TITLE: Solar power system for low electrical requirements

Product verification protocol:	E006/PVDC-VP1.0
Product specification:	E006/PVDC 01
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Contents

1. Scope

This document sets out the requirements for a type-examination protocol to be used for the prequalification evaluation of solar power systems for crucial cold chain devices with low power requirements, including equipment monitoring systems (EMS) such as remote temperature monitoring devices (RTMD) and other necessary peripherals.

A second quality verification protocol, **E006/PVDC-VP2** completes the package. This document is initially completed by an employer to describe the requirements for specific installation(s). The document also sets out the subsequent installation, commissioning and handover procedures to be carried out by the installer and the user. The completed protocol should be read in conjunction with equipment specification **E006/PVDC 01**, to which it refers.

The **WHO PQS E006/PVDC 01** specification sets out the requirements for solar power systems that are appropriate for present day EMS and for other load devices with similar power requirements of less than 400 Wh/day. This specification also details the requirements for a generic low voltage direct current (DC) standalone solar power system with a photovoltaic solar module or array of solar modules powering an EMS, such as an RTMD that complies with **WHO PQS E006/TR03** specifications. These requirements may also be applicable to other load devices that require low voltage low power DC input. Note: the current specification document does NOT apply when using solar direct drive energy harvesting to power an EMS, RTMD or similar device (see **WHO PQS E007/EHC01** specifications and verification protocols for requirements).

2. Terms and definitions

Note: Solar energy definitions are contained in **IEC 61194.**

Alternating current (AC): an electric current that reverses its direction at regularly recurring intervals the value of which varies as a sine wave.
Autonomy: time in hours that a solar power system can maintain the load under low solar radiation conditions (e.g. rain). Autonomy is determined as described in **E006/PVDC 01** Clause 4.2.3: Battery set sizing.
Design day: the day that is selected to size the solar power system to meet all EMS electrical load requirements (the "design day") must be largest of the following three options 1) based on the lowest monthly solar radiation reference period; 2) based on the highest average daily electrical load requirement for a given month; or 3) both if occurring simultaneously.
Direct current (DC): an electric current flowing in one direction.
Employer: the organization that contracts with the legal manufacturer or reseller who will supply the system components and the installation and maintenance advisory services described in this specification. The employer will typically contract with an installer who will install, commission and maintain the installation.
Equipment monitoring system (EMS): measurement and recording device intended to monitor cold chain temperature, performance, events and alarms in walk-in cold rooms and freezer rooms (PQS E001) and refrigeration appliances (PQS E003).
In writing: communication by letter, fax or email.
Installation: the complete solar power system installation described in **E006/PVDC 01** equipment specification and in the companion **E006/PVDC-VP1** document, together with any other employer's requirements documentation issued for a specific installation or installations.
Installer: a person or organization who has been appointed by the employer to carry out the installation of the system.
Legal manufacturer: the natural or legal person with responsibility for the design, manufacture or integration of components, packaging and labelling of a product or device before it is placed on the market under the person's own name, regardless of whether these operations are carried out by that person or on that person's behalf by a third party.
Load: any end-use device in an electrical circuit that can consume power when the electrical circuit is energized.
Maximum power point tracking (MPPT) control: a type of photovoltaic (PV) to battery charge control that optimizes solar array output by operating as a DC-to-DC converter. It uses the DC input from the PV array and converts it back to a different DC voltage and current so that the PV module is correctly matched to the battery. This allows a solar array to be wired at optimal voltage to overcome long cable distances that otherwise would result in excessive voltage drop or unacceptably large cable diameter.
Montreal Protocol: the Montreal Protocol, finalized in 1987, is a global agreement to protect the stratospheric ozone layer by phasing out the production and consumption of ozone depleting substances (ODS).
QA assessor: the person or entity appointed by the employer to assess the quality and suitability of manufacturing sites and/or candidate approved installers.
QA: Quality Assurance.
Remote temperature monitoring device (RTMD): a system including programmable temperature and event monitor and peripheral devices in compliance with **WHO PQS E006/TR03**.

Reseller: a commercial entity, licensed to act on behalf of a legal manufacturer and which carries product liability and warranty responsibilities no less onerous than those carried by the legal manufacturer.
Solar radiation reference period: the minimum average daily solar radiation on the plane of the solar array that is required to properly power the EMS, expressed in kWh/m²/day.
Standalone: solar power system capable of independently powering 100% of all connected electrical loads.
User: the person responsible for the day-to-day operation of the cold chain equipment and/or solar power system.

3. Normative references

EMAS: European Union Eco-Management and Audit Scheme.
IEC 60335-1: 2006 Household and similar electrical appliances - Safety - Part 1: General requirements.
IEC 60364-1: 2005 Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions.
IEC 61000-6-1 edition 2.0: 2005 Electromagnetic compatibility (EMC) Generic standards - Immunity for residential, commercial and light-industrial environments.
IEC 61000-6-3 edition 2.1: 2011 Electromagnetic compatibility (EMC) Generic standards - Emission standard for residential, commercial and light-industrial environments.
IEC 61194: 1992 Characteristic parameters of stand-alone photovoltaic (PV) systems.
IEC 61215: 2005 Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval.
IEC 61646: 2008 Thin film terrestrial photovoltaic (PV) modules – Design qualification and type approval.
IEEE 1562: 2007 Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems.
ISO 1461: 2009 Hot dip galvanized coatings on iron and steel articles - specifications and test methods.
ISO 9001: Quality Management Systems – Requirements.
ISO 14001: 2004 Environmental management systems - Requirements with guidance for use.
ISO 20282-1: 2006 Ease of operation of everyday products - Part 1: Context of use and user characteristics.
Solar Autonomy Calculation Tool, H.Toma and T. Markvart, University of Southampton, UK 2009.
UL2054: Second edition, 2009 Household and Commercial Batteries.
UL1642: First edition, 2012 Standard for Safety, Lithium Batteries.
WHO PQS E006/PVDC 01: Solar power system for low electrical requirements.
WHO PQS E006/PVDC-VP2: PQS Quality assurance protocol.
WHO PQS E006/TR03.2: Programmable remote temperature and event monitoring systems.
WHO PQS E007/EHC01.1: Solar direct drive surplus energy harvest control.

4. Applicability

Type-examination will be carried out by an independent evaluator, appointed by WHO. The extent of the geographical limits of any grant of prequalification status will be reviewed and decided upon by WHO.

5. Sample-examination checklist

5.1 Evidence of conformity assessment

Key components must carry the CE mark and/or equivalent internationally accepted evidence of conformity assessment.

5.2 Samples and supporting material

The legal manufacturer or reseller must supply the employer with a full duplicate set of the Product Dossier already supplied to WHO in accordance with the requirements of specification Clause 7, together with the following:

- a fully worked example of a solar array sizing, battery sizing and an autonomy calculation for all load(s) included and at a specified location. Confirmation of the model(s) of PQS prequalified load(s) and/or other load(s) included as part of a complete installation,
- confirmation of the type(s) of available array support structure, meeting specification Clause 4.2.2. Provide detailed photographs of each type that is offered,
- sample of the instructions listed in Clause 4.11, in English language.
- detailed high-resolution digital images of a typical solar array in .jpeg format.

5.3 Test 1 - type-examination

- **Step 1:** Complete the compliance checklist in Annex 1. Record general comments and recommendations for each section.
- **Step 2:** Obtain any additional supporting information required in writing from the legal manufacturer or reseller and attach this information to the report.

Acceptance criteria: Inspection indicates full conformity with all major specification requirements.

5.4 Criteria for qualification

A final report must be issued after the type-examination is complete. The report must contain the following data and analyses:

- **Summary:** Conclusions and recommendations.
- **Compliance checklist:** Completed Annex 1 checklist.
- **Photographs:** Submitted photographs as listed in Clause 5.2.
- **Annexes:** Additional supporting documentation requested and received from the legal manufacturer or reseller during the course of the type- examination.

Annex 1 – Compliance checklist[1]

Specification Clause	Item		
A. General information			
7.	Dossier fee received:	Yes No Part payment	
7.	Type-examination fee received:	Yes No Part payment	
7.	System identification: Code: Model:		
4.2.4	Battery type(s) offered	Integrated in load? Standalone? Lithium? Lead acid?	
7.	Legal manufacturer details: Name: Address 1: Address 2: Address 3: Address 4: Tel: Fax: Email: Web:		
7.	Reseller details: Name: Address 1: Address 2: Address 3: Address 4: Tel: Fax: Email: Web:	Applicable Not applicable	
7.	Status:	Legal Manufacturer Reseller	
7.	Countries/regions where support services can be offered:		
General information comments:			
B. Technical details:			
4.1.2	Load(s) specified	Conforms to specification?	Yes No
4.1.2	Solar array sizing	Conforms to specification?	Yes No
4.2.4	Autonomy calculation	Conforms to specification?	Yes No
Comments on example calculations:			
4.2.1	Photovoltaic array	Conforms to specification? Yes	Yes No
4.2.1	Cable: Manufacturer, diameter and rating type	Conforms to specification? Yes	Yes No
Comments on array:			

[1] This is a Word 'Form' document. It needs to be copied and 'protected' before it can be used for data entry. Then activate View/Toolbars/Forms and click the 'lock' icon on the Forms toolbar. See also Word Help. Margins can be adjusted so form fits on a single page.

Specification Clause	Item		
4.2.2	Array support structure	Roof/ground mounting offered? Pitched roof mounting offered? Flat roof mounting offered? Wall mounting offered? Ground mounting offered? Pole mounting offered? Materials conform to specification?	Yes No Yes No Yes No Yes No Yes No Yes No Yes No
Comments on array support structure:			
4.2.4	Battery type	Conforms to specification?	Yes No
Comments on batteries:			
4.2.5	Battery set housing	Conforms to specification?	Yes No
Comments on battery housing:			
4.2.4	Battery charge regulator	Conforms to specification?	Yes No
4.2.6	Battery safety	Conforms to specification?	Yes No
4.2.6	Lithium battery safety (if Li battery included)	Conforms to UL1642 & UL2054 specifications?	Yes No
Comments on battery charge regulator:			
4.2.4	Battery isolation switch	Conforms to specification?	Yes No
4.2.7	Electrical safety rating	Certified as conforming to IEC 60335-1?	Yes No
4.2.8	Electrical protection	Conforms to specification?	Yes No
4.2.9	Lightning protection	Conforms to specification?	Yes No
4.2.10	Tool kits	Conforms to specification?	Yes No
4.2.11	Electromagnetic comp.	Certified conforming IEC61000-6-1 & 6-3?	Yes No
Comments on electrical safety:			
4.3.1	Ambient temperature during transport & storage	Conforms to specification?	Yes No
4.3.2	Ambient temperature during use	Conforms to specification?	Yes No
4.3.3	Ambient humidity range	Conforms to specification?	Yes No
Comments on environmental requirements:			
4.4.1	Overall dimensions	Component sizes comply?	Yes No
4.4.2	Weight	Component weights comply?	Yes No
Comments on physical characteristics:			

Specification Clause	Item		
4.5.1	EMS/RTMD interface components complete	Conforms to specification?	Yes No
4.6.1	General human factors	Conforms to specification?	Yes No
4.6.2	Safe access	If observed, conforms to specification?	Yes No
Comments on human factors:			
4.7.1	Restricted materials	Conforms to specification?	Yes No
4.8	Warranty	Conforms to specification?	Yes No
4.9.1	Servicing provision	Conforms to specification?	Yes No
4.9.2	Spare parts, supplies	Conforms to specification?	Yes No
4.10	Disposal and recycling	Conforms to specification?	Yes No
4.11	Instructions	Conforms to specification?	Yes No
4.11	Sample manual(s)	Is it satisfactory?	Yes No
4.12	Training - EMS	Conforms to specification?	Yes No
5.	Packaging	Conforms to specification?	Yes No
6.	On-site installation	Offered? If YES is it satisfactory?	Yes No Yes No
C. Norms and standards:			
7.	Type approval details:	Details supplied: Satisfactory?	Yes No Yes No
7.	Environmental audit scheme	Type: Current? (Note: not mandatory)	Yes No Yes No
7.	Laboratory test reports	Details: Satisfactory?	 Yes No
7.	Type approval details:	Details supplied: Satisfactory?	Yes No Yes No
7.	Current ISO 9001: certification:	Either Satisfactory? Or Pending?	Yes No Yes No
8.	On-site maintenance service (optional)	Offered? If YES is it satisfactory?	Yes No Yes No
Norms and standards comments:			
D. Conclusions:			
Overall summary:			
	DECISION: **QA Assessor** **Contact info**	Prequalify? Reject?	

Revision history			
Date	Change summary	Reason for change	Approved