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| <p style="text-align: center;"><b>O&amp;M PROCEDURES</b><br/> <b>WATER MANAGEMENT FOR MODULE CLEANING</b></p> |   |


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|---|----------------|--------------------------|
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| Water Management for<br>Module Cleaning   | Date:          | 25/02/2013               |
|   | Issue:         | 00                       |
|   | Page:          | 2 of 5                   |

## INDEX

|      |                        |   |
|------|------------------------|---|
| 1    | INTRODUCTION .....     | 3 |
| 2    | CONDITIONS.....        | 3 |
| 3    | PROCEDURE.....         | 3 |
| 3.1. | Previous works .....   | 3 |
| 3.2. | Water management ..... | 4 |
| 4    | H&S PRECAUTIONS.....   | 5 |

|   |                |                          |
|---|----------------|--------------------------|
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| Water Management for<br>Module Cleaning   | Date:          | 25/02/2013               |
|   | Issue:         | 00                       |
|   | Page:          | 3 of 5                   |

## 1 INTRODUCTION

One of the advantages of solar photovoltaic plants is that water is not necessary to operate the plant and consequently they can be implemented in locations where water is a limited resource. However, in order to ensure maximum power output, cleaning of PV modules is recommended to be performed once a year (as a planned preventive activity), and can be also recommended as a result of a periodic visual inspection of the modules (corrective activity).

Water shall be used for module cleaning and if necessary, water may also be used to establish vegetation according to environmental regulation.

For module cleaning activities refer to the procedure “O&M Procedures for PV Modules - Cleaning of modules”.

Any kind of instructions from the PV modules manufacturer shall be observed when cleaning the modules (failure to comply with this might void module warranty).

In case of contradiction with the following conditions and procedure, instructions of the PV modules manufacturer and applicable regulation requirements will prevail over the general procedure.

## 2 CONDITIONS


Modules shall be cleaned with clean water, without any type of additive, and with low mineral content (preferably less than 400 mg/l).

Only under extreme dirtiness condition of the modules in which the sole use of water is not enough for the cleaning, and after the verification of compliance with environmental regulations and instructions of the PV module manufacturer, mild, non-abrasive and non-caustic detergent can be used.

## 3 PROCEDURE

### 3.1. Previous works

Before cleaning, verify that water shall be abstracted from a legitimate source (agreement with landowner, wells registered if required, agreement with a water treatment plant, etc.) and complies with all the legal and environmental requirements.

|   |                |                          |
|---|----------------|--------------------------|
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| Water Management for<br>Module Cleaning   | Date:          | 25/02/2013               |
|   | Issue:         | 00                       |
|   | Page:          | 4 of 5                   |

Mark out the 2MW area to be cleaned in white/red tape and verify that all previous works stated at O&M procedure “O&M Procedures for PV Modules - Cleaning of modules” are observed, including any previous works specified by the PV module manufacturer.

### 3.2. Water management

Consumption of water for module cleaning activities will depend on the cleaning method, nevertheless, around 3 litres of water per square meter of module surface shall be necessary.

Water abstracted from wells or boreholes on site can be used for cleaning the PV modules if:

- (i) it complies with the environmental requirements, if applicable (for example, unauthorised water abstraction shall be avoided and abstraction volumes will not exceed authorized volumes.)
- (ii) the quality of water is appropriate according to PV module manufacturer instructions (for example, water with high mineral content is not recommended because it may leave deposits on the glass surface).

If there is no water supply on site, or it cannot be used for module washing, vehicles provided with high capacity water tanks shall be driven to the PV plant.

A mini-tractor with trailer to transport the water tank needed for module cleaning shall be used. When necessary, tanks on the mini-tractors shall be refilled with water by connecting a high capacity tank positioned along the internal roads or by operating the pump on the appropriate wells.


Maximum speed permitted shall be 15 Km/h to minimize dust generation.

Vehicle access between the panel rows shall be limited to avoid destruction of the existing vegetation cover.

Ensure establishment of vegetation in previously disturbed areas if applicable.

As a general rule, water shall be used in a responsible way to minimize consumption and prevent wastage. Water leaks shall be avoided and the use of high pressure hoses shall be implemented to reduce water consumption, nevertheless, any kind of instructions from the PV module manufacturer regarding water pressure for module cleaning shall be always observed.

For PV plants locations where water is a limited resource other module cleaning alternatives shall be taken into account as for example, the use of rain harvested water as opposed to

|   |                |                          |
|---|----------------|--------------------------|
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| Water Management for<br>Module Cleaning   | Date:          | 25/02/2013               |
|   | Issue:         | 00                       |
|   | Page:          | 5 of 5                   |

abstracted ground water, hand washing of the solar modules or even, air cleaning of PV modules as opposed to water based cleaning whenever possible.

In order to prevent pollution of surface or ground water, modules shall be always washed with clean water without any type of additive. This water for the cleaning of the modules shall be expected to evaporate quickly and consequently no significant waste water shall be generated.

Water consumption quantities shall be monitored and reported quarterly in the corporate tool SIS

#### 4 H&S PRECAUTIONS

Cleaning activities create potential risk for electric shock and also create risk of fall with potential trauma from impact against the ground or the structures and/or sprain to lower limbs. Appropriate risk assessment shall be performed prior to developing such operations and control measures are to be taken in accordance with risk assessment and with respect to hierarchy of control measures.

Cracked or broken modules represent a shock hazard due to leakage currents, and the risk of shock is increased when modules are wet.

The voltage and current present in an array during daylight hours are sufficient to cause a lethal electrical shock.

When performing cleaning activities, consider the following:

- If possible, clean modules at night time
- Always check that the polarities of modules/arrays are not connected to ground
- Check integrity of modules before cleaning
- Avoid manual cleaning – prefer mechanical cleaning

Appropriate Personal Protective Equipment (PPE), safe work instructions and adequate training shall be considered as control measures in cleaning activities.