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 **Environmentalenergies**  
Generate power. Generate savings

# PEAR Building PV Array O & M



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## 1 System Data

The following section indicates the basic system information for the 31 kW<sub>p</sub> photovoltaic (PV) system.

The Solar PV installation has been designed in accordance with the ‘Guide to the Installation of photovoltaic systems 2012’, which is published by the Microgeneration Certification Scheme. ISBN: 978-0-9574827-1-5 (Electronic Copy).

### 1.1 Key Components

Modules:  
 Inverters:

Commission Date:

Estimated System Output: 25,100 kWh/yr  
 Estimated CO<sub>2</sub> Saving\*: 13.28 kg/yr  
 \*CO<sub>2</sub> savings based on 0.529 kgCO<sub>2</sub>/kWh

### 1.2 Estimated Systems Performance

The following table indicates the estimated yield of the system using Standard Estimation Method(SEM) methodology, prescribed in ‘Guide to the Installation of Photovoltaic Systems 2012’.

<b>System Size</b>	31 kW <sub>p</sub>		
<b>Predicted Output</b>	25,100kWh/yr	<b>Predicted CO<sub>2</sub> saved*</b>	13.28 kg CO <sub>2</sub> /yr

\*CO<sub>2</sub> savings based on 0.529 kgCO<sub>2</sub>/kWh

#### Standard energy prediction disclaimer:

“The performance of Solar PV Systems is impossible to predict with certainty due to the variability in the amount of solar radiance (sunlight) from location to location and from year to year. This estimate is based upon the standard MCS Procedure and is given as guidance only. It should not be considered as a guarantee of performance. This system performance calculation has been undertaken using estimated values for array orientation, inclination or shading. Actual performance may be lower or higher if the characteristics of the installed system vary from the estimated values. This assessment has been undertaken using the standard MCS procedure – it is estimated that this method will yield results within 10% on the actual energy yield for most systems.”

### 1.3 Basic System information

The following table summarises the key system components:

Component	Manufacturer	Model	Comments
PV Panels			102 panels
Inverter(s)			1
Meter(s)			1

Table 1.1



## 2 Health & Safety

Solar PV systems can be hazardous and potentially lethal. Your system has been designed to minimise the risks, but care should be taken by any persons who may carry out work in your buildings where the solar PV system is installed.

The DC part of the system, which includes the solar modules, DC cabling, DC Isolation Switches and the Inverters should only be inspected and maintained by qualified and competent persons.

In this document advice is given on how to isolate the system from the AC electrical system and the DC parts of the system from the inverter, including by using DC switches mounted on the roof so that the cables which carry the DC power from the modules to the inverters in the building can be isolated.

The solar modules cannot be isolated and during daylight will be live. The DC cables running through the buildings also will always be live during daylight (unless isolated on the roof), and therefore present a risk which may be overlooked by other tradesmen working in the building who may believe that they have isolated the electricity supply.

The inverters are compliant with the regulations pertaining to systems that generate power in parallel to the National Grid, and therefore will disconnect themselves automatically from the AC electrical system should there be a loss of AC power to them, either from a power cut, or if the AC supply is deliberately or otherwise isolated.

For any queries relating to the safety of the system please contact Environmental Energies on the contact information supplied on page two of this document.

## 3 Operation & Maintenance Data

PV systems have low maintenance requirements. However, periodic maintenance routines carried out by the end user can identify faults early and avoid downtimes, which, in turn, maximises the system yield.

### 3.1 Maintenance Checklist

When to check	Check Description	Comments
Every week	Energy yield	Check and record the generation meter readings regularly. You should see them increasing each week. If the number does not increase, this indicates that the system has a problem.
Every month	Assess PV Array surface area	Observe the surface of the array for dirty solar modules and/or build up leaves or other debris. Dirty panels inhibit the performance of the system
Every year	Check of all system components for condition and function. Including inverters, strings and ac circuits	Only to be carried out by a qualified and competent person. See section 5
If poor performance of the array is suspected	Checking output of strings of individual panels, or inverter functionality	Only to be carried out by a qualified and competent person

### 3.2 Procedures for Verifying Correct System Operation.

Check that the inverter(s) are ON, check that the display of the inverter(s) does not indicate any faults. Please refer to the inverter's manual for reference to inverter troubleshooting.



### 3.3 Maintenance & Cleaning Recommendations

To ensure maximum output of the panels, they should be cleaned at regular intervals. Warm water with a non-abrasive cleaning and that does not contain salt will be appropriate. Citrus based cleaners are often suitable. Washing up liquid contains high levels of salt so should not be used.



Build up organic matter on the surface of solar panels can promote the growth of mould around the edges which will shade the solar cells and reduce the systems performance.

**Example of organic build up on solar panels – regular cleaning will keep this under control**

### 3.4 Considerations for Future Building Works That May Affect the Solar PV System

Consideration should be given to avoid shading any part of a solar PV array as shading has a significantly negative effect on the performance. Even small amounts of shading will have a disproportionate negative effect.



### 3.5 What to Do in the Event of a Problem

Check that the inverter(s) are on and that the display does not indicate any faults. Please refer to the inverter's manual for information about the inverters display.

If there is a power cut, or the electricity supply to the building or parts of the building have been switched off for any reason then the inverters will be shut down and will start up automatically when the supply is restored.

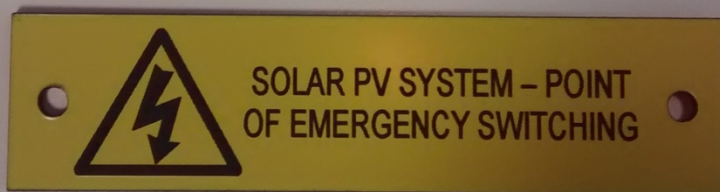
If the inverter(s) is showing a fault, then contact Environmental Energies using the telephone number or email address on page 2 of this document.

### 3.6 How to Shut Down the System, Emergency Isolation and Re-Starting

When the AC and DC isolation switches are switched on the inverters will start and connect to the electricity grid automatically. It can take up to three minutes for the inverter to connect to the grid, which is a requirement of the regulations that govern energy generating systems.

Even when DC and AC isolation is switched off the PV system and DC cabling will still be live during daylight hours.

Each inverter has a number of isolation switches so they can be shut down and isolated from the AC electrical system in the building. The AC isolation switches are fitted with the following label and these can be used for **Emergency Shutdown** or simply isolating the system for maintenance or other reasons:



Example of a label that would be attached to an AC isolation switch



## 4 Warranty

### 4.1 Environmental Energies Warranty Information

Environmental Energies guarantees all its workmanship for two years from date of commission and will fix any faults arising from any defects during this period. If any problems should arise or you have any queries, please contact us.

Please see the Environmental Energies website (<http://www.EnvironmentalEnergies.co.uk>) for complete details.

Warranty information for the panels is included in the appendices.

Photovoltaic modules and the inverter are not covered by this guarantee, instead they are covered by their manufacturer's warranty.

For two years from commission date Environmental Energies will ensure this is carried out in accordance with the Supply of Goods and Services Act (1982).

All equipment is covered by manufacturer's warranty.

Within the first two years EE must be the only installer to work on the array.

#### Exclusions to Guarantee:

This guarantee will become null and void in:

The event of damage occurring as a result of any work unauthorised by Environmental Energies taking place on the installation

The case of *Force majeure* events (e.g. fire, terrorism, vandalism etc)

If the PV is not serviced as per recommendations of the system installer (at least once per annum) by an MCS approved installer.



## 5 Maintenance plans at PEAR Building

### 5.1 Location

30.5 kWp of photovoltaic panels mounted on a non-penetrative East / West system are to be installed on the roof of PEAR Building at the Royal Free Hospital, London.

### 5.2 Tasks

The list below shows the task available for a standard annual O&M contract via Environmental Energies.

Task	Responsibility
Visual check of Panel mounting	Environmental Energies
Visual inspection of clamps and mounting frame.	Environmental Energies
Check Inverter connections for tightness	Environmental Energies
Check AC connections	Environmental Energies
Check DC connections	Environmental Energies
Check operation of G99 Relay if present	n/a
Check incoming Supply Voltage - Record	Environmental Energies
Check DC Voltages	Environmental Energies
Remote Monitoring	Environmental Energies
Test DC Voltage and current	Environmental Energies
Check DC isolators at the inverter.	Environmental Energies
Check AC isolators at the inverter.	Environmental Energies
Check DB and MCBS feeding inverters	Environmental Energies
Inverter location - ventilation - clear of obstruction	Environmental Energies
Check for any signs of leaks in roof space	n/a
Visual inspection of AC and DC cabling condition.	Environmental Energies
Schematic Present? Sequence of Isolation Label?	Environmental Energies
Check labelling is still present and correct	Environmental Energies
Review data collected by inverter and check for any fault codes Access Equipment Required	Client
Panel Cleaning Required	n/a





5.3 Risk Assessment of O&M on a flat roof.

Hazard / Consequences	Control Procedures	Likelihood (a)	Severity (b)	Risk Ranking (a x b)
<b>Slips, trips and falls</b>	<p>Staff will ensure that good standards of housekeeping are maintained at all times; cables and other equipment will be managed so as not to cause a trip hazard.</p> <p>Ensure walkways and emergency escape routes are kept clear of obstruction at all times.</p> <p>The Engineer will check the roof area being worked on prior to installation to confirm that the area is safe to work on, extra vigilance is required when working on pitched roofs /metal/trapezoidal roofs as slipping is more likely, this will include the safety of employees due snow, ice or heavy rain .</p>	2	5	10
<b>Injury to staff and visitors during works</b>	<p>It is vitally important that potentially hazardous areas are signposted, barricaded and, where appropriate, covered to avoid possible injury to workers and members of the public.</p> <p>Anyone who may be affected by the works to be informed of site work, especially tenants and other contractors.</p> <p>Staff will cordon off work area and ensure tenants do not enter area of danger.</p> <p>Hand tools and power tools will not be left unattended.</p> <p>The site will be made safe at the end of works.</p> <p>Staff will follow the method statement devised for this task.</p>	2	3	6
<b>Manual handling</b>	<p>Dual lifting to be used on awkward lifts.</p> <p>All staff members have received instruction and training in house for manual handling.</p>	2	3	6













	<p>Ensure that the route to be taken while lifting is clear of any obstructions.</p> <p>Ensure local staff members are aware of activities in advance to prevent accident.</p> <p>Ensure use of suitable PPE - gloves, to prevent cuts and provide adequate grip.</p>			
<b>Injury to staff and visitors during potential handling solar Panels</b>	<p>Appropriate gloves and suitable eye protection must be worn when handling the solar panels. Only competent persons should carry out the work.</p>	<b>2</b>	<b>3</b>	<b>6</b>
<b>Use of power tools and hand tools</b>	<p>All power tools and machinery must be regularly inspected and maintained in good condition.</p> <p>A visual inspection must be carried out prior to use, any defects must be reported, and the equipment withdrawn from service for repair or replacement.</p> <p>Battery operated tools will be used wherever practical.</p> <p>Power tools and hand tools to be tethered at all times on roof</p>	<b>2</b>	<b>4</b>	<b>8</b>
<b>Use of hand tools</b>	<p>Operatives must be deemed competent to use relevant hand tools.</p> <p>All hand tools should be in good condition and must be inspected prior to use.</p> <p>Ensure the correct tool is used for the task e.g. do not use screwdrivers as chisels.</p> <p>All hand tools are kept in tool bags/boxes when not in use.</p>	<b>2</b>	<b>3</b>	<b>6</b>
<b>Driving company vehicles</b>	<p>The company will hold a copy of each driver's licence on file renewed annually.</p> <p>Drivers are not allowed to work whilst under the influence of alcohol or drugs and face severe disciplinary measures for breaches.</p> <p>Staff will adhere to speed limits at all times.</p> <p>All vehicles used for company business are maintained and serviced on a regular basis.</p>	<b>1</b>	<b>5</b>	<b>5</b>



	Drivers will carry out vehicle checks prior to starting work including tyres pressures and damage, oil and water levels, headlights, side lights and indicators, windscreen washers etc.			
<b>Working at height</b>	<p>Safe and adequate means of access and egress to be provided to the roof area.</p> <p>No person shall be permitted to walk or traverse over a fragile roof.</p> <p>Working at heights using fall arrest systems: Only workers who are trained in the correct selection, installation and use of the equipment, will use fall arrest systems. All anchor devices and lateral man-safe systems should be tagged to indicate they have been tested. The tag will show the next test due date. Workers should not use any equipment which is not in-date. Only lanyards and harnesses which comply with the specification of equipment and method statement should be used. Where a fall arrest system is used an emergency rescue plan must in place before work commences.</p>	2	5	10
<b>Installation of electrical equipment/cable</b> <b>Electric shock</b>	<p>AC works will be carried out by electrical contractor and all relevant paperwork will be available prior to the energising of the system and commissioning.</p> <p>DC cables will be live and works will be in accordance with MCS guidelines.</p> <p>Commissioning of the PV will be in accordance with the requirements of BS7671 (18<sup>th</sup> Edition)</p> <p>Appropriate isolation will be installed. Correct insulated tools must be used. All DC cables will be terminated and labelled when connected to the panels.</p>	1	5	5
<b>Inclement weather</b>	<p>Take account of weather conditions: wear appropriate clothing and take warm drinks in cold weather; cover up or apply sun block to prevent sunburn.</p> <p>The team leader will be responsible for suspending work if weather conditions make the task unsafe.</p>	2	2	4



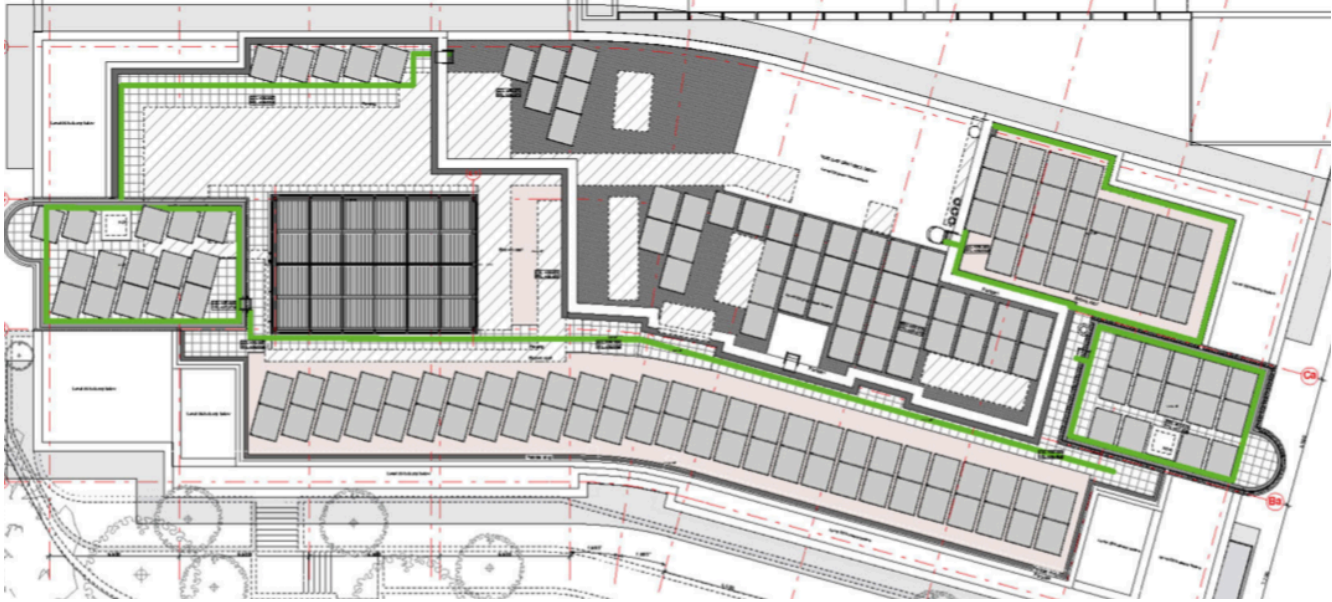
<b>Asbestos</b>	<p>If you come across any hidden or dusty materials which you suspect may contain asbestos, stop work and get advice. A specialist survey will then be carried out to determine the extent and nature of the asbestos risk to your staff.</p> <p>If no information is available to the contrary, you must presume that asbestos is present and take the appropriate measures to control the release of fibres at source.</p>	<b>1</b>	<b>5</b>	<b>5</b>
<b>Cramped spaces</b>	The work should take less than 30 minutes. If the work is carried out in a cramped space this will be the maximum duration. Staff will alternate to ensure extended times are not involved.	<b>2</b>	<b>3</b>	<b>6</b>
<b>Incompetence/poor housekeeping</b> <b>Various including slips/trips/falls</b>	All personnel to be competent to perform the tasks they are asked to do. Operatives to ensure work area is free from obstructions, leads to be festooned where possible, adequate lighting is in place, ensure good housekeeping at all times	<b>1</b>	<b>5</b>	<b>5</b>

PPE Required									
									
Hand Protection / Safety Gloves, Hard Hat, Boots	Overalls / Protective Clothing	Boots / Protective Footwear	Safety Glasses	Face Shield / Mask	Respirator	Hearing Protection	Hi-Vis	Hard Hat	Harness If (necessary)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



## 6 Mansafe Layout

The below design shows the mansafe line layout – the PV array shown in design is no longer correct.



## 7 Troubleshooting

### 7.1 How do I know if I have a fault?

Keep an eye on your generation meter and note down results periodically. Compare the results to the estimated energy output given in your quote, or a month by month breakdown available from <http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php>.

If your generation over the month is more than 20% lower than the expected then there may be a problem.

If your generation is less than expected please take a look at your inverter. Depending on the manufacturer, faults are highlighted in different ways. Please see inverter guide for details.

### 7.2 What should I do if I have a fault?

Note down the fault reference from the inverter screen and contact Environmental Energies.

