

White Paper for PV Modules Operation and Maintenance

光伏组件运维白皮书

Foreword

前言

Along with the continuous development of the PV technology, new types of PV modules are being launched constantly, involving the maintenance for modules during their operation on the site of the PV power station so as to maintain their performance and service life. This White Paper aims to explain the maintenance for Trina's PV modules in system application for the reference by a PV system application client.

随着光伏技术的不断发展，光伏组件类型的不断推陈出新，涉及到光伏电站现场运行时组件的维护保养，保持性能和寿命，本白皮书旨在说明天合光伏组件的在系统应用中的维护保养，供光伏系统应用端参考使用。

Contents 目录

1. Significance of PV Modules Operation and Maintenance 光伏组件运维的意义.....	3
1.1Function of PV Modules 光伏组件的作用	3
1.2Basis for PV Modules Operation and Maintenance 光伏组件运维依据.....	3
2. Applicable Module type 适用的组件类型	3
3. Operation & Maintenance Modes 运维方式.....	3
3.1 Replacement of PV Module 光伏组件更换	3
3.2Cleaning of PV Array 光伏方阵清洁	4
3.2.1Requirements for Cleaning Water 清洗用水要求	4
3.2.2 Notes for Cleaning of PV Modules 光伏组件清洗注意事项	4
3.2.3Inspection over PV Module after Cleaning 清洁后光伏组件的检查	6
3.3 Removal of Vegetation in PV Array Area 光伏方阵区植被清理.....	7
3.3.1 Matters to Be Noted During Removal of Vegetation in PV Array Area 光伏方阵区植被清 理注意事项.....	7
3.3.2Inspection after Removal of Vegetation 植被清理后检查	7
3.4 Tour Inspection over PV Array 光伏方阵巡查.....	8
4. 结语 Conclusion.....	8

1. Significance of PV Modules Operation and Maintenance 光伏组件运维的意义

1.1 Function of PV Modules 光伏组件的作用

In a PV power station, a PV module, as the core power generation unit, is the equipment which changes light into electricity. The operation of the PV module in the PV power station is of great importance to the generating capacity and the earning of the whole station. As a result, the maintenance over the PV module can reduce dust and dirt deposit and prevent the PV module from producing hot spots to finally improve the generation performance and the service life of the PV module.

在光伏电站中，光伏组件作为核心发电单元，是将光能直接转换成电能的设备，光伏组件在光伏电站中的运行情况对整个电站的发电量及收益有举足轻重的影响。因此，对光伏组件的维护保养，减少积灰污物沉积，避免光伏组件发生热斑效应，从而提升光伏组件的发电性能和寿命。

1.2 Basis for PV Modules Operation and Maintenance 光伏组件运维依据

The installation manual, the warranty, and the parameter list of a module, the PV modules certification standard, the White Paper and the user manual of each type of modules, and the relevant product certification standards like IEC61730, IEC61215 and 2004 UL1703 shall be observed; actually the certification which the relevant module passes at that time shall be based on; and the *Technical Specification for Performance Inspection and Quality Assessment for PV Power Station Connected to Grid* and the *Working Regulations on Electrical Safety* shall be followed.

依据组件的安装手册，质保书，参数表，光伏组件的系认证标准，各类型组件白皮书，用户手册，相关产品认证标准，如：IEC61730，IEC61215 和 2004 UL1703，实际以当时组件通过的认证为准，并遵循《并网光伏电站性能检测与质量评估技术规范》和《电业安全工作规程》。

2. Applicable Modules type 适用的组件类型

Applicable to common frame modules, dual-glass modules, optimizer modules.

主要适用于普通边框组件，双玻组件，优化器组件等。

3. Operation & Maintenance Modes 运维方式

3.1 Replacement of PV Module 光伏组件更换

Please refer to the relevant installation manual. Replacement with a module of the same model and power is recommended. 参考安装手册。建议更换同型号同功率的组件。

3.2 Cleaning of PV Array 光伏方阵清洁

3.2.1 Requirements for Cleaning Water 清洗用水要求

pH: 5~7;

Chloride or salinity: 0 - 3,000 mg/L

氯化物或盐分含量 (Chloride and Salinity) : 0 - 3,000 mg/L

Turbidity: 0-30 NTU

浑浊度 (Turbidity) : 0-30 NTU

Specific conductance: 1500~3000 $\mu\text{s}/\text{cm}$

电导率 (Specific conductance) : 1500~3000 $\mu\text{s}/\text{cm}$

Total dissolved solids (TDS): ≤ 1000 mg/L

总溶解固体 (Total dissolved solids (TDS)) : ≤ 1000 mg/L

Water hardness—calcium and magnesium ions: 0-40 mg/L

水硬度 (Water Hardness—calcium and magnesium ions) : 0-40 mg/L

Non-alkaline water shall be used or otherwise softened water shall be used when the relevant conditions are met.

必须采用非碱性水，具备条件时应使用软化水。

3.2.2 Notes for Cleaning of PV Modules 光伏组件清洗注意事项

- (1) Dry or wet clean soft cloth shall be used to wipe a PV module and the use of corrosive solvent or a hard object is strictly prohibited. To brush it lightly first, scrape it then and clean it finally shall be followed.

应使用干燥或潮湿的柔软洁净的布料擦拭光伏组件，严禁使用腐蚀性溶剂或用硬物擦拭光伏组件；应该做到一掸二刮三清洗；

- (2) A PV module shall be cleaned when the irradiance is lower than $200\text{W}/\text{m}^2$; to clean a PV module with liquid whose temperature greatly differs from that of the module is not recommended.

应在辐照度低于 $200\text{W}/\text{m}^2$ 的情况下清洁光伏组件，不宜使用与组件温差较大的液体清洗组件；

- (3) A PV module shall not be cleaned under a meteorological condition where the wind power is higher than Beaufort Force 4 or there is heavy rain or snow.

严禁在风力大于 4 级、大雨或大雪的气象条件下清洗光伏组件；

- (4) The temperature difference between the cleaning water for a PV module and the module shall not be higher than 10°C . No cleaning shall be allowed when the ambient temperature is lower than 5°C so as to prevent the glass of the PV module from being frost-cracked.

光伏组件清洁使用水与组件温差不大于 10℃。环境温度低于 5℃时不得清洗，以免光伏板玻璃冻裂；

- (5) When cleaning is done with pressurized water, the water pressure on the glass surface of a module shall not exceed 0.7 MPa and the module is not allowed to suffer from additional external force.

压力水流清洗时，组件玻璃表面的水压不得超过 0.7 兆帕，组件严禁承受额外的外力；

- (6) When there is a hard foreign matter on a PV module, it shall be removed with a yarn ball with medium hardness; and for scraping, the use of a highly-hard device shall be prohibited, to avoid scratching or damaging the glass surface.

光伏组件上有硬性异物，使用中等硬度的纱球进行去除，禁止使用高硬度的器物进行刮擦。划伤或损坏玻璃表面；

- (7) When there is a substance which is hard to clean, on the surface of a PV module, such as greasy dirt, frictionless neutral liquid cleanser shall be used and any organic solution cleanser is prohibited.

光伏组件表面有油污等难清洁物质，使用无摩擦的中性液体清洁剂，禁止使用有机溶液清洁剂；

- (8) To prevent a shock hazard, a PV module with broken glass or an exposed cable shall not be cleaned.

为防止电击危险，不得清洁玻璃破碎的光伏组件或暴露在外的线缆；

During cleaning of a PV module, the module shall not be treaded on; the running water shall not scatter to any cable or the back of the module; the back of the module shall not be cleaned; a connector shall keep clean and dry to prevent electric shock and fire risk; the usage of a steam cleaner shall be prohibited.

光伏组件清洁工作中，严禁踩踏组件、严禁流水溅射至组件背面和电缆，严禁清洁组件背面，要保证连接头的清洁和干燥，防止电击和火灾危险；严禁使用蒸汽清洁器；

- (9) A module shall not be cleaned with any organic solution cleanser.

严禁使用有机溶剂清洗组件；

- (10) No tool or material which may cause scratch to the surface of a module shall be used.

严禁使用会对组件表面造成划伤的工具和材料；

- (11) When the snow on the surface of a module is being removed, all the snow on the PV module shall be removed with a mop slightly. A mottled situation where some places are covered by snow while some are not on a PV module shall be avoided. Forced removal of frost and snow ice shall be prohibited so as not to damage the surface glass of the module.

清除光伏组件表面的积雪时，用拖布轻轻清除光伏组件上所有积雪。避免光伏组件上出现“部分

有雪部分没雪”的斑状现象。严禁强行清理冰霜和冻雪，防止损坏组件表面玻璃；

- (12) After cleaning, a PV module shall have no dust or dirt retained on the glass surface of the module.

清洁后光伏组件玻璃表面要求无积尘、无污垢；

3.2.3 Inspection over PV Module after Cleaning 清洁后光伏组件的检查

- (1) The overall appearance of the module shall keep clean and bright, without any dirt, through visual inspection

目视组件整体外观清洁、明亮，无污渍；

- (2) A sampling inspection shall be done to confirm whether there is any dust retained on the surface of the module.

抽样检查组件表面是否有积灰存在；

- (3) The surface shall be touched by hand slightly to confirm whether there is any foreign matter untreated.
用手轻轻触摸表面是否有异物未处理干净；

- (4) Whether the cell module is completely clean shall be judged on the basis of the generating capacity.

根据发电量判断电池组件是否完全清洗干净；

- (5) There shall be no obvious scratch on the surface of the cell module.

电池组件表面无明显的刮伤痕迹；

- (6) There shall be no man-made fracture phenomena on the surface of the module.

组件表面无人为造成的破裂现象；

- (7) Whether the rack of the module is inclined or bent shall be checked after cleaning.

清洗后组件支架有无倾斜、弯曲现象；

- (8) Whether the road in the PV array area is level shall be checked.

光伏方阵区道路是否平整；

- (9) Whether any terminal of the cell module falls off shall be inspected.

电池组件接线端子是否有脱落的现象等；

- (10) After the PV module is cleaned, the written record about the cleaning of the PV module shall be made.

光伏组件清洗完后，完成光伏组件清洗文字记录。

3.3 Removal of Vegetation in PV Array Area 光伏方阵区植被清理

3.3.1 Matters to Be Noted During Removal of Vegetation in PV Array Area 光伏方阵区植被清理注意事项

(1) During the removal of the vegetation in the PV area, the *Working Regulations on Electrical Safety* as well as the provisions and the systems of the provincial grid company, concerning safe production, shall be observed, so as to ensure personal safety and the safety of the PV module system and protect the environment.

光伏植被清理过程中，须遵守《电业安全工作规程》及省电网公司安全生产有关规定、制度，确保人身及光伏组件系统的安全，并保护好环境；

(2) When a vegetation inhibitor is sprayed, this drug shall employ any component which may not corrode or oxidize the module system.

如果使用植被抑制剂喷洒，药品应采用不含腐蚀、氧化组件系统成分；

(3) No removal of vegetation before or behind the module, which may cover the module, shall be done when the wind power is higher than Beaufort Force 4.

严禁在风力大于 4 级条件下清理组件前后会造成组件遮挡的植被；

(4) The removed vegetation shall be taken out of the PV array area for treatment.

清理后植被应带出光伏方阵区处理；

3.3.2 Inspection after Removal of Vegetation 植被清理后检查

(1) The vegetation pile shall not be higher than 5cm. It shall be confirmed that the light receiving face of the module is not covered by vegetation, through visual inspection.

植被桩高不得高于 5cm。目视组件受光面无植被遮挡；

(2) It shall be confirmed that the light receiving face of the module is not covered by vegetation, through visual inspection.

目视组件受光面无植被遮挡；

(3) Vegetation shall not be grubbed.

植被不得除根；

(4) The site where removal is done shall keep clean and the PV module shall have no scratch.

清除现场干净，光伏组件无刮痕；

(5) After the vegetation in the PV array area is removed, the written record about the cleaning of the PV module shall be finished.

光伏方阵区植被清理后，完成光伏组件清理文字记录；

3.4 Tour Inspection over PV Array 光伏方阵巡查

(1) Regular tour inspections shall be carried out on the array area of a PV power station to check whether there is any damage of the PV module, such as broken glass, broken back sheet, twisted or deformed frame, cable broken by the teeth of animal, falling-off connector, or damaged junction box; and the PV module shall be replaced in time.

应定期巡查光伏电站方阵区，查看光伏组件是否有损坏，如玻璃破碎，背板破碎，边框扭曲变形，线缆被动物啃咬破皮，接头是否脱落，接线盒是否损坏等情况发生，并及时进行光伏组件更换；

(2) Whether the ground vegetation covers the PV module shall be checked and the removal of vegetation shall be organized in a timely way.

查看地面植被是否存在遮挡光伏组件现在，并及时组织植被清理；

(3) For others, the regulations of the relevant system integrator, concerning professional power station operation and maintenance, shall be followed.

其它遵照系统集成商关于专业电站运维管理规定执行；

4. 结语 Conclusion

As the operation of a PV module in the PV system is related to the generating capacity of a PV power station, good maintenance shall be provided for the PV module. Trina Solar will do continuous research and monitoring on the basis of the development of new products and technologies as well as update the White Paper when appropriate.

光伏组件在光伏系统中的运行情况关系到光伏电站的发电量产出，因此需要对光伏组件进行良好的维护保养。天合光能会持续不断进行根据新产品新技术的发展，不断研究和监控，并在适宜时候更新该白皮书。

The right to interpret this White Paper shall belong to Trina.

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