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New testing and technical services for photovoltaic power generation industry
光伏发电行业新型测试与技术服务

TÜV SÜD Greater China

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PV module
光伏组件



1.
Smart module

Smart module is an electronic device with partly or totally perform functions such as DC-DC or DC-AC power conversion, protection, control, monitoring and communication. Normal PV modules with only bypass diodes are not in this scope, which should be evaluated in accordance with IEC 61215 and IEC 61730-1/-2. These electronic devices are benefit to lower power lost caused by hot spot effect, increase array amount of modules and etc., which can avoid unnecessary costs and add yield. Considering current standards IEC 61215 and IEC 61730-1/-2 can not provide a completely guideline for performance and safety evaluation respectively, such as electrical rating output, hot spot and temperature, our smart module certification requirements have been extended based on extensive experience and knowledge in PV module to meet the demands of market and support you better for products development.

Test standards/methods

- TÜV SÜD internal requirements

智能组件

智能组件是指具有DC-DC/DC-AC转换、保护、控制、监控、通讯等部分或全部功能电子器件的光伏组件。常规组件中的旁路二极管不属于上述电子器件，需按照IEC 61215和IEC 61730-1/-2标准进行考核。这些电子器件可以帮助电站降低因热斑引起的功率损失，增加组件的串联数量等，有利于光伏电站降低建设成本并提高收益。由于目前的IEC 61215和IEC 61730-1/-2标准并不能完全适用于智能组件的性能安全评估，例如电性参数输出、热斑、温升的评估等。针对市场需求，TÜV南德意志集团基于丰富的经验和对产品的深刻理解开发了智能组件认证方案，为客户开发及推广此类新产品提供帮助。

测试标准/方法

- TÜV南德意志集团内部要求

2.

Light and elevated Temperature Induced Degradation (LeTID)

C-Si modules have now shown that their modules power degrade obviously in influence of carrier density and elevated temperature, which called LeTID effect. The experiment data indicate that after hundreds of hours of use, the degradation sometimes can up to about 6% depending on the cell types. Practically, LeTID may occur in a slow process for many years, which will reduce the revenue of end user. It is necessary for end users to verify whether PV modules have LeTID effect before purchasing.

In general, there are two testing methods for LeTID, high temperature condition of light and current injection. The latter is more popular. The research shows that the test results of the two methods are equivalent, and we can perform the test in accordance with your needs. Under the testing temperature of 75˚C, module internal remained carrier density is in the state of Isc-Imp, which is a suitable testing status to find out degradation lower limit. Meanwhile, we also can perform testing according to client's requirements, such as injecting 2 times of Isc-Imp and mornitoring dark voltage simultaneously to save time and cost.

Besides, LeTID can recover to a limit level. We suggest a recovery test to find out the final stable power.

Test standards/methods

- TÜV SÜD internal requirements

热辅助光致衰减测试/评估

近年来，人们发现一些晶硅组件有明显的LeTID（Lightand elevated Temperature Induced Degradation，热辅助光致衰减）效应，即在电流和高温同时作用下组件功率发生明显的衰减。实验测试数据表明，在使用几百小时后，组件功率衰减率根据电池类型的不同有时能高达6%。实际情况中，LeTID可能会以一个很慢的速度持续很多年，这将降低终端用户的收益。因此，有必要在采购之前确认光伏组件是否具备LeTID效应。

通常，有光照高温和通电流高温两种LeTID测试方法，后者更受欢迎。研究表明，两者测试结果是等效的，我们可以根据客户的需求来选择测试方法。关于测试条件，通常测试温度为75˚C，此时组件内部残余载流子数量处于Isc-Imp状态，这是一个用来发现LeTID衰减下限的比较合适的测试状态。同时，我们也可以根据客户的需求来定制化测试状态，比如注入两倍Isc-Imp同时监控暗电压，以节省测试时间和测试费用。

另外，LeTID可以部分恢复，建议进行恢复测试以了解组件最终恢复后的稳定功率。

测试标准/方法

- TÜV南德意志集团内部要求

3.

Initial Light-induced Degradation(LID)

The main reason of early power degradation of regular PV modules is sunlight. Laboratory studies found that due to differences in solar cell technology and materials, the power degradation of different PV modules before reaching power stability varies greatly. And the power degradation of some PV modules exceeds the warranty requirements, which leads the module suppliers in the risk of compensation at a later stage. The LID testing involves final stable power and required irradiance in the simulated environmental conditions. The test result provides an reference for module suppliers in production and later quality assurance.

Test standards/methods

- TÜV SÜD internal requirements

光致衰减测试/评估

导致常规组件早期功率衰减的主要原因是光照。实验室研究发现，由于电池片工艺差异以及材质的不一样，不同组件在出厂后达到功率稳定所衰减的功率值差别很大，部分光伏组件的功率衰减超出质保要求，导致组件供应商在后期存在赔偿风险。本测试模拟室外环境，测量组件在达到功率稳定时所需辐照度以及最终稳定功率值，为组件供应商的生产以及后期质保提供参考依据。

测试标准/方法

- TÜV南德意志集团内部要求



4.
Potential Induced Degradation (PID)

With the expanding of PV market, the materials of PV modules become diversified and the application areas are becoming widely. The ensuing problem is that a series of PV power plants suffer generating capacity reduction and irregular power degradation. One of the main causes is the PID.

PV plant with PID effect is always found with obvious module power output degradation phenomenon, especially in high temperature and high humidity environment. In condition of high temperature and high humidity, Modules affected by long-term high voltage will produce leakage current among glass or package materials. The electric charges accumulate on the surface of PV cells, which will interfere passivation effect, and degrade modules performance. In a word, PID effect has become the “invisible killer” to PV power plants!

Test standards/methods

- IEC TS 62804-1, PID effect testing method
- IEC 61215 and IEC 61730-1/-2, safety and performance requirements
- TÜV SÜD internal requirements

电势诱导衰减测试/认证

随着光伏市场的不断扩大，光伏组件使用材料变得多样化，应用区域也日趋广泛。随之而来的问题是一系列光伏电站发电量降低以及组件功率不规则下降的现象变得非常明显，导致此现象的主要原因之一就是PID。

PID效应，又称电势诱导衰减。通过大部分出现PID效应的电站数据可以发现组件输出功率明显下降，在高温高湿的环境中尤其明显。组件长期受高电压作用影响，其玻璃、封装材料之间出现漏电流，电荷聚集在电池片表面使其钝化效果恶化，从而导致了组件性能的下降。简而言之，PID效应已经成为光伏电站的“隐形杀手”。

测试标准/方法

- IEC TS 62804-1，光伏组件电势诱导衰减测试的检测方法
- IEC 61215和IEC 61730-1/-2，安全及性能要求
- TÜV南德意志集团内部要求

5.
New standards IEC 61215 and IEC 61730

IEC 61215-1, IEC 61215-1-1 and IEC 61215-2 were published in March 2016 to supersede IEC 61215:2005 and IEC 61646:2008, which had been applied for more than 10 years.

IEC 61730-1and IEC 61730-2 were published in August 2016 to supersede IEC 61730-1:2004 and IEC 61730-2:2004, which have been applied for more than 10 years.

Australia CEC announced that from February 8, 2018, all listed crystalline PV modules must demonstrate compliance with the latest versions of IEC 61215 and IEC 61730. Europe will also transfer to new standard version in April of 2021. And more and more markets will apply new standard version in the near future.

IEC 61215和IEC 61730新标准

IEC 61215-1、IEC 61215-1-1和IEC 61215-2新标准已于2016年3月发布，替换已应用10多年的IEC 61215:2005和 IEC 61646:2008标准。

IEC 61730-1和IEC 61730-2新标准已于2016年8月发布，替换已应用10多年的IEC 61730-1:2004和IEC 61730-2:2004标准。

澳洲CEC宣布自2018年2月8日起，所有已列名晶体硅光伏组件必须符合IEC 61215和IEC 61730新版本标准。欧洲也将在2021年4月过渡到新版标准的要求。而在不远的将来，越来越多的市场也将采用新版标准。

6.
PANFILE

As packaged semiconductor power-generating device, PV modules can't perform as in Standard Test Condition (STC) laboratory because of various factors, such as illumination intensity, temperature, installation angle and so on in actual application, which give uncertainties on prediction of accuracy for energy yield. Based on the common temperature and radiance that PV modules used in outdoor environments, the PANFILE testing measure power on different conditions. The test result provides PV plant owners an actual power output reference for modules.

Test standards/methods

- IEC 61853 series standards

PANFILE

光伏组件作为封装后的半导体发电器件，在实际应用中受到光照强度、温度、安装角度等各种因素的影响，这导致电站无法按照实验室标准条件所测功率进行发电，给电站的发电量预测带来了不准确性。本测试基于光伏组件在室外使用时常见温度与光强，在不同温度和多种辐照度条件下进行功率测量，为电站持有方提供该组件在室外环境常见条件下的实际功率输出参考数据。

测试标准/方法

- IEC 61853 系列标准



7.
PV · Discovery

PV · Discovery is not only a typical pass/fail test service, but also an interactive data analysis platform based on result evaluation, which will improve reliability and safety.

What are reliable PV modules? How to choose the right PV module?

The answers are:

- Big data analysis of power degradation for PV module
- Evaluation of outdoor performance for PV module
- Prediction of generation for PV module

We test the performance of PV module under different temperature, radiance and installation angle in accordance with IEC 61853-1 and IEC 61853-2. Based on these general data, the energy yield of PV module under different climate and installation method can be calculated on professional software.

TÜV SÜD lifts the curtain and explores the secrets behind PV power generation.

光伏 • 发现

“光伏·发现”不仅仅只是一项定义通过/未通过的传统测试服务，还是一个基于实际测试结果评估而设计的交互式数据分析平台，以提高可靠性和安全性。

什么是可靠的光伏组件？如何区分光伏组件良莠？

答案是：

- 光伏组件功率衰减大数据分析
- 光伏组件户外性能评估
- 光伏组件发电量预测

根据IEC 61853-1和IEC 61853-2标准可以测量光伏组件在不同温度、辐照度、倾角下的性能。基于这些基础数据，可以使用专业软件计算在不同气候和安装方式下光伏组件的发电量。

TÜV南德意志集团与您一同探索光伏发电的“黑匣子”。



8.
Transportation

PV modules are electrical devices which operate in outdoor environments. However, the existing type approval standards IEC 61215/61730 have no consideration about the influence from mechanical stresses during transportation and installation.

Standard IEC 62759-1 describes methods for the simulation of transportation of complete package units of modules and combined subsequent environmental impacts.

IEC 62941 published in 2019 describes specific requirements for quality management about PV module production. It mentions the packaging materials should be designed in accordance with the IEC 62759 transportation test standard especially.

Reference standard

- IEC 62759-1

运输测试/认证

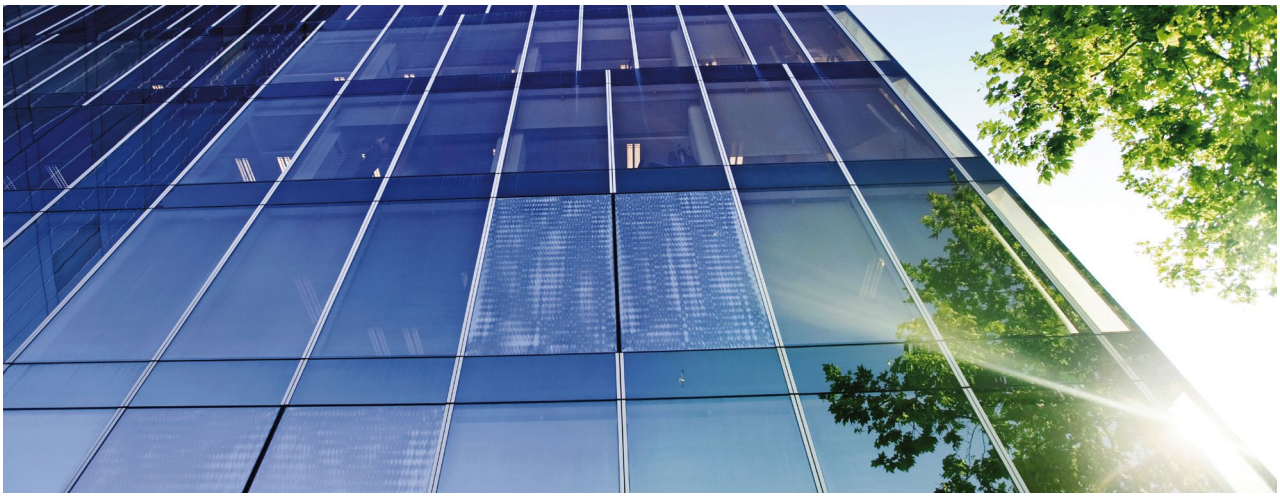
光伏组件是长期在户外使用的电器设备。现有的型式认可标准IEC 61215/61730没有考虑组件在运输和安装过程中机械应力带来的影响。

IEC 62759-1标准提供了具体的评估方法，采用模拟运输以及后续的环境测试，对组件的完整包装单元进行评估。

2019年发布的IEC 62941标准针对光伏组件工厂生产体系提出了具体的要求。其中特别提到，相关组织在设计包装材料时应该按照IEC 62759运输测试标准进行设计。

参考标准

- IEC 62759-1



9.
Dynamic load

The aim of mechanical load testing program in IEC 61215 is verifying the static load carrying capacity for sustaining wind, snow or ice surrounding for PV module. However, PV modules are required to withstand long-term oscillations or alternating forces caused by wind from practical use. These alternating force may cause the fatigue of rigid parts, such as solar cell, solder strip. What's worse, the output power and safety may reduce or degrade in condition of bad weather. Dynamic load testing assessment is aim to evaluate dynamic mechanical loading capacity under extra whether and various installation angle, so that to make sure long-term stable operation for PV plant.

Test standards/methods

- IEC TS 62782, dynamic mechanical load testing for PV modules
- IEC 61215 and IEC 61730-1/-2, safety and performance requirements
- TÜV SÜD internal requirements

动态载荷测试/认证

IEC 61215标准中机械载荷测试的主要目的是验证光伏组件承受风、雪或覆冰等的静态承载能力。但在实际应用中，光伏组件需要长期承受阵风等引起的振荡或交变力。这种交变力可能导致组件的电池片、焊带等刚性部件产生疲劳，并在恶劣的气候条件下进一步恶化，造成光伏组件输出功率或安全性能的衰减，而这正是动态载荷测试评估的内容。

测试标准/方法

- IEC TS 62782 测试方法，光伏组件动态机械载荷测试方法
- IEC 61215和IEC 61730-1/-2，安全及性能要求
- TÜV南德意志集团内部要求

10.
Salt mist

When PV modules applied in area with salt-laden atmosphere such as littoral, coastal or foggy, its performance and integrity might be influenced or damaged by erosive salt mist. It is important to verify whether PV modules applicable in salt mist area or not by test in specific salt mist condition. Through different test cycles, the test is also applicable to the temporary salt mist corrosion environment caused by dissolving the heavy snowfall with salt.

Test standards/methods

- IEC 61701 Edition 2.0 2011-12, salt mist corrosion testing of PV modules

盐雾测试/认证

光伏组件应用于濒海、沿海或是雨水、雾气中含有较多盐分的区域时，具有腐蚀性的盐雾会侵蚀光伏组件部件，甚至破坏组件的完整性，从而影响其性能。因此需要通过特定的盐雾测试条件来确认光伏组件是否适合应用于相关的盐雾环境区域。通过不同的测试循环，该测试还适用于因用食盐溶解积雪而造成的暂时性盐雾腐蚀环境。

测试标准/方法

- 依据IEC 61701 2.0 2011-12版本，光伏模块盐雾腐蚀测试标准



11.
Dust and sand

When PV modules are used in harsh environments in presence of sand where gravel and sand rolled up, the surface of modules, such as glass (especially outer coating film), back sheet, junction box and frames will be rubbed frequently, which cause the influence on appearance, power output as well as safety, what's worse, the performance degrade or damaged. Dust and sand testing is aim to ensure the feasibility of PV modules in harsh environments. The results of testing can be a reference for power plant development in similar environment.

Test standards/methods

- IEC 60068-2-68

沙尘测试/认证

目前，光伏组件已广泛应用于沙漠或沙漠化地区的恶劣环境中，这些地区的大风会卷起一定量的沙石、沙粒等频繁地冲击组件表面，对组件的玻璃（特别是外层镀膜玻璃）、背板、接线盒、边框等造成摩擦侵蚀，降低甚至是破坏材料的性能，从而影响光伏组件的外观、功率输出和安全性。本测试旨在检验光伏组件在沙漠或沙漠化环境条件下的适用性，为该环境条件下的电站项目提供参考。

测试标准/方法

- IEC 60068-2-68

12.
Ammonia

Currently, PV power system has been widely used in household, commercial, public services, agriculture, forestry, animal husbandry, fishery and many other areas, while agriculture and husbandry represent an important market. The special environment of high ammonia levels may corrode the PV components and materials, which will affect modules performance. Therefore, resistance of the modules to corrosion of ammonia in such environment constitutes the point of concern for the buyers.

Test standards/methods

- IEC 62716 Edition 1.0 2013-06, PV modules Ammonia corrosion testing

氨气测试/认证

目前，光伏发电已被广泛地应用于家用、商用、公共事业、农林牧渔等各个领域，而农业和畜牧业更是占据了重要市场，该特殊环境的高含量氨气可能会腐蚀光伏组件部件，从而影响组件的性能。因此，此环境下的组件是否能够抵抗氨气腐蚀则成为了买家所关注的要点。

测试标准/方法

- IEC 62716版本1.0 2013-06，光伏组件氨气腐蚀测试

13.
Thresher

IEC 61215 and IEC 61730-1/-2, as the design qualification standards, provide reference for long-term outdoor use of PV modules, but it is far from being equivalent to the 25 years durability test conditions currently advertised by most of the PV module manufacturers. Based on the Laboratory's data of years of studies, TÜV SÜD works with renowned manufacturers and research institutes and introduces more stringent Thresher Certification based on IEC standards. The certified modules have better performance in the actual operation than the conventional modules, and make the buyers and banks more confident to the modules.

Test standards/methods

- TÜV SÜD internal requirements

Thresher

作为设计鉴定标准的IEC 61215及IEC 61730-1/-2为光伏组件的室外长期使用提供了参考，但远远不能等价于目前大多数光伏组件厂家宣传的25年耐久性测试条件。TÜV南德意志集团基于实验室多年研究数据以及与知名厂家，研究机构之间的合作研究，基于IEC标准推出了更为严苛的Thresher认证，通过此认证的组件，较常规组件在实际运营中会有更好的表现，也可使买家和银行对该组件更放心。

测试标准/方法

- TÜV南德意志集团内部要求



14.
Power measurement system validation

Do you really know your PV module power measurement system? Do you know the uncertainty of your measurement result? Do you know the influence from different simulators and reference devices for measurement result? Is declared rating of power resulting in the loss of your business if it is rated too low or get complaint by the buyer/end users if it was rated too high? TÜV SÜD cooperates with National Institute of Metrology of China offering a power rate system assessment service, which can help you assess the power measurement system from aspects of personnel, equipments, environments, test methods and so on for PV modules. Through our comprehensive PV service portfolio, we can support your specific needs of ensuring assets and strengthening brand image.

Test standards/methods

- IEC 60904 series standards
- TÜV SÜD internal requirements

功率测量体系评估

您真正了解您的光伏组件功率测量体系吗？您知道测量结果的不确定度吗？您知道不同的模拟器和参考组件对于测量结果的影响吗？您的光伏组件功率标称是偏低导致经济利益损失，还是偏高导致买家投诉？TÜV南德意志集团和中国计量科学研究院合作推出的功率体系评估服务，可以帮助您从人员、设备、环境、测试方法等各个方面评估光伏组件功率测量体系，让您有的放矢地做出改进，提高测量的准确性和稳定性，保证您的经济利益并提升品牌形象。

测试标准/方法

- IEC 60904 系列标准
- TÜV南德意志集团内部要求



15.
PV module production system evaluation

The requirements of IEC 62941:2019 are defined with the assumption that the quality management system of the organisation has already fulfilled the requirements of ISO 9001 or equivalent quality management system, it is to provide more confidence in the ongoing consistency of performance and reliability of certified PV modules, it lays out best practices for product design, manufacturing processes, and selection and control of materials used in the manufacture of PV modules.

What are the major changes compared to ISO 9001?

- **Specific requirements of quality management system**
  1. Underline ESD materials/components and related environment monitoring;
  2. Underline product life-cycle management and focus on design lifetime;
  3. Add PV module manufacturing process design, underline using DFMEA, PFMEA, Control plan, MSA, SPC to control process and product and conducting manufacturing process capability studies;
  4. Add process audit and product audit, etc.
- **Special requirements of PV modules technology**
  1. Ongoing/periodic reliability monitoring/production monitoring program that uses appropriate tests for the known failure mechanisms of the product;
  2. Underline IV measurement, including reference module/solar simulator calibration, temperature control, IV correction method, measurement uncertainty analysis;
  3. Intensify the packaging method for PV module, the packaging method of the PV module shall be tested as defined in IEC 62759-1 or equivalent, etc.

光伏组件生产体系评估

IEC 62941: 2019是基于ISO 9001要求或与其等效的质量管理体系为光伏组件制造企业规定的特殊要求。旨在有效提高光伏组件的性能和持续一致的可靠性，使其通过认证，为光伏组件设计、制造过程及材料选择和控制提供了最佳实践。

和ISO 9001相比主要变化是什么？

- **质量体系特殊要求**
  1. 识别静电敏感材料和元件及环境监控；
  2. 强调产品的生命周期管理和设计寿命；
  3. 强调使用DFMEA, PFMEA, Control Plan, MSA及SPC对产品和过程实施控制，并对制造过程能力实施研究；
  4. 增加过程审核和产品审核等。
- **技术特殊要求**
  1. 适用于已知存在故障配件的产品的持续或可靠性周期监控及生产监控机制；
  2. 强调功率测试，包括标板、模拟器管控、温度控制、IV修正方法和测量不确定度分析；
  3. 强化组件包装要求，需按照IEC 62759-1标准或其他等同标准进行测试。



16.
Uncertainty assessment

PV module power is one of the most focus of attention in PV field. Power measurement is very important, and power measurement uncertainty can provide the confidence level of power measurement result.

IEC 62941 issued in 2019 describes specific requirements for quality management about PV module production, it is specially mentioned that, power measurement with solar simulators and the methodology used for performance rating shall have an initial estimate of the uncertainty according to ISO/IEC Guide 98-3. The uncertainty analysis shall be re-evaluated at least annually.

TÜV SÜD and NIM together to provide power measurement evaluation service, please feel free to contact us for this service.

不确定度评估

组件功率是行业内最关注的话题之一。功率测量非常重要，而功率测量不确定度则能说明测量结果的可信度。

2019年颁发的标准IEC 62941针对光伏组件生产工厂体系提出了具体的要求其中有特别提到，要依据ISO/IEC Guide 98-3，对太阳能模拟器的功率测量不确定度要进行评估，至少每年再评价一次。

TÜV南德意志集团和中国计量科学研究院（National Institute of Metrology of China，简称NIM）联合推出不确定度评估服务及培训。如果您有相关需求，欢迎随时联系我们。

PV material and component
光伏材料和零部件

PV material and component testing and certification

- Seek the "suitable" PV material and component.
- TÜV SÜD provides testing and certification services for PV material and component manufacturers.

Applicable categories

- Back sheet materials
- EVA encapsulating materials
- Sealant, pouring sealant, ECA
- Glass
- PV mounting system
- Floating body for floating PV plant
- Tracker for PV system
- PV junction-box
- PV connector
- PV interconnected system
- PV diodes testing

光伏材料与零部件检测认证

- 寻找“合适的”光伏材料与零部件。
- TÜV南德意志集团为光伏材料与零部件制造商提供检测与认证服务。

相关解决方案覆盖以下领域

- 背板材料
- EVA等封装材料
- 密封胶、灌封胶、导电胶
- 玻璃
- 安装支架
- 水面光伏电站用浮筒
- 跟踪系统
- 光伏接线盒
- 光伏交/直流连接器
- 光伏互联系统
- 光伏二极管测试（抗静电、正反向切换管）

Renewable cable
新能源线缆

TÜV SÜD is a cable project expert in providing cable qualification and safety certificate services with EU and international regulations.

TÜV南德意志集团是根据欧洲及国际法规为线缆行业提供质量和安全认证服务的专家。

Product scope and major standards:

- Cables for PV system
- EN 50618, IEC 62930
- Aluminum conductor cables for PV systems
- PPP 11029A
- Cables for EV charging
- EN 50620, IEC 62893
- Cables for electronic vehicles
- ISO 19642, ISO 6722, ISO 14572, etc.
- Battery cable for electric energy storage system
- PPP 58049A
- Cables for railway
- EN 50264, EN 50306, etc.
- Cables for industrial robot (TÜV SÜD internal requirement)

认证范围及标准：

- 光伏电缆
- EN 50618、IEC 62930
- 铝合金光伏电缆
- PPP 11029A
- 充电桩电缆
- EN 50620、IEC 62893
- 电动汽车车内电缆
- ISO 19642、ISO 6722、ISO 14572等
- 电力储能系统用电池连接电缆
- PPP 58049A
- 轨道机车电缆
- EN 50264、EN 50306等
- 工业机器人用电缆（TÜV南德意志集团内部要求）



PV power plant
光伏电站

TÜV SÜD is widely known as a reliable quality partner. Our services throughout the greenfield to operation stage, committed to helping you minimisie investment risk and guarantee revenue.

TÜV南德意志集团是值得您信赖的优质合作伙伴，我们提供的服务贯穿项目规划至运营阶段，帮助您降低投资风险、保障项目收益。

Our services:

- Site assessment
- Energy yield evaluation
- Design review
- Key contracts and bidding documents review
- Critical equipments quality management
- Installation and construction quality management
- Final acceptance inspection and testing
- Performance acceptance assessment
- Operation and maintenance assessment

我们提供的服务：

- 选址评估
- 发电量预测评估
- 设计评估
- 关键合同及招标文件评估
- 关键设备质量管控
- 施工管控
- 验收检查与测试
- 性能评估
- 运维评估

TÜV SÜD has provided technical services for more than 30GW of PV power plants in China up to now.

目前，TÜV南德意志集团在中国已为超过 30GW的光伏电站提供技术服务。

TÜV SÜD provides PV power plant technology service throughout the greenfield to operation stage.
TÜV南德意志集团光伏电站技术服务贯穿项目开发直至运营各阶段

Development 开发	Design 设计	Procurement 采购	Construction 建设	Commissioning 试运行	Operation 运营
WP1 Site assessment WP1 项目选址评估	WP2 Designing assessment WP2 项目设计评估	WP3 Equipments quality controlling WP3 项目设备质量控制			
WP1.1 Licenses and permits assessment WP1.1 核准文件评估	WP2.1 Design review WP2.1 系统设计评估	WP3.1 Factory inspection WP3.1 工厂审核	WP3.1 Factory inspection WP3.1 工厂审核		
WP1.2 Site evaluation WP1.2 厂址评估	WP2.2 Yield study WP2.2 发电量评估	WP3.2 Pre-production check WP3.2 生产前检查	WP3.2 Pre-production check WP3.2 生产前检查		
WP1.3 Preliminary yield study WP1.3 发电量预评估		WP3.3 Production monitoring WP3.3 生产过程监造	WP3.3 Production monitoring WP3.3 生产过程监造		
		WP3.4 Lab sampling test	WP3.4 实验室抽样测试		
		WP3.5 Pre-shipment inspection WP3.5 发货前检查			
		WP3.6 Loading supervision WP3.6 监装			
			WP3.7 Post-shipment inspection WP3.7 到货检查		
				WP3.8 Installation inspection WP3.8 安装后检查	
					WP3.9 Operation inspection WP3.9 运营期测试
			WP4 Construction quality controlling WP4 项目建设期评估		
			WP4.1 Installation training WP4.1 安装培训指导	WP3.8 Installation inspection WP3.8 安装后检查	
			WP4.2 Quality controlling during constructing WP4.2 过程质量检查		
			WP4.3 Project supervision WP4.3 项目监理		
				WP5 Comprehensive acceptance inspection and testing WP5 项目综合验收	WP6 Operation assessment WP6 项目运营评估
				WP5.1 Documents acceptance inspection WP5.1 文件验收	WP6.1 Operation and maintenance assessment WP6.1 运维评估
				WP5.2 Equipments acceptance inspection WP5.2 设备验收	WP6.2 Inspection and testing WP6.2 项目测试检查
				WP5.3 Project acceptance inspection and testing WP5.3 检查测试验收	WP6.3 Performance evaluation WP6.3 系统性能评估

The service footprints of TÜV SÜD PV power plant technology:
TÜV南德意志集团光伏电站技术服务足迹:





PV power electronic systems and equipments
光伏电子系统和设备

PV inverters key elements in PV power generation systems, which convert the DC power into AC power to the grid and load.

光伏逆变器将光伏组件产生的直流电力转换为交流电力输入电网和负载，是光伏发电系统的核心部件。

Due to the expensive assembly cost of PV power generation systems and the long life span of PV modules, which usually lasts more than 25 years. Having a safe, stable and high efficiency PV inverter is important to a PV power generation systems.

鉴于光伏发电系统昂贵的安装费用以及光伏组件通常超过25年的使用寿命。拥有安全，稳定且高效的光伏逆变器对于光伏发电系统来说至关重要。

With over 150 years of experience, TÜV SÜD is one of the world's leading technical service providers, offering knowledge services, inspections, testing, expert opinions, certification and training. Experts from TÜV SÜD provide technology, system and knowhow optimisation to help your PV inverter products to access to global markets.

TÜV南德意志集团拥有超过150年的悠久历史，是全球领先的技术服务提供商之一，可为您提供知识服务、测试、检验、专家咨询、认证和培训服务。TÜV南德意志集团的专家们可以为您提供各项服务，帮助您的光伏逆变器产品顺利进入国际市场。

Test standards:

Safety standards

- IEC 62109-1
- EN 62109-1
- IEC 62109-2
- EN 62109-2
- UL 1741 (USA)

Grid-connection standards

- Germany: VDE-AR-N 4105, BDEW, FGW TR3, FGW TR4, FGW TR8
- Australia: AS/NZS 4777.2
- UK: G98, G99
- Italy: CEI 0-21, CEI 0-16
- France: UTE C15-712, VDE 0126-1-1 VFR 2019
- Belgium: C10/11
- Spain: RD 1699, RD 413, UNE 206006, UNE 206007-1, P012.2, P012.3, NTS
- Austria: TOR Erzeuger Typ A, Typ B, Typ C, Typ D
- EU: EN 50549-1, EN 50549-2

测试标准：

安全标准

- IEC 62109-1
- EN 62109-1
- IEC 62109-2
- EN 62109-2
- UL 1741（美国）

并网标准

- 德国：VDE-AR-N 4105、BDEW、FGW TR3、FGW TR4、FGW TR8
- 澳大利亚：AS/NZS 4777.2
- 英国：G98、G99
- 意大利：CEI 0-21、CEI 0-16
- 法国：UTE C15-712、VDE 0126-1-1 VFR 2019
- 比利时：C10/11
- 西班牙：RD1699、RD 413、UNE 206006、UNE 206007-1、P012.2、P012.3、NTS
- 奥地利：TOR Erzeuger Typ A、Typ B、Typ C、Typ D
- 欧盟：EN 50549-1、EN 50549-2

- Southeast Asia: IEC 62116, IEC 61727
- USA: UL 1741 SA, IEEE 1547, IEEE 1547.1, Rule 21, HECO 14H
- Thailand: PEA, MEA
- Brazil: ABNT NBR 16149, ABNT NBR 16150

EMC standards

- Small-power PV inverter
  - EN 61000-6-1 (EN 61000-6-2)
  - EN 61000-6-3
- Large-power PV inverter
  - EN 61000-6-2
  - EN 61000-6-4

Efficiency standards

- EN 50530
- IEC 61683

Construction requirements:

Overvoltage category

III (Grid-side), II (PV side)

Altitude: below 2000m (clearance for use in altitude above 2000m shall be calculated with a correction factor)

- Indoor, conditioned
  - Ambient temperature range: 0°C to +40°C
  - Ingress protection: min. IP20
  - Pollution degree: min. PD2
  - UV exposure: not required
- Indoor, unconditioned
  - Ambient temperature range: -20°C to +50°C
  - Ingress protection: min. IP20
  - Pollution degree: min. PD3
- Outdoor
  - Ambient temperature range: -20°C to +50°C
  - Ingress protection: min. IP34
  - Pollution degree: min. PD3

Main test items:

Safety test

- Heating test
- Single-fault test
- Humidity test (48h)
- Backfeed voltage/current test
- Capacitor discharge test
- Electrical tests related to shock hazard
- IP test
- UV conditioning test

- 东南亚： IEC 62116、IEC 61727
- 美国： UL 1741 SA、IEEE 1547、IEEE 1547.1、Rule 21、HECO 14H
- 泰国： PEA、MEA
- 巴西： ABNT NBR 16149、ABNT NBR 16150

EMC标准

- 小功率逆变器
  - EN 61000-6-1（EN 61000-6-2）
  - EN 61000-6-3
- 大功率逆变器
  - EN 61000-6-2
  - EN 61000-6-4

能效标准

- EN 50530
- IEC 61683

关键结构要求：

过电压等级

III（电网侧）、II（PV 侧）

海拔：2000m 以内（超过2000m 电气间隙有特殊要求）

- 室内、有调节
  - 环境温度：0°C 到 +40°C
  - 防护等级：最低IP20
  - 污染等级：最低PD2
  - UV防护：无要求
- 室内、无调节
  - 环境温度：-20°C 到 +50°C
  - 防护等级：最低IP20
  - 污染等级：最低PD3
- 室外
  - 环境温度：-20°C 到 +50°C
  - 防护等级：最低IP34
  - 污染等级：最低PD3

主要测试项目：

安全相关测试

- 温升测试
- 单一故障测试
- 湿热测试（48小时）
- 反灌电压/电流测试
- 电容放电测试
- 防电击测试（耐压、泄漏、接地阻抗）
- IP测试
- UV老化测试



Environmental test
- Weather tests

Functional safety
- EN 62109-1 Annex B
- EN 60730-1 Annex H

Grid-connection tests
- Voltage monitoring test
- Frequency monitoring test
- DC current injection measurement test
- PV array ground insulation resistance measurement
- Array residual current detection test
- Anti-islanding test
- Harmonics measurement
- Power factor measurement
- Flicker and voltage fluctuation
- Active and reactive power regulation
- LVRT/HVRT

Efficiency tests
- European efficiency
- CEC efficiency
- Static MPPT efficiency
- Dynamic MPPT efficiency
- Conversion efficiency

Renewable Energy Storage Systems (RESS)

PPP 59034A mainly covers three aspects of requirements for household and small- and medium-sized energy storage systems: electrical safety of the system, compliance of grid connection and safety requirements of energy storage batteries.

Electrical safety requirements

Electrical safety requirements are set based on the IEC 62477-1 safety standard for electronic converter systems. For RESS with PV input, the requirements of structure and testing in the PV inverter standards IEC 62109-1 and IEC 62109-2 is apply to special failure testing, automatic break device, PV array earth impedance inspection and residual current detection.

环境测试
- 天气测试

功能安全
- EN 62109-1 附录 B
- EN 60730-1 附录 H

并网相关测试
- 电压监控测试
- 频率监控测试
- 直流注入测试
- PV 接地绝缘阻抗测量
- 漏电流监控测试
- 防孤岛测试
- 谐波测量
- 功率因数测量
- 电压闪烁和扰动
- 有功及无功控制
- 高/低电压穿越

能效测试
- 欧洲能效
- 加州能效
- 静态MPPT效率
- 动态MPPT效率
- 转换效率

储能系统

PPP 59034A主要涵盖了家用和中小型储能系统电气安全、并网符合性和储能电池的安全三个方面的要求。

电气安全要求

电气安全要求以功率电子转换设备的安全标准IEC 62477-1为基础。带有光伏输入的RESS可参考光伏逆变器标准IEC 62109-1和IEC 62109-2中对于特殊故障测试，以及自动断路装置、光伏阵列对地阻抗检测、残余电流检测等的相关结构和测试要求。



Requirements on synchronsation compliance
For grid-interaction type RESS, tests are performed in accordance with synchronsation requirements of the manufacturer's target countries or of the IEC. For off-grid RESS, it is not required to consider the requirements on grid code compliance but required to comply with IEC 62109-2 in terms of requirements on output waveforms.

并网符合性要求
对于并网型RESS，可依据厂家目的国或者IEC的并网要求进行测试。对于离网型RESS，不需要考虑并网符合性要求，但需要满足IEC 62109-2 对于输出波形的要求。

Safety requirements on energy storage batteries
For Li-ion batteries which are applied most widely in energy storage, refer to the safety standard for industrial secondary Li-ion batteries IEC 62619. In consideration of the vital role played by the performance of battery in keeping stability of energy storage system, TÜV SÜD suggests that the Li-ion batteries for energy storage shall comply with performance standard of industrial secondary Li-ion batteries IEC 62620.

储能电池的安全要求
对于在储能中应用最广泛的锂离子电池，工业用二次锂电池的安全标准IEC 62619将对其适用。考虑到电池性能在保持储能系统稳定性方面所起的关键作用，TÜV南德意志集团建议储能用锂离子电池应符合工业用二次锂电池的性能标准IEC 62620。

Besides the above reference standards, PPP 59034A:2014 has also widely referred to relevant standard drafts and various technical literature on RESS technical requirements of Germany, Australia, Italy and other countries, such as German energy storage system regulation draft standards VDE-AR-E 2510-2 and VDE-AR-E 2510-50. On the basis of the prediction of the trend of technical development, guide RESS enterprises in forward-looking product development.

除以上参考标准，PPP 59034A:2014还广泛参考了德国、澳洲、意大利等国家相关标准草案和各种技术文献中对于RESS的技术要求，例如德国储能系统法规草案VDE-AR-E 2510-2和VDE-AR-E 2510-50。通过对技术发展趋势的预测，应引导RESS企业面向前瞻性产品开发。

Large-scale energy storage system

With respect to household energy storage system, TÜV SÜD has formulated certification scheme of large-scale container-type energy storage systems, covering various requirements for electric installation, battery safety, function safety, environment compliance, and lighting and ventilation of energy storage systems. Certification procedures include document review, structure inspection and acceptance testing.

大型储能系统

相对于家用储能系统，TÜV南德意志集团定制了大型集装箱式的储能系统认证方案。覆盖储能系统的电气安装、电池安全、功能安全、环境符合性以及照明通风的多项要求。认证流程包括文件审核、结构检查和验收测试。

Grid-connected PV inverter quality control service

Guideline

TÜV SÜD PPP is the test program of "Product Quality" for grid-connected PV inverter.

Service process
Work process 1: factory inspection
Work process 2: during-production audits
Work process 3: sample testing in laboratory
Work process 4: pre-shipment inspection
Work process 5: installation supervision
Work process 6: arrival inspection
Work process 7: final inspection after installation

光伏并网逆变器全程产品质量控制服务

规范

TÜV南德意志集团并网逆变器产品质量管控测试程序。

服务流程
工作流程1：工厂检查
工作流程2：生产过程监造
工作流程3：实验室抽样测试
工作流程4：发货前检查
工作流程5：监督安装
工作流程6：到货检查
工作流程7：安装后终检

PV combiner box

Safety standards

- IEC 62109-1
- EN 62109-1
- IEC 61439-1
- EN 61439-1
- IEC 61439-2
- EN 61439-2
- IEC 60670-1
- IEC 60670-22

General construction requirements

- Class II
- Overvoltage category III
- Outdoor and indoor use
- IP 65 enclosure
- UV/salt mist resistant
- Non-condensing

Critical test items

- Heating test
- Humidity test (48h)
- IP test
- UV conditioning test
- Salt mist test
- Impulse voltage test
- Dielectric strength test

光伏汇流箱

安全标准

- IEC 62109-1
- EN 62109-1
- IEC 61439-1
- EN 61439-1
- IEC 61439-2
- EN 61439-2
- IEC 60670-1
- IEC 60670-22

通用结构要求

- 二类产品
- 过电压等级III
- 户内外使用
- IP 65防护外壳
- 防紫外防盐雾
- 防冷凝

关键测试项

- 温升测试
- 湿热测试（48小时）
- IP测试
- 紫外线辐照测试
- 盐雾测试
- 脉冲电压测试
- 耐压测试



Why choose TÜV SÜD?

As one of the world's most respected technical service providers, TÜV SÜD has over 150 years of experience, and headquartered in Munich, Germany. We are recognised as expert in certificating quality and safety in line with EU and national regulations and codes in the whole Asian-Pacific region. Choosing us as your partner allow you to increase asset value.

- **Client-oriented strategies** - TÜV SÜD provides closed support since testing plan stage. We offer project schedule and monthly reports regularly. Our experts conduct certification of factory based on the professional insights on certification requirements.
- **Gain a competitive edge** - with the TÜV SÜD Product Mark, a universally recognised symbol of trust.
- **Impartiality and independence** - TÜV SÜD is widely known as a third-party solutions provider with a reputation for independence and impartiality.
- **Qualification and certification** - TÜV SÜD covers a series of qualification recognitions such as Micro-generation Certification Scheme (MCS) and bilateral agreement in key areas (CQC in China and JET in Japan).
- **Gain widely acceptance** - ensure gain widely acceptance based on our professional reputation of testing and certification. Up to now, we have issued more than 570,000 product certifications and management system certifications.
- **Enjoy global support** - through TÜV SÜD's strong presence and high level of knowledge in global markets.
- **Full transparency** - Our experts response timely during tests and certifications， and update project scheme report regularly.

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TÜV南德意志集团总部位于德国慕尼黑，有着150多年的历史，是全球领先的技术服务提供商之一。在整个亚太地区，我们是依照欧洲和国际法规为光伏行业进行质量和安全认证的公认专家。选择TÜV南德意志集团作为您的合作伙伴，将为您的业务带来真正的增值。

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- **全程透明** —— 在整个测试和认证过程中及时响应，定期更新项目进度报告。

Greater China

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TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Through more than 25,000 employees across over 1,000 locations, it adds value to its customers, inspiring trust in a physical and digital world.

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