

TÜVNORD

PV Power Plant 光伏电站

TÜV NORD Renewable Energy
TÜV NORD 可再生能源



Company Profile

公司介绍



With over 150 branches in more than 70 countries of Europe, Asia, America and Africa, TÜV NORD is actively devoted to its national and international customers. The core services of TÜV NORD GROUP mainly include testing, inspection, certification, which covers a wide area of expertise in industry, energy, railway, mobility, environmental protection, IT, natural resources and aerospace, etc. As a world-leading technical provider, TÜV NORD dedicates itself to offering manufactures, installers, suppliers and investors a comprehensive range of testing and certification services covering assessing safety, performance and quality of PV products and PV system in the field of solar energy.

TÜV NORD 在全球 70 多个国家设有超过 150 家分支机构，这些分支机构遍布欧洲、亚洲、非洲和美洲。TÜV NORD GROUP 核心服务主要体现在测试、检验、认证、教育及工程，涉及行业包含：工业、能源、铁路、车辆、环境保护、IT、自然资源、航空航天等。作为全球领先技术服务专家，TÜV NORD 在太阳能领域致力于为制造商、安装商、服务供应商及投资商提供从太阳能光伏组件、零部件到光伏发电系统整个产品供应链的全方位测试和认证服务。

TÜV NORD offers professional technical services related with PV power plants, including entire-process technical solution and risk management, international owner engineer and independent engineer, etc. Besides, TÜV NORD develops a series of innovative technology in PV detection, such as M.A.P. photovoltaic digital inspection and analysis technology, which facilitates the diagnosis of inefficient components in PV power plant by means of big data analysis and AI algorithm to realize a greater investment return. By the end of April 2023, TÜV NORD had completed 80GW performance evaluation of PV product and PV system worldwide.

TÜV NORD 为光伏电站提供专业的技术服务，包括全过程技术服务及风险管控，国际业主工程师，国际独立工程师等。此外，TÜV NORD 还在光伏电站检测领域开发了一系列创新技术，如 M.A.P. 光伏数字化检测与分析技术，利用大数据分析 with AI 算法对电站低效能部件进行诊断，使光伏资产实现价值回归。截止到 2023 年 4 月，TÜV NORD 在全球累计完成 80GW 的全球光伏产品及光伏系统评估量。

PV Power Plant

光伏电站业务



World-leading Quality Assessment Service for PV Power Plant

世界领先的光伏电站质量评估服务

TÜV NORD Greater China is affiliated with TÜV NORD GROUP, which is an authoritative third party accredited by DAkkS. We have accumulated wide project experience in the area of PV power plant assessment. TÜV NORD provides operators and investors with a chain of quality assessment and certification service covering the whole lifetime of PV power plant. Including project feasibility research, design, purchase, construction, grid-connection, operation & maintenance, selling. Among these stages, TÜV NORD not only offers professional technical service but also assists investors with project financing. We issue a certificate to a qualified PV power plant in compliance with relevant standards.

TÜV 北德大中华区隶属于 TÜV NORD GROUP, 是德国认可委员会认可的权威第三方检测认证机构。我们在光伏电站质量评估领域积累了丰富的项目经验。我们为光伏电站运营方和投资方提供的电站质量认证服务贯穿电站整个生命周期：包括项目的可行性研究、设计、采购、施工、并网、运营维护、出售。在各个环节中，TÜV NORD 既提供专业的技术服务，同时也助力项目融资。我们对评估后符合相关标准的电站颁发证书。

- To minimize the risk of investment cycle and optimize the energy yield with the strong support from TÜV NORD.

TÜV NORD 帮助您降低整个电站投资周期内的风险，提高您的发电收益。

- To improve the specialized knowledge and skills of the staff on site by professional training.

通过专业化的培训，提高电站现场工作人员的专业知识技能。

- To assist the owner with setting up or revising the internal standards of enterprise and ensure the quality of equipment purchasing and construction.

帮助业主建立和修改企业内部标准，确保设备采购和施工安装的质量。

- To create customized checklists regarding detailed inspection of PV plants and minimize the risk affecting safety and benefits according to different projects.

根据不同项目情况，TÜV NORD 建立定制化的检查清单，对光伏电站进行详细检查，将影响安全和收益的风险最小化。

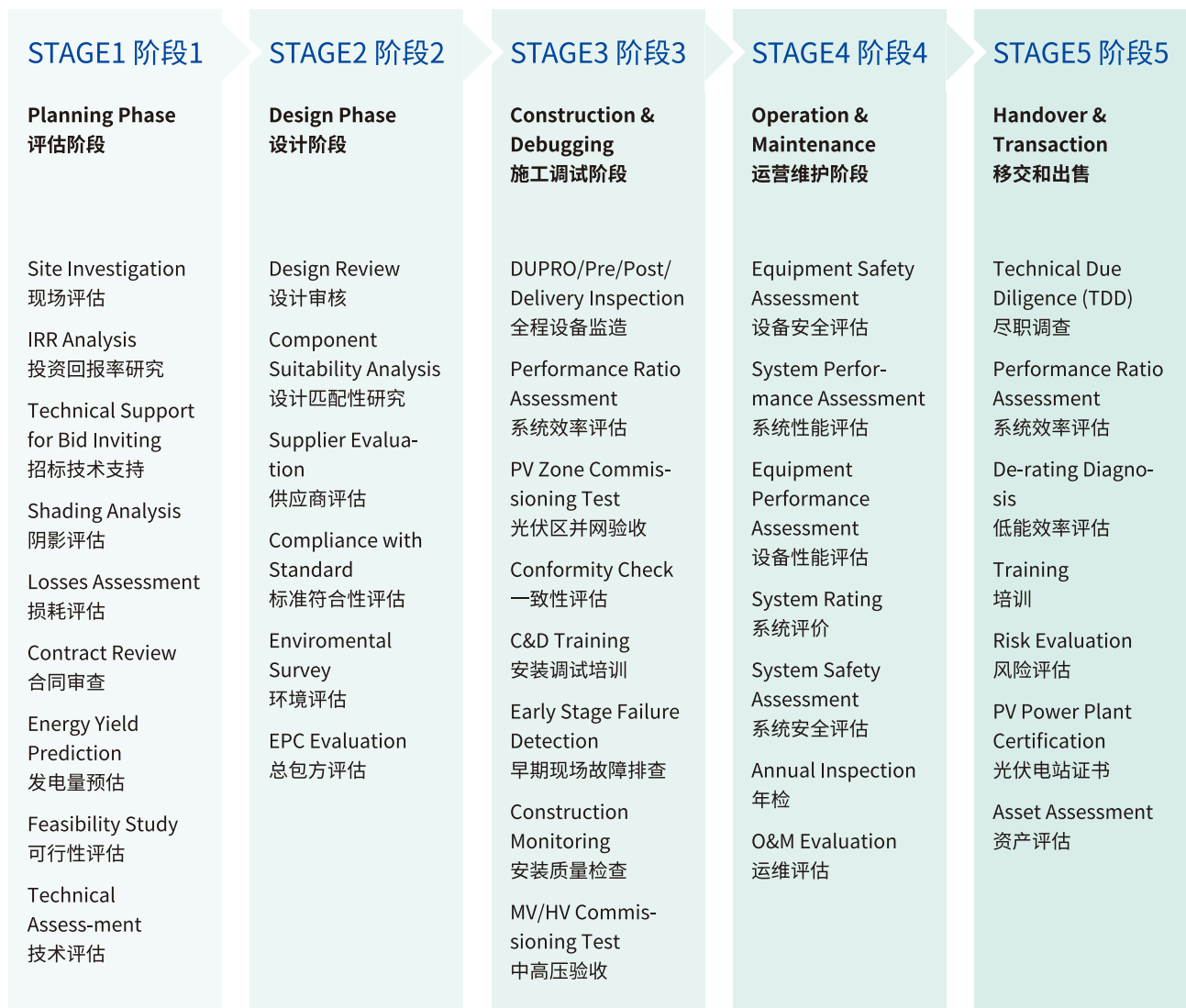


Dakks and CNAS accreditation makes TÜV NORD certificates have the highest level of recognition and influence in the global PV market.

Dakks 与 CNAS 认可加持使得 TÜV NORD 证书在国内外光伏领域具备了高等级的识别度与影响力。

Entire Process Technical Solution and Risk Management

全过程技术服务及风险管控



Technical Due Diligence

技术尽职调查



Based on rich evaluation experience in solar projects, TÜV NORD provides an integrated technical due diligence service for PV plants at hand-over acceptance or trading stage.

TÜV NORD 基于丰富的项目评估经验，针对验收及交易中的光伏电站提供完整的技术尽职调查方案。

- Compliance risks
合规性风险
- Equipment related risks
设备相关风险
- O&M risks
运营风险
- Construction quality
施工质量
- System performance
发电性能

Find out potential risks from the technical documents of various stages of PV project.

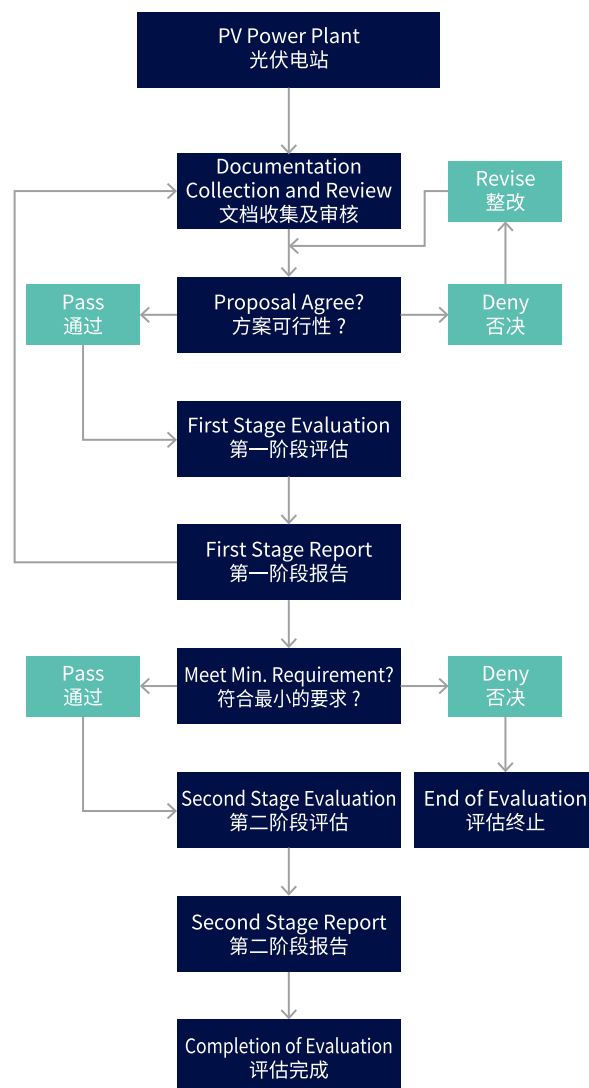
从光伏电站各个环节的技术资料中发现潜在风险。

Conduct the interviews with the person in charge of key aspects such as development, construction, operation and maintenance.

针对电站开发、建设及运维等关键环节负责人的面谈交流。

Check out quality defects through detailed on-site inspection and testing.

通过现场的详细检查测试排查各种质量缺陷。



Technical Advisory 技术顾问服务



For a long time, TÜV NORD has been active in the PV plant transaction market with the role of professional technical adviser. Provide a series of technical assessment services for financial institutions, insurance companies, power plant owners, investors and securities companies.

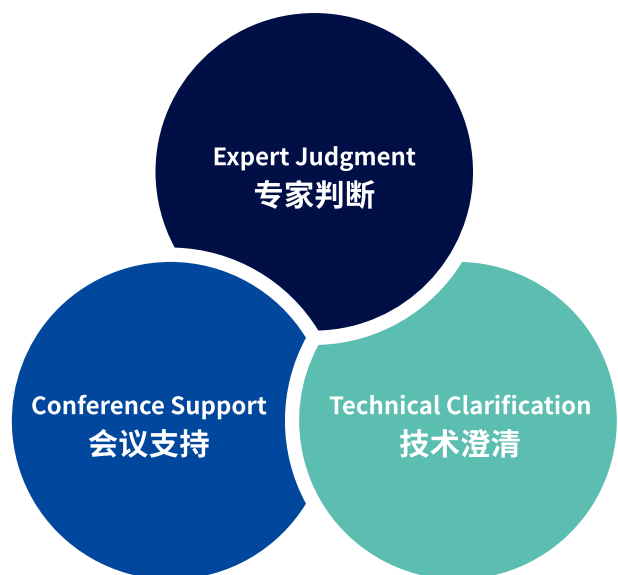
TÜV NORD 长期以第三方专业技术顾问的角色活跃在光伏电站资产交易市场上。为金融机构、保险公司、电站业主、投资者、证券公司等提供一系列技术评估服务。

In addition, at the aim of activating assets, TÜV NORD combines finance and guarantee corporation to issue long-term corporate bonds for listed companies. As technical advisory, TÜV NORD provides quality and risk endorsement which makes a strong guarantee for financial institutions.

另外,为帮助企业盘活旗下资产,TÜV NORD 可协助金融和担保公司为上市企业发行长期企业债券。TÜV NORD 以第三方技术顾问的角色为抵押的光伏电站资产进行质量与风险背书,为金融机构的资金安全提供强有力的保障。

For large equity investment and portfolio acquisition, TÜV NORD provides reliable performance evaluation of PV power plants and identify technical risks, qualitative and quantitative analysis for investors in a limited decision time.

针对大型的股权投资以及资产包并购项目,TÜV NORD 为投资者在有限的决策时间内做出可靠的电站性能评估,以及技术风险的识别、定性和定量分析。



International Independent Engineer

国际独立工程师



Act as a representative of lender, financier or owner, to provide an independent technical assessment of PV project including both engineering and financing. In addition to regular technical review and risks analysis, TÜV NORD will evaluate the technical assumptions to the financial model used by the stakeholder.

作为贷方，金融机构或业主的代表工程师，提供光伏项目中的独立技术评估服务，同时包含技术工程与融资方面。除了定期的技术审查和风险分析以外，TÜV NORD 还为利益相关方评估财务模型中的技术假设。

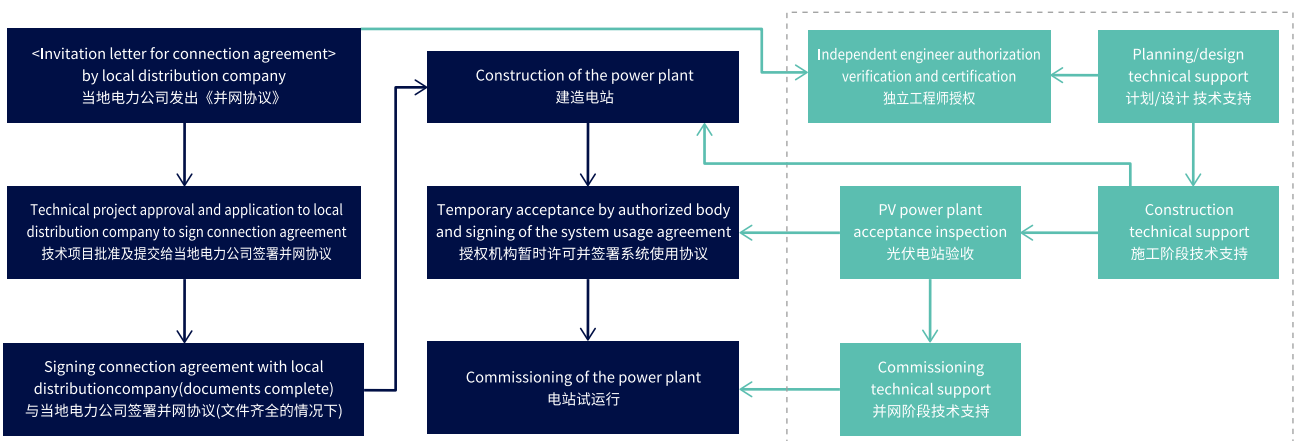
During the implementation of the project, TÜV NORD provides quality management of whole process, including the confirmation of technical indicators of supply chain, acceptance and certification of milestones, and ensure the construction schedule and performance requirements.

在项目执行过程中，TÜV NORD 提供全过程的质量管控，包括确认供应链的技术指标、关键节点的验收及证书发放、以及保障项目的建设进度和性能要求。

TÜV NORD has been qualified by some countries on grid-connection acceptance of local PV power plant. For example, TÜV NORD is the first to be accredited by BDEW of Germany and get grid-connection permission from Pakistan official bodies.

我们已经得到一些国家的并网验收认可，比如率先获得德国中压入网和巴基斯坦并网许可。

- Top-class Professional Technique Service
一流专业的技术服务
- Technical Support from International Team
国际化团队的支持
- Quicken Grid-connection
并网等待时间缩短
- Rapid Response of Local Agency/Institution
快速响应的本地窗口
- None Communication Obstacle
无语言沟通障碍



International Owner Engineer

国际业主工程师



As an Owner Engineer (“OE”), on behalf of the owner, TÜV NORD will support the client on the project management and engineering assessment services to facilitate successful commercial operation of the Project. The OE will provide technical input in relation to any project commercial agreements, documents and services, to protect the owner's interest by overseeing the technical and commercial due diligence aspects of the works throughout the project life. The service scope is summarized as follows:

作为业主工程师 (“OE”), TÜV NORD 代表电站投资者及业主, 将支持客户进行项目管理和工程评估服务, 以促进项目的成功商业运营。OE 也将提供与任何项目商业协议、文档和服务相关的技术投入, 以在整个项目周期中监督工程的技术和商业尽职调查等方面, 以保护所有者的利益。服务范围如图:

Project Management 项目管理	Construction Monitoring 施工监控
Technical Assessment on Tendering 招标技术评估	Final Acceptance Test 最终验收测试
Design and Engineering Management 设计与工程管理	<ul style="list-style-type: none"> • Mechanical completion certificate 机械完工证书 • Commissioning test certificate 试运行测试证书 • Reliability run test certificate 可靠性运行测试证书 • Performance certificate 系统效率证书
<ul style="list-style-type: none"> • Design review 设计审查 • Energy yield simulation 发电量模拟 • Technical assumptions on financial model 财务模型中的技术假设 	HSE 健康, 安全与环境
Supply Chain Quality Management 供应链质量管理	
<ul style="list-style-type: none"> • DUPRO inspection 设备监造检查 • Factory acceptance test witnessing 工厂验收测试见证 • PV module testing at third party laboratory 第三方实验室的光伏组件测试 • Post-shipment inspection 到货检验 	

International Case Study

国际项目案例

Britain
英国

Technical Due diligence
技术尽调

Netherlands
荷兰

45M drone infrared
inspection service
45M 无人机红外检测服务

Germany
德国

Modules EL inspection
service
组件 EL 检测服务

Belarus
白俄罗斯

130MW Independent
Engineer Service
130MW 独立工程师服务

Azerbaijan
阿塞拜疆

312MW modules technical
supervision service
312MW 组件技术监督服务

Italy
意大利

Overseas outdoor perform-
ance evaluation service
海外实证服务

Kuwait
科威特

50MW Independent
Engineer Service
50MW 独立工程师服务

Cuba
古巴

62MW Owner
Engineer Service
62MW 业主工程师
服务

Brazil
巴西

80MW On-site inspection
Service
80MW 现场检测服务
450MW Technical Due
Diligence
450MW 技术尽职调查服务

Namibia
纳米比亚

12MW Owner Engineer
Service
12MW 业主工程师服务

The United Arab Emirates
阿联酋

15MW modules technical
supervision service
15MW 组件技术监督服务
Transformer technical
supervision service
变压器技术监督服务

Malaysia
马来西亚

Overseas outdoor perform-
ance evaluation service
海外实证服务

Australia
澳大利亚

120MW Independent
Engineer Service
120MW 独立工程师服务

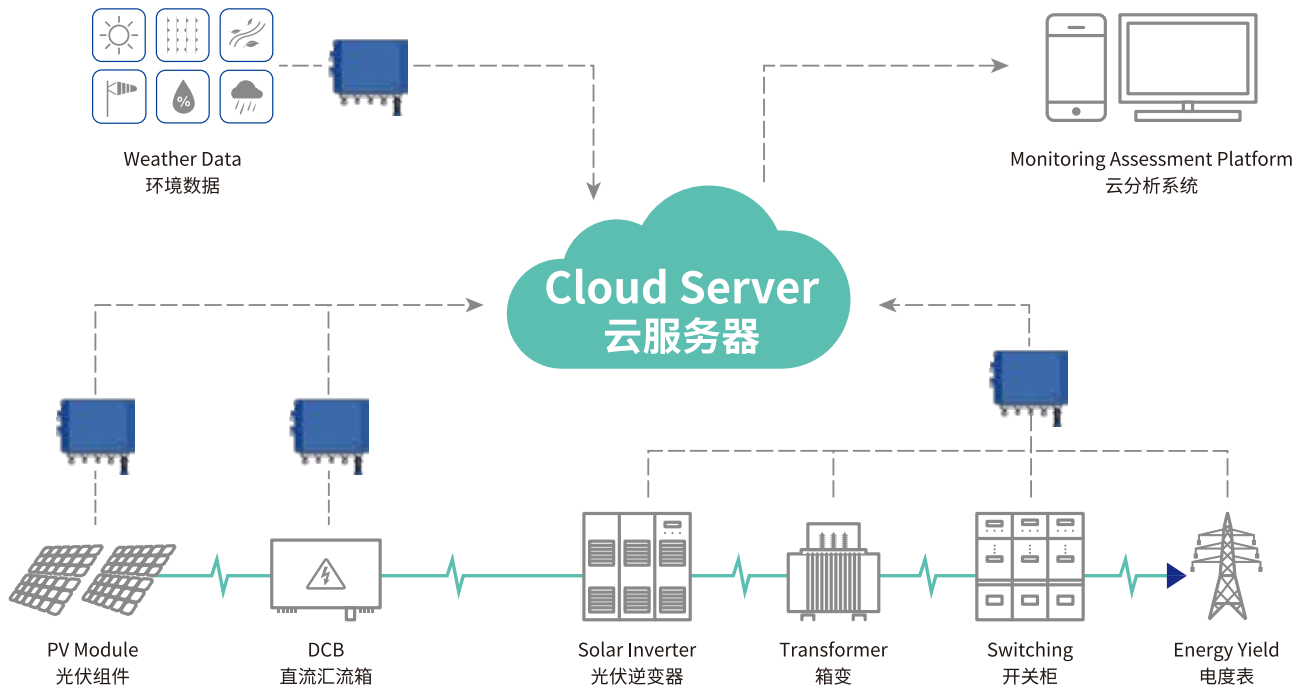
International Case Study

国际项目案例



M.A.P. Digital Inspection Solution

M.A.P. 数字化检测解决方案



M.A.P. System (power plant), which is developed independently by TÜV NORD. It can evaluate the performance of PV modules, electrical equipment, arrays and plants by online continuous monitoring. A series of metrics are used to characterize the real status of power plants. Combined with TÜV NORD's asset evaluation service, a high-fit regression model of future income can be established, to achieve two-dimensional objective plants' evaluation of technology and finance (rating from D to A+). TÜV NORD will endorse the results of digital inspection and issue a test report. By now, M.A.P. has evaluated hundreds of PV systems (power plants) around the world.

M.A.P. 是 TÜV NORD 自主研发的用于光伏系统(电站)自动化检测的评估系统。其通过在线持续监测的方式,实现对光伏组件、电气设备、方阵与电站的性能评估。该系列指标用于表征电站的真实状态,结合 TÜV NORD 的资产评估服务,可建立高拟合度的未来收益回归模型,实现技术与金融双维度的电站客观评价(评价等级从 D 至 A+)。TÜV NORD 将为数字化检测结果背书并出具检测报告。迄今, M.A.P. 已为全球数百个光伏系统(电站)进行了性能评估。

Item 评估项

- Module performance online monitoring
组件在线性能检测
- String performance online monitoring
组串在线性能检测
- Plant performance ratio evaluation
电站系统效率评估
- DC combiner box data quality evaluation
直流汇流箱数据质量评估
- Inverter data quality evaluation
逆变器数据质量评估
- Weather data acquisition
气象数据采集
- PV assets evaluation and rating
光伏资产评估评级

M.A.P. AI Algorithm Example

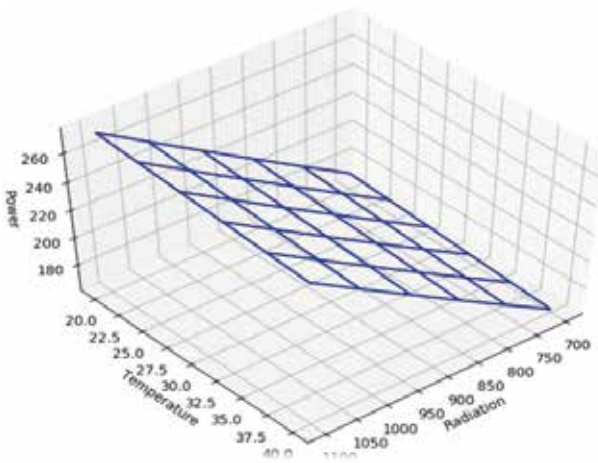
M.A.P. 人工智能算法案例

Relying on high-precise data of M.A.P. sensors and adopting multiple advanced data analysis approaches, AI algorithm can locate the low efficient component by big data processing, and supply related solutions for owner.

依托 M.A.P. 传感器传递的高精度高密度数据，采用多种先进的数据分析方法，实现对电站运营过程中的大数据分析，检索出电站低效能部件并给出解决方案。

Module's Performance Characteristic Modeling

组件性能特性模型

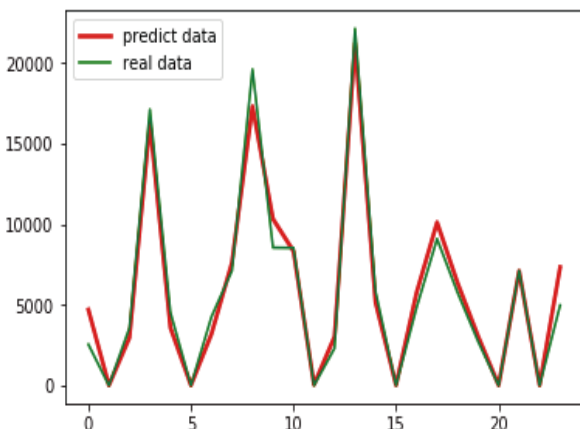


Through the AI algorithm combined with big data, it can realize the online analysis on low efficiency PV module localization, degradation under operation condition, deviation rate by modeling and make the optimization strategy. This test can greatly increase power generating and bring significant economic benefits.

通过大数据分析结合智能算法运算，对不同组件工作状态建模，实现低效组件定位、组件运行工况衰减率与离群率在线分析，并制定优化策略。该测试可大幅提升组串的发电能力，产生显著的经济效益。

Key Metrics Prediction

关键指标预测



By constructing the relationship equation between different variables, using machine learning methods to continuously iterate a large amount of measured data, an optimal solution can be fitted to the regression curve, some key metrics, such as power generation can be predicted.

通过构建不同变量之间的关系方程与运用机器学习的方法对大量实测数据的不断迭代，可寻求最优解拟合回归曲线，实现对光伏系统关键指标，诸如发电量的预测。

Certification 认证

01 | PV System Quality Certification 光伏系统质量认证

IEC 62446 is the basic requirements of documentation, inspection and commissioning of PV grid connected system. TÜV NORD through detailed document review and on-site inspection, certifies the PV system which meets the standard requirements.

IEC 62446 是光伏并网系统的最基础质量要求。TÜV NORD 通过详细的文档审核以及现场检查，为满足标准要求的光伏系统颁发认证证书。

Document Review 文档审核

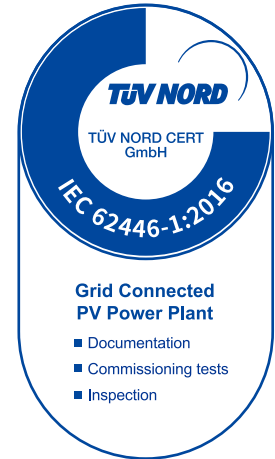
- Minimum requirements
最低要求

On-site Inspection 现场检查

- AC system
交流系统
- DC system
直流系统

Certification 认证

- Compliance with standard
符合标准



02 | K Series Certification K 系列认证

K series certification is the grade certification of PV power plant quality. TÜV NORD subdivides the certification into three levels with different categories of tests, sample rate and coverage.

K 系列认证是对光伏电站质量的等级认证。通过不同类别的测试、样本数量与覆盖范围，TÜV NORD 将该认证细分为三个等级。

K-1 certificate is the highest level, to represent the system qualified by full-scope and strict quality assessment.

K-1 认证为优秀质量等级，代表系统通过全方面、严格的质量考核及检查。

K-2 certificate is the medium level, to represent the system qualified by routine technical testing and inspection.

K-2 认证为中等质量等级，代表系统通过常规性的技术检测。

K-3 certificate is the basic level, to represent the system qualified by basic safety and performance testing.

K-3 认证为基础质量等级，代表系统通过最基础的安规和性能检测。

Certification 认证

03 |

PV Systems Operation and Maintenance (O&M) Certification 光伏系统运维认证

TÜV NORD is one of the first batch of third-party organizations to carry out photovoltaic O&M certification in China. By now, a number of domestic and foreign enterprises have passed the TÜV NORD O&M Certification requirements. These enterprises have improved their core competitiveness and are active in O&M and capital markets.

TÜV NORD 是国内首批开展光伏运维认证的知名第三方机构。迄今，境内外多家运维企业已通过 TÜV NORD 运维认证，这些企业具备了核心竞争力并活跃于运维与资本市场。

What is PV Systems O&M Certification 什么是光伏系统运维认证

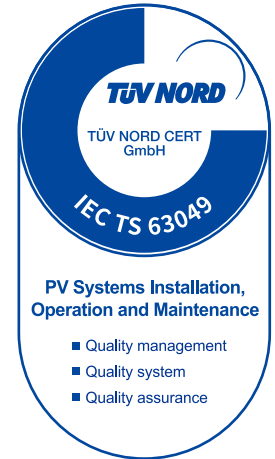
The object of O&M certification is an enterprise which is engaged in photovoltaic operation and maintenance activities. The certification aims at setting the entry threshold for the O&M market so as to ensure the healthy and orderly development to the photovoltaic market. Based on the assessment of O&M system and implementation quality of PV power plant, the evaluation and rating of O&M capability will be achieved. The certificate will be issued for a qualified enterprise.

光伏系统运维认证是面向从事光伏运维活动的企业。该认证旨在为光伏运维市场设立准入门槛，从而保障光伏市场健康有序地发展。该认证通过对运维体系与电站运维质量的评估，实现对企业运维能力的评定与评级，并颁发认证证书。

Why do the O&M Certification 为什么要做运维认证

- Market orientation (the demand from the owners, invertors, finance and insurance)
市场导向 (电站持有方、投资方、金融与保险方需求)
- Industry system and normative constraints
行业制度与规范约束
- The value evaluation and industry positioning of O&M enterprises
运维企业价值评价与行业定位
- Market recognition
市场认知度与认可度
- Leading brand
领先品牌

Certification Process 认证流程



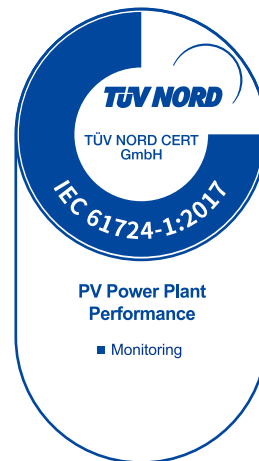
04 | PV Monitoring System Certification 光伏监控系统认证

What is PV Monitoring System Certification 什么是光伏监控系统认证

The PV monitoring system certification follows the IEC 61724-1 standard. It is a comprehensive evaluation of the sensors, sampling and storage units and data quality in the PV power plant. The ratings are Class A, Class B and Class C in descending order. Certificate will be issued to the monitoring system which meet the certification requirements.

光伏监控系统认证遵循 IEC 61724-1 标准, 是对光伏电站内传感器、采集存储单元与数据质量的综合评价。评定等级由高至低依次为 Class A, Class B, Class C。TÜV NORD 将为符合认证要求的监控系统颁发等级证书。

Certification Process 认证流程



05 | PV System Design Certification 光伏系统设计认证

The PV system design certification follows the IEC 62548 / IEC 62738 standard. It is a comprehensive evaluation of PV components, system design, safety, system acceptance and O&M in the PV power plant. The certification is conducive to the realization of the type design and application of PV system. Certificate will be issued to the PV systems which meet the certification requirements.

光伏系统设计认证遵循 IEC 62548 / IEC 62738, 是对电站内的光伏部件、系统设计、安全性能、系统验收与运行维护的多方面的综合评估, 该认证有助于实现光伏系统的型式化设计与应用。TÜV NORD 将为符合认证要求的光伏系统颁发证书。

Application 申请	Apply for certificate 提出申请	Submit relevant documents as requirements 按要求提交相关资料
Audit 审核	Document review 文件审核	On-site audit 现场审核
Correction & Certificate 整改与证书	Non-conformity correction 不符合项整改	Report and certificate 报告与证书
Validity 时效	Annual audit 年度审核	The certificate is valid for 3 years 证书有效期三年
Re-audit 重新审核	The certificate will be reaudited if the certificate expires 若证书到期需要重新审核	



80 GW

全球光伏产品及光伏系统评估量
Worldwide PV Product and PV System Performance Evaluation

30+

全球市场准入
Global Market Access

150+

全球分支
Global Branches

280+

全球覆盖区域
Global Regions

400+

年度工厂检查
Annual Factory Audit

800+

并网认证
Grid-connection

5000+

项目总数
Project Amounts

4000+

证书签发
Certificates

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