



TITLE: Solar power system for compression-cycle vaccine refrigerator or combined refrigerator and water-pack freezer.

Product verification protocol: E003/PV01-VP1.2
Applies to specification ref(s): E003/PV01.2
Issue date: 6 July 2010
Date of last revision: 2 August 2007

Contents:

1. Scope: 1

2. Normative references: 2

3. Terms and definitions:..... 2

4. Applicability: 3

5. Sample-examination checklist:..... 3

 5.1 Evidence of conformity assessment:..... 3

 5.2 Samples and supporting material:..... 3

 5.3 Test 1 - type-examination:..... 4

 5.4 Criteria for qualification:..... 4

Annex 1 – Compliance checklist 6

1. Scope:

E003/PV01-VP1.2 is a type-examination protocol to be used for the pre-qualification evaluation of solar power systems for compression cycle vaccine refrigerators and combined refrigerator and water-pack freezers. It should be read in conjunction with **E003/PV01.2** which describes the required performance characteristics for this category of products, and with specifications **E003/RF04** and **E003/RF05** and **E003/RF06** which describe the performance characteristics for the associated refrigeration equipment.

Two alternative systems are covered by this protocol. **Type 1** systems use a solar array to charge an electrical storage battery pack, which then powers refrigeration equipment complying with specification **E003/RF04**. **Type 2** systems use a solar array directly to power the refrigerator compressor. Direct drive refrigeration equipment complying with specification **E003/RF05** is entirely battery free. Direct drive refrigeration complying with specification **E003/RF06** uses an integrated battery to power ancillary equipment such as fans, instrumentation and control. This battery is charged from the solar array.

A second verification protocol, **E003/PV01-VP2.2** completes the package. This document is initially completed by a [procurement agency](#) to describe the requirements for a specific installation or installations. The document also sets out the subsequent installation, commissioning and handover procedures to be carried out by the [installation technician](#) and the [user](#). The completed protocol should be read in conjunction with **E003/PV01.2**, to which it refers.

2. 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 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*.
- ISO 1461: 1999: *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*.
- Toma, H. and Markvart, T. *Solar Autonomy Calculation Tool*, University of Southampton, UK 2009.
- WHO/PQS/E003/PV01.2: *Solar power system for compression-cycle vaccine refrigerator or combined refrigerator and water-pack freezer*.
- WHO/PQS/E003/PV01-VP2.2: *Solar power system for compression-cycle vaccine refrigerator or combined refrigerator and water-pack freezer – on-site checklists for completed installations*.
- WHO/PQS/E003/RF04.2: *Refrigerator or combined refrigerator and water-pack freezer: compression-cycle. For solar powered rechargeable battery storage*.
- WHO/PQS/E003/RF05.2: *Refrigerator or combined refrigerator and water-pack freezer: compression-cycle. Solar direct drive without battery storage*.
- WHO/PQS/E003/RF06.1: *Refrigerator or combined refrigerator and water-pack freezer: compression-cycle. Solar direct drive with ancillary rechargeable battery*.

3. Terms and definitions:

Note: Solar energy definitions are contained in IEC 61194.

Autonomy: Time in days that a solar refrigerator, or combined refrigerator and water-pack freezer, can maintain the vaccine load within the acceptable temperature range under low solar radiation conditions (e.g. rain). **Autonomy** is determined as described in **E003/PV01** – Section 4.1.2 and measured as described in **E003/RF05-VP.2** and **E003/RF06-VP.1**.

Evaluator: An individual or organization (including a testing laboratory) responsible for evaluating the suitability of the components and services described in this specification for inclusion in the register of PQS pre-qualified products.

In writing: means communication by letter, fax or email.

Installation: The solar power system specified in this document connected to a refrigerator, or combined refrigerator and water-pack freezer, complying with specification **E003/RF04**, **E003/RF05** or **E003/RF06**.

Legal Manufacturer: The natural or legal person with responsibility for the design, manufacture, packaging and labelling of a product or device before it

is placed on the market under his own name, regardless of whether these operations are carried out by that person himself or on his behalf by a third party.

Montreal Protocol: Montreal Protocol on Substances that Deplete the Ozone Layer.

Procurement Agency: The organization which purchases the equipment covered by this specification and which provides the **qualified supplier** with details of the installation site(s).

Qualified Supplier: A **qualified supplier** may be either a **legal manufacturer** or a **reseller** and must:

- Supply a coherent, correctly sized **installation** where the settings of all the components have been adjusted for optimum performance at the installation site.
- Have installed and supported at least ten photovoltaic systems in a developing country or countries for at least two years (detailed references, including donors, locations and contacts, must be provided).
- Have the capacity and financial resources to provide long term support to the systems in the country of destination.
- Offer one or more refrigerators or combined refrigerator-water-pack freezers complying with PQS standards **E003/RF04** and/or **E003/RF05** and/or **E003/RF06** and which are currently pre-qualified by WHO.

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 solar refrigerator, or combined refrigerator and water-pack freezer, expressed in kWh/m²/day.

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 pre-qualification 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 testing laboratory 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 (if used) and an **autonomy** calculation for a named vaccine refrigerator model at a specified location.

- Confirmation of the model(s) of PQS-pre-qualified refrigerators or combined refrigerator and water-pack freezers which can be included as part of a complete [installation](#).
- Confirmation of the type(s) of array support structure, meeting specification clause 4.2.2, that can be supplied. 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 typical array panels 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.

6. **Quality control checklist:**

6.1 Quality control standards:

All reporting must be carried out in accordance with the requirements of this document.

6.2 Quality control checklist:

An on-site inspection of the manufacturing plant is not required.

7. **Pre-qualification evaluation:**

A product will qualify for inclusion on the register of PQS pre-qualified Solar power system for compression-cycle vaccine refrigerator or combined refrigerator and water-pack freezers in accordance with WHO procedures provided the final report indicates full conformity with the requirements of specification **E003/PV01.2** and the [system](#) is fully compatible with at least one refrigerator complying with PQS specification **E003/RF04** and/or **E003/RF05** and/or **E003/RF06**.

8. **Modified products:**

The [legal manufacturer](#) or [reseller](#) must notify WHO [in writing](#) of any changes which affect the performance of the product. WHO will carry out a desk

evaluation of the reported change(s). If any change is deemed adversely to affect the performance of the product, WHO may request full or partial re-verification based on the type-examination procedures described in this document.

Annex 1 – Compliance checklist¹

Spec clause	Item	
A. General information:		
7.	Dossier fee received:	Yes <input type="checkbox"/> No <input type="checkbox"/> Part payment <input type="checkbox"/>
7.	Type-examination fee received:	Yes <input type="checkbox"/> No <input type="checkbox"/> Part payment <input type="checkbox"/>
7.	System identification: Code: Model:	
7	System type(s) offered	Type 1 <input type="checkbox"/> Type 2 <input type="checkbox"/> Both types <input type="checkbox"/>
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 <input type="checkbox"/> Not applicable <input type="checkbox"/>
7.	Status: Legal Manufacturer Reseller	<input type="checkbox"/> <input type="checkbox"/>
7.	Countries/regions where support services can be offered:	
<i>General information comments:</i>		
B. Technical details:		
4.1.2	Solar array sizing	Example conforms to best practice? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.1.2 4.2.3	Battery sizing (Type 1 systems only)	Example conforms to best practice? n/a <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>
4.1.2	Autonomy calculation	Example conforms to best practice? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on example calculations:</i>		
4.2.1	Photovoltaic array	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on array:</i>		
4.2.2	Array support structure	Roof/ground mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/> Pitched roof mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/>

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.

Spec clause	Item	
		Flat roof mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/> Wall mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/> Ground mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/> Pole mounting offered? Yes <input type="checkbox"/> No <input type="checkbox"/> Materials conform to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on array support structure:</i>		
4.2.4	Battery type	Sealed? <input type="checkbox"/> Flooded? <input type="checkbox"/> Both types? <input type="checkbox"/> n/a (Type 2) <input type="checkbox"/> Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on batteries:</i>		
4.2.5	Battery set housing	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/> n/a (Type 2) <input type="checkbox"/> Battery housing material(s)
<i>Comments on battery housing:</i>		
4.2.6	Battery charge regulator	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/> n/a (Type 2) <input type="checkbox"/> Varistor? <input type="checkbox"/> Spark-gap? <input type="checkbox"/> Surge protection? <input type="checkbox"/>
4.2.6	Battery charge display	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/> n/a (Type 2) <input type="checkbox"/> Voltmeter? <input type="checkbox"/> LED? <input type="checkbox"/> Other? <input type="checkbox"/> Acoustic option? <input type="checkbox"/>
4.2.7	Battery safety kit	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/> n/a (Type 2) <input type="checkbox"/>
<i>Comments on battery charge regulator:</i>		
4.2.8	Power switch	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.2.9	Electrical safety rating	Conforms to IEC 60335-1? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.2.10	Electrical protection	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.2.11	Lightning protection	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on electrical safety:</i>		
4.3.1	Ambient temperature during transport & storage	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.3.2	Ambient temperature during use	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.3.3	Ambient humidity range	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.3.4	Resistance to storm damage	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on environmental requirements:</i>		
4.4.1	Overall dimensions	Component sizes comply? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.4.2	Weight	Component weights comply? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on physical characteristics:</i>		
4.5.1	Compatible refrigerators	Details supplied with dossier:
4.6.1	General human factors	Conforms to specification? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on human factors:</i>		
4.7.1	Restricted materials	Restricted materials in system components? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Comments on restricted materials:</i>		
C. Norms and standards:		
7.	Type approval details:	Details supplied: Satisfactory? Yes <input type="checkbox"/> No <input type="checkbox"/>
7.	Current ISO 9001: certification ² :	EITHER: Satisfactory? Yes <input type="checkbox"/> No <input type="checkbox"/> OR: Pending <input type="checkbox"/>

² See specification E003/PV01 clause 7 for details of the period-of-grace allowed to achieve ISO 9001 certification.

Spec clause	Item	
7.	Environmental audit scheme	Type: Current? Yes <input type="checkbox"/> No <input type="checkbox"/> (Note: not mandatory)
7.	Laboratory test reports	Details:
<i>Norms and standards comments:</i>		
<i>D. Installation documentation:</i>		
4.8	Warranty agreement	Supplied? Yes <input type="checkbox"/> No <input type="checkbox"/> If 'yes' is it compliant? Yes <input type="checkbox"/> No <input type="checkbox"/>
4.11	Sample manual	Supplied? Yes <input type="checkbox"/> No <input type="checkbox"/> If 'yes' is it satisfactory? Yes <input type="checkbox"/> No <input type="checkbox"/>
6	On-site installation service (optional)	Offered? Yes <input type="checkbox"/> No <input type="checkbox"/> If YES is it satisfactory? Yes <input type="checkbox"/> No <input type="checkbox"/>
8.	On-site maintenance service (optional)	Offered? Yes <input type="checkbox"/> No <input type="checkbox"/> If YES is it satisfactory? Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>Documentation comments:</i>		
<i>E. Conclusions:</i>		
Overall summary:		
DECISION:		Pre-qualify? <input type="checkbox"/> Reject <input type="checkbox"/>

Revision history:			
Date	Change summary	Reason for change	Approved
02.03.2007	New protocol.		UK
09.05.2007	Revised to SMc comments & teleconference UK, SMc, AG 26.04.07. Compliance checklist substituted for clause 5.3		UK
16.05.2007	Final review version		UK
02.08.2007	5.2: Reference to Annex 1 methodology removed. Annex 1 checklist: 4.1.2: 'methodology' changed to 'best practice'. 4.2.6: 'Other' checkbox added.	In response to industry comment.	UK
06.07.2010	'Icepack' changed to 'water pack'. 1: Scope description changed. 2: Normative references updated. Generally: Cross references added to E003/RF06 equipment. 5.2: Bullet point added.	Compatibility with new E003/RF06 documents and revised E003/RF04 and E003/RF05 documents.	