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 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.
   
   
   
   
   
   
   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.
### A. General information:

<table>
<thead>
<tr>
<th>Spec clause</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Dossier fee received: Yes ☐ No ☐ Part payment ☐</td>
</tr>
<tr>
<td>7.</td>
<td>Type-examination fee received: Yes ☐ No ☐ Part payment ☐</td>
</tr>
<tr>
<td>7.</td>
<td>System identification:</td>
</tr>
<tr>
<td></td>
<td>Code:</td>
</tr>
<tr>
<td></td>
<td>Model:</td>
</tr>
<tr>
<td>7.</td>
<td>System type(s) offered: Type 1 ☐ Type 2 ☐ Both types ☐</td>
</tr>
</tbody>
</table>

**Legal Manufacturer details:**
- Name: 
- Address 1: 
- Address 2: 
- Address 3: 
- Address 4: 
- Tel: 
- Fax: 
- Email: 
- Web: 

**Reseller details:**
- Name: 
- Address 1: 
- Address 2: 
- Address 3: 
- Address 4: 
- Tel: 
- Fax: 
- Email: 
- Web: 

**Status:**
- Legal Manufacturer ☐
- Reseller ☐

**Countries/regions where support services can be offered:**

### B. Technical details:

<table>
<thead>
<tr>
<th>Spec clause</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.2</td>
<td>Solar array sizing Example conforms to best practice? Yes ☐ No ☐</td>
</tr>
<tr>
<td>4.1.2</td>
<td>Battery sizing (Type 1 systems only) Example conforms to best practice? n/a Yes ☐ No ☐</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Autonomy calculation Example conforms to best practice? Yes ☐ No ☐</td>
</tr>
</tbody>
</table>

**Comments on example calculations:**

<table>
<thead>
<tr>
<th>Spec clause</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1</td>
<td>Photovoltaic array Conforms to specification? Yes ☐ No ☐</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Array support structure Roof/ground mounting offered? Yes ☐ No ☐</td>
</tr>
</tbody>
</table>

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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.
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<thead>
<tr>
<th>Spec clause</th>
<th>Item</th>
<th>Flat roof mounting offered?</th>
<th>Wall mounting offered?</th>
<th>Ground mounting offered?</th>
<th>Pole mounting offered?</th>
<th>Materials conform to specification?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Comments on array support structure:**

4.2.4 Battery type

Sealed? □ Flooded? □ Both types? □ n/a (Type 2) □ Conforms to specification? Yes □ No □

4.2.5 Battery set housing

Conforms to specification? Yes □ No □ n/a (Type 2) □ Battery housing material(s)

4.2.6 Battery charge regulator

Conforms to specification? Yes □ No □ n/a (Type 2) □ Varistor? □ Spark-gap? □ Surge protection? □

4.2.7 Battery charge display

Conforms to specification? Yes □ No □ n/a (Type 2) □ Voltmeter? □ LED? □ Other? □ Acoustic option? □

4.2.8 Battery safety kit

Conforms to specification? Yes □ No □ n/a (Type 2) □

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 □

4.3.4 Resistance to storm damage

Conforms to specification? Yes □ No □

**Comments on electrical safety:**

4.4.1 Overall dimensions

Component sizes comply? Yes □ No □

4.4.2 Weight

Component weights comply? Yes □ No □

4.5.1 Compatible refrigerators

Details supplied with dossier:

4.6.1 General human factors

Conforms to specification? Yes □ No □

**Comments on human factors:**

4.7.1 Restricted materials

Restricted materials in system components? Yes □ No □

**C. Norms and standards:**

7. Type approval details:

Details supplied: Satisfactory? Yes □ No □

7. Current ISO 9001: certification^2:

EITHER: Satisfactory? Yes □ No □ OR: Pending □

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^2 See specification E003/PV01 clause 7 for details of the period-of-grace allowed to achieve ISO 9001 certification.
<table>
<thead>
<tr>
<th>Spec clause</th>
<th>Item</th>
<th>Type:</th>
<th>Details:</th>
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<tbody>
<tr>
<td>7.</td>
<td>Environmental audit scheme</td>
<td>Current? Yes ☐ No ☐ (Note: not mandatory)</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Laboratory test reports</td>
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</table>

**Norms and standards comments:**

**D. Installation documentation:**

<table>
<thead>
<tr>
<th>4.8</th>
<th>Warranty agreement</th>
<th>Supplied? Yes ☐ No ☐</th>
<th>If ‘yes’ is it compliant? Yes ☐ No ☐</th>
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</thead>
<tbody>
<tr>
<td>4.11</td>
<td>Sample manual</td>
<td>Supplied? Yes ☐ No ☐</td>
<td>If ‘yes’ is it satisfactory? Yes ☐ No ☐</td>
</tr>
<tr>
<td>6</td>
<td>On-site installation service (optional)</td>
<td>Offered? Yes ☐ No ☐</td>
<td>If YES is it satisfactory? Yes ☐ No ☐</td>
</tr>
<tr>
<td>8. On-site maintenance service (optional)</td>
<td>Offered? Yes ☐ No ☐</td>
<td>If YES is it satisfactory? Yes ☐ No ☐</td>
<td></td>
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**Documentation comments:**

**E. Conclusions:**

Overall summary:  

**DECISION:** Pre-qualify? ☐ Reject ☐
## Revision history:

<table>
<thead>
<tr>
<th>Date</th>
<th>Change summary</th>
<th>Reason for change</th>
<th>Approved</th>
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<tbody>
<tr>
<td>02.03.2007</td>
<td>New protocol.</td>
<td></td>
<td>UK</td>
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<tr>
<td>09.05.2007</td>
<td>Revised to SMc comments &amp; teleconference UK, SMc, AG 26.04.07. Compliance checklist substituted for clause 5.3</td>
<td></td>
<td>UK</td>
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<tr>
<td>16.05.2007</td>
<td>Final review version</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>06.07.2010</td>
<td>‘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.</td>
<td>Compatibility with new E003/RF06 documents and revised E003/RF04 and E003/RF05 documents.</td>
<td></td>
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