EU Environmental Technology Verification pilot programme

Statement of Verification

Technology:	PVStop
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Accreditation Mark

UKAS INSPECTION

4601

Type A
Inspection Body

Accredited to
ISO/IEC 17020:2012

BRE Global Verified ETV

Internet address where this Statement of Verification is available:
https://ec.europa.eu/environment/ecoap/etv

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1. Technology description

PVStop is a black sprayable/rollable/brushable water based polymer.

2. Application

The application of PVStop to PV modules will restrict light from reaching the PV cells thereby reducing the PV system's ability to generate electricity. This reduces the risk of electric shock through direct or indirect contact with PV modules.

2.1. Matrix

Solar photovoltaics.

2.2. Purpose

Inhibit solar photovoltaic function.

2.3. Conditions of operation and use

Application in accordance with manufacturer's instructions.

2.4. Verification parameters definition summary

The verified performance parameters of PVStop are:

- Reduction in DC current generated by PV array caused by the application of PVStop
- Reduction in DC voltage generated by PV array caused by the application of PVStop
- Reduction in DC electrical power generated by PV array caused by the application of PVStop

3. Test and analysis design

3.1. Existing and new data

No existing data were accepted for the verification of PVStop. However it was noted that videos showing the application and flame retardant properties of PVStop are publicly available from the PVStop website (http://www.pvstop.com.au/).

3.2. Laboratory or field conditions

Tests were performed on Tuesday 18th April 2017 and Wednesday 19th April 2017 at London Fire Brigade's Southwark Training Centre

Weather conditions were clear, bright and dry with a calm or gentle breeze, with an ambient temperature of approximately 13°C.

3.3. Matrix compositions

The PV array used in the tests comprised of 6 x Canadian Solar CS6P-260P 260W polycrystalline modules providing a theoretical maximum power output of 1560W under standard test conditions (STC - Solar irradiance of 1000 Wm^{-2}, ambient temperature of 25°C). Each module consisted of 3 banks of 20 polycrystalline silicon cells each protected by a bypass diode. The modules were arranged facing due south in a 1 x 6 array with each module oriented in portrait mode at 35° from horizontal. The total module area was 1.638m x 0.992m x 6 = 9.75m2.

3.4. Test and analysis parameters

The measured operational parameters were:

- PV array initial power/voltage/current
- Time needed to apply PVStop according to manufacturer's instructions
- PV array power/voltage/current during application of PVStop

3.5. Tests and analysis methods summary

PVStop was applied to a test PV array according to the manufacturer's instructions.

London Fire Brigade (LFB) personnel, trained and supervised in the use of PVStop by Solar Developments Pty Ltd, applied PVStop to the test PV array. This was witnessed by BRE Global and BRE National Solar Centre. Test parameters were recorded by BRE National Solar Centre and BRE Global.

3.6. Parameters measured

The following parameters were measured:

- Irradiance
- DC voltage
- DC current
- Electrical Power

Electrical power may also be determined by calculation using the equation:

P = V x I

Where: P = Electrical Power

V = Voltage

I = Current

4. Verification results (performance, operational and environmental parameters)

PVStop when applied, according to the manufacturer's instructions will restrict the amount of sunlight falling on an array of PV modules thereby reducing the electrical output of PV system

Test results indicate that the electrical output of the PV array was significantly reduced during the first 7 ± 1 seconds following the start of the application of PVStop.

In test 1 PVStop was applied according to the manufacturer's instructions to a solar PV array consisting of 6 Canadian Solar CS6P-260P 260W PV modules with a nominal electrical output of 1.56kW/225V_{oc}/9.12A_{sc} (at STC) experiencing between 759 – 764 Wm^{-2} of solar radiation. Under these conditions the output DC current of the array was reduced from 6.7 ± 0.5 ADC to 0.0 ± 0.2 ADC in 7s ± 1s from the start of the application of PVStop to the PV array. During the first 7s ± 1s from the start of the application of PVStop the indicated output of the inverter reduced from 1125.3W to 0.0W. See figure 1 and figure 2.

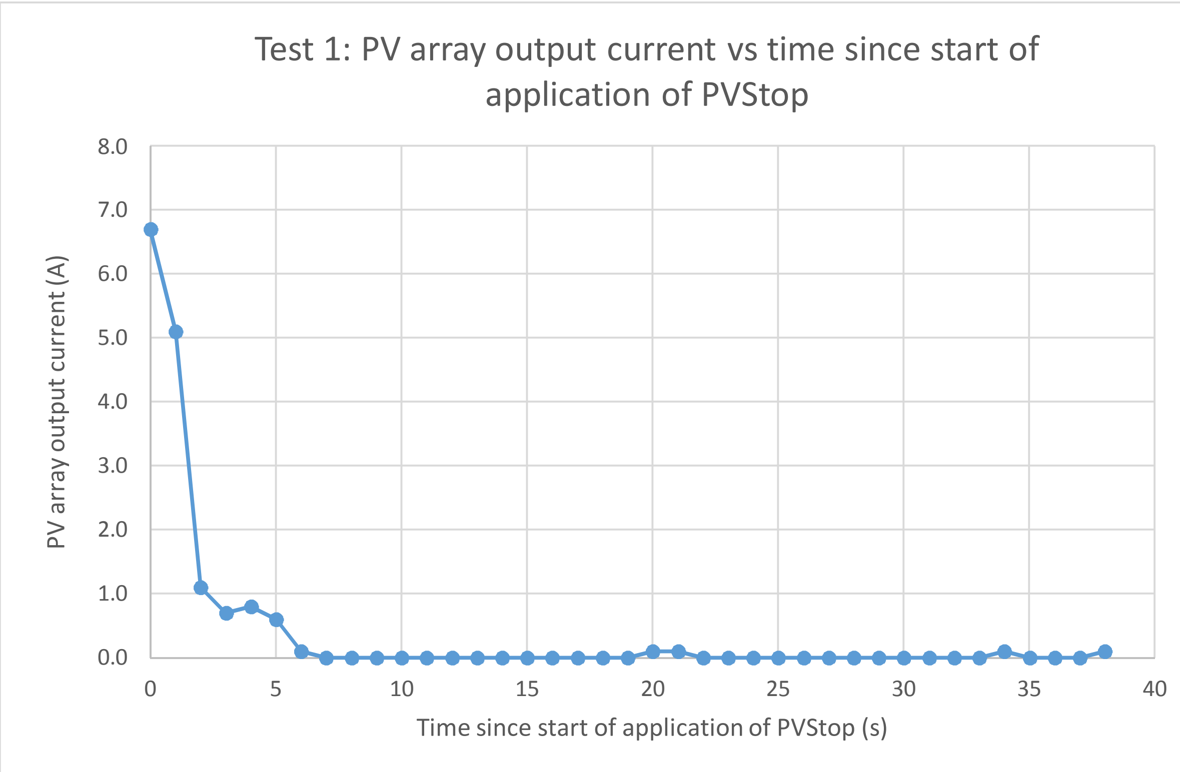

Figure 1 PV Array output vs time since start of application of PVStop

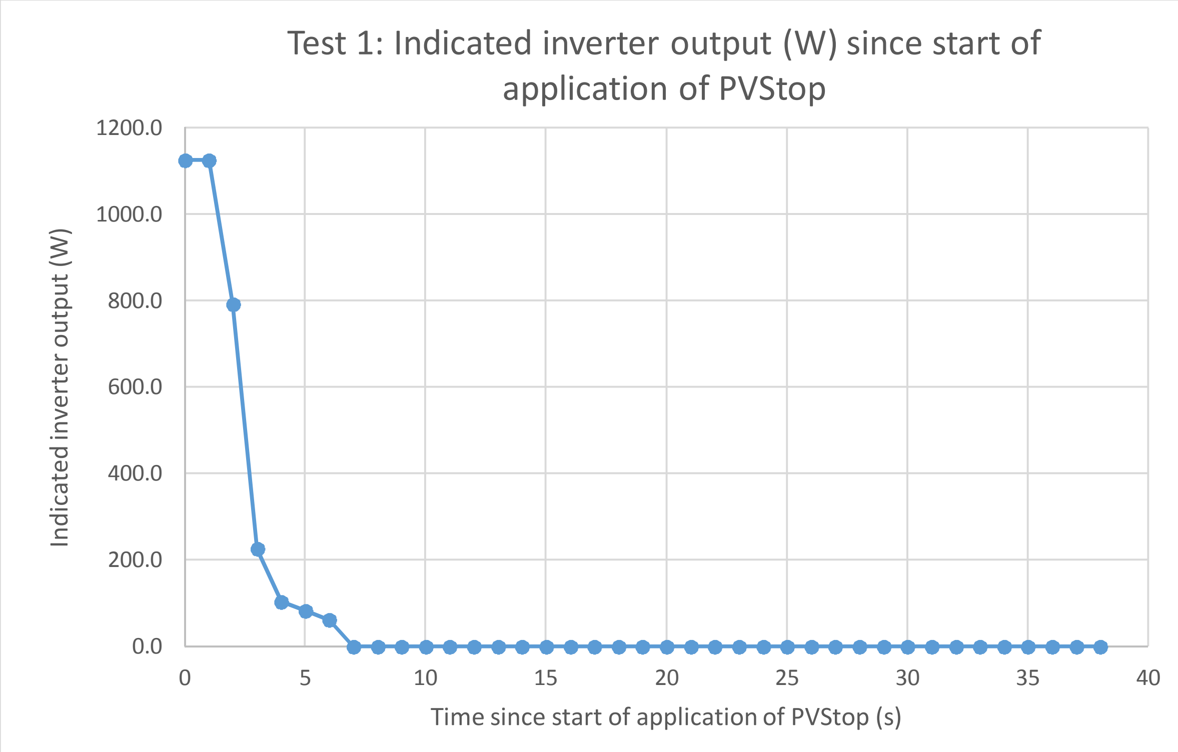

Figure 2 Indicated inverter output since start of application of PVStop

In test 2 using the same application process for PVStop and the same PV array, but this time experiencing between 898-951 Wm^{-2} of solar radiation, the DC voltage of the PV array was reduced from 168.0 ± 8.6VDC to 72.0 ± 3.8 VDC in 4s ± 1s from the start of the application of PVStop.

It is worth noting that some residual DC voltage is to be expected following the application of PVStop. This is because, even small, areas of the modules not completely blocked from exposure to sunlight will give rise to low (ca. 0.5VDC) DC voltages which cumulatively can result in the residual DC voltage levels recorded. Such residual voltage should be considered alongside the associated DC current which, as seen in test 1, rapidly reduces to 0.0 ± 0.2 ADC. Since the output power of the PV array is the product of output current and voltage (I x V) the output power will also fall sharply if the either, or both, of the output current or voltage is rapidly reduced.

During the first 4s ± 1s from the start of the application of PVStop the indicated output of the inverter reduced from 1322.3W to 33.1W after which indicated output remained in the range 24.9 – 29.5W. See figure 3 and figure 4.

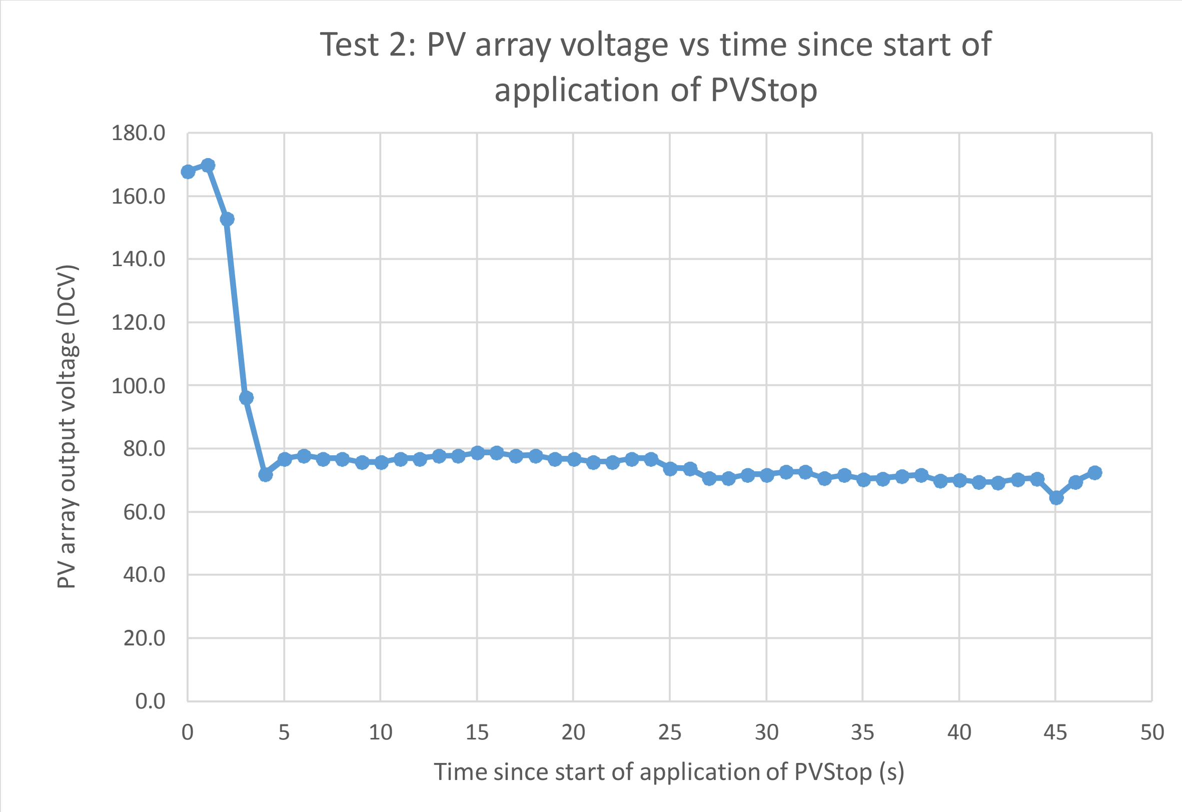

Figure 3 PV array voltage vs time since start of application of PVStop

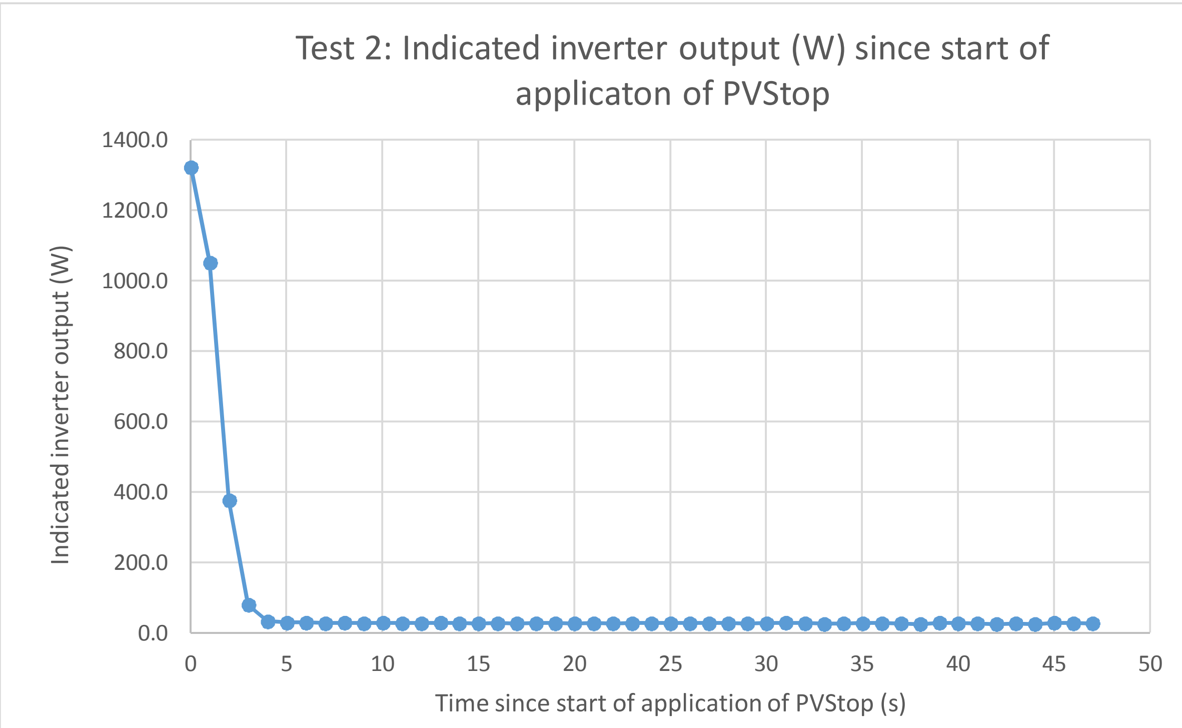

Figure 4 Indicated inverter output since start of application of PVStop

5. Additional information, including additional parameters

Solar radiation during the tests was recorded using a calibrated Seaward Solar Survey 200R instrument. The solar radiation recorded during the tests was:

Test 1: 759 – 764 Wm^{-2} (average = 761.5)

Test 2: 898 - 951 Wm^{-2} (average 924.5)

The ambient temperature at the location during the tests (10:45 – 12:49) was reported to be 12.6 – 12.8°C, average = 12.7°C

https://www.wunderground.com/personal-weather-station/dashboard?ID=ILONDON161%20-%20history/s20170419/e20170419/mdaily#history/s20170419/e20170419/mdaily

The temperature of the solar cells within the PV modules may be determined from the ambient temperature from the equation:

$$T_{Cell} = T_{Air} + \frac{NOCT - 20}{80} S$$

Where:

T_{air} = ambient air temperature (see above)

NOCT = Nominal Operating Cell Temperature (from module manufacturer)

S = Incident solar radiation (in $mWcm^{-2}$)

Using the above the cell temperature (T_{cell}) during the tests is calculated to be:

Test 1: T_{cell} = 12.7 + ((43-20)/80)*76.1 = 34.6°C

Test 2: T_{cell} = 12.7 + ((43-20)/80)*92.4 = 39.3°C

6. Quality assurance and deviations

This verification was conducted according to the documented procedures of BRE Global. These procedures fall within the scope of BRE Global's Schedule of Accreditation to ISO/IEC 17020:2012 issued by the United Kingdom Accreditation Service (UKAS). The verification process included independent internal and external review of the specific verification protocol, verification report and this statement of verification.

This Statement of Verification is valid only when presented alongside the Verification Report Ref No. IN20160117UK03E.