone				
Mobile Phone				
Name of Alternate Contact				
Position				
E-mail				
Phone				
Mobile Phone				
Information on the company management structure showing where the contact person is positioned is included with the application? (*Please tick if yes, cross if no)*				
List any accreditations that company might have and the dates of their expiry				
Copies of accreditation certificates are attached (*please tick if yes, cross if no)*				
Is the business registered? Please Tick	Yes		No	

Company is a: Please Tick	Private Limited Liability Company;		Public Company	
Year Company was first registered:				
Copy of an Incorporation Certificate is included with the application (*please tick if yes, cross if no*)				
Taxpayers Identification Number (TIN)				

10. Example of Complaints Submission for Complaints

1	Date of complaint:	DD/MM/YYY	
2	Complainant:	End User (Enter Name of the end user)	Another Company (Enter Name of the company)
3	Complainant's full name and contact details (Telephone number and email if any)	Full Name: Address: Email: Telephone/ Mobile:	
4	Nature of complaint:	Please tick the relevant nature of complaint	
	(a)	The system not performing as per the expectations of the customer;	
	(b)	Equipment failing due to a manufacturer/equipment defect;	
	(c)	Substandard equipment used (using equipment not approved through the framework);	
	(d)	Substandard system design (not following design guidelines);	
	(e)	Substandard system installation (not following the installation guidelines);	
	(f)	Substandard customer services (not following the customer service best practice guideline in section 8);	
	(g)	a combination of two or more of the above reasons.	
5	Details of the system under complaint:	PV Module capacity and make: Battery capacity and make: Controller type and make: Location of PV modules installed: What are the loads / appliances connected to the system?	
6	Location of the system installed:	Please enter detailed physical address and contact number	
7	Date of installation:	DD/MM/YYY	

8	Date from which system is malfunctioning:	DD/MM/YYY
9	What action has been taken to resolve the problem:	
10	Was there a similar or other problem in the system before?	If yes, what was the problem and whether the problem was addressed by the company/ installer?
11	Name of the company who installed the system:	

Annexe 1: International Standards for Components and Installation

This quality assurance framework has adopted International Electrochemical Commission standards. For components, references are also given to the Underwriters Laboratory (UL) standards from the United States of America. As an alternative to IEC Standards some products associated with systems with PV modules less than 350 W_p may be approved for use if they meet the requirements of the Lighting Global Quality Standards as evidenced by a listing on the VeraSol website with a Specification Sheet and VeraSol Certificate.

Most of the standards listed in this guideline are standards that specify the testing and performance requirements of components used in PV systems.

A designer or installer does not need to have copies of the standards that apply to testing a product. These standards have been specified so that designers and installers are aware that they should only install components within an off-grid solar energy system that have been tested and approved in accordance with those specific standards.

IEC standards that relate to the installation of an off-grid solar energy system are listed below; however, these have been provided for information only. An installer is not required to have copies of these standards.

Standards relevant to off-grid solar energy system products and components:

- IEC 61215: Terrestrial photovoltaic (PV) modules - Design qualification and type approval
    - IEC 61215-1 Part 1: Test requirements
    - IEC 61215-2 Part 2: Test Procedures
- IEC 61730: Photovoltaic (PV) module safety qualification.
    - IEC 61730-1 Part 1: Requirements for construction.
    - IEC 61730-2 Part 2: Requirements for testing.
- UL Standard 1703: Flat Plat Photovoltaic Modules and Panels
- IEC 62109: Safety of power converter for use in photovoltaic power systems.
    - IEC 62109-1 Part 1: General requirements.
    - IEC 62109-2 Part 2: Particular requirements for inverters.
- IEC 62509: Battery charge controllers for photovoltaic systems - Performance and functioning
- IEC 60335-1: (Household and similar electrical appliances - Safety - Part 1: General requirements) **and** IEC 60335-2-29: (Household and similar electrical appliances - Safety - Part 2-29: Particular requirements for battery chargers).

- IEC 61427-1: Secondary Cells and Batteries for Solar Photovoltaic Energy Systems - General Requirements and Methods of Test - Part 1: Photovoltaic off-grid application
- IEC 62619: Secondary cells and batteries containing alkaline or other non-acid electrolytes—Safety requirements for secondary lithium cells and batteries, for use in industrial applications
- IEC 60896: Stationary lead-acid batteries (series)
- UL 1973: Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
- UL 1642: Standard for Lithium Batteries
- UL 2054: Household and commercial batteries. This standard is typically used for battery packs, whereas UL 1642 is applied only to cells.
- IEC 62133-2: IEC safety standard for lithium-based cells and batteries for portable applications. (IEC 62133 is an older version that is still being phased out; in 2017, it was split into two parts with -1 covering Ni batteries and -2 for Li.)
- UL 62133: UL version of IEC 62133 (UL 62133-2 is expected to be published shortly)
- IEC 62930: Electric Cables for Photovoltaic Systems with a voltage rating of 1.5 kV d.c.
- IEC 62257-9: Recommendations for small renewable energy and hybrid systems for rural electrification
    - IEC 62257-9-5 Part 9-5: Integrated systems - Laboratory evaluation of stand-alone renewable energy products for rural electrification.
    - IEC TS 62257-9-8:2018: Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W.

Standards relevant to off-grid solar energy system installation:

- IEC 62548: Photovoltaic (PV) Arrays-Design Requirements
- IEC 62257-9: Recommendations for small renewable energy and hybrid systems for rural electrification -
    - IEC 62257-9-1 Part 9-1: Micropower systems
    - IEC 62257-9-2 Part 9-2: Microgrids
    - IEC 62257-9-3 Part 9-3: Integrated System-User Interface
    - IEC 62257-9-4 Part 9-4: Integrated System-User installation

Annexe 2: Inspection Checklist

To be developed based on the Code of Practice.

Annexe 3: Test Certificate Application Checklist

Product	Standard	Requirement	Tick if correct
Solar Modules	IEC 61215	Test certificate has name of test laboratory	
		Test report or certificate number listed on the certificate	
		Test certificate states product has been tested to this standard	
		Test laboratory is accredited	
		Test certificate validity is confirmed	
	IEC 61730	Test certificate has name of test laboratory	
		Test report or certificate number listed on the certificate	
		Test certificate states product has been tested to this standard	
		Test laboratory is accredited	
		Test certificate validity is confirmed	
OR			
Solar Module	UL 1701	Test certificate has name of test laboratory	
		Test report or certificate number listed on the certificate	
		Test certificate states product has been tested to this standard	
		Test laboratory is accredited	
		Test certificate validity is confirmed	
Battery	• IEC 61427 • IEC 60896 • UL 1973 • UL 1989	Test certificate has name of test laboratory	
		Test report or certificate number listed on the certificate	
		Test certificate states product has been tested to one of these standards	

		Test laboratory is accredited	
		Test certificate validity is confirmed	
		Battery cycle life is 1100 cycles or greater at 50% depth of discharge (battery capacity retention is 80%)	
Inverter	• IEC 62109 • UL 1741	Test certificate has name of test laboratory	
		Test report number or certificate number listed on the certificate	
		Test certificate states product has been tested to one of these standards	
		Test laboratory is accredited	
		Test certificate validity is confirmed	
Solar Controller	• IEC 62109 • IEC 62509 • IEC 60335-1 **and** IEC 60335-2-29 • UL 1741:	Test certificate has name of test laboratory	
		Test report number or certificate Number listed on the certificate	
		Test certificate states product has been tested to one of these standards. (If IEC 60335 then both parts 1 and 2-29 must be listed on the certificate)	
		Test laboratory is accredited	
		Test certificate validity is confirmed	

Annexe 4: Product Application Checklist

PRODUCT APPLICATION CHECKLIST				
Name of Company				
Date of Submission				
Solar modules meet the component requirements?				Yes/No
Approved modules include:				
Brand		Models		
Brand		Models		
Were there any solar modules that did not meet the component requirements?				Yes/No
If so what brand and models were they and why?				
Brand		Models		
Reason				
Solar controllers meet the component requirements?				Yes/No
Approved solar controllers include:				
Brand		Models		
Brand		Models		
Were there any solar controllers that did not meet the component requirements?				Yes/No
If so what brand and models were they and why?				
Brand		Models		
Reason				
Batteries that meet the component requirements?				Yes/No
Approved batteries include:				

Brand		Models	
Brand		Models	
Were there any batteries that did not meet the component requirements?			Yes/No
If so what brand and models were they and why?			
Brand		Models	
Reason			
Inverters that meet the component requirements?			Yes/No/NA
Approved batteries include:			
Brand		Brand	
Brand		Brand	
Were there any inverters that did not meet the component requirements?			Yes/No/NA
If so what brand and models were they and why?			
Brand		Brand	
Reason			
Name of Verifier			
Signature			
Date			