P267-ILF-CHN-OD-0017/REV.1

Symbior Solar
Symbior 太阳能

Bidding Document for Procurement of Plant Design, Supply and Installation
电站设计、采购与施工工程总承包招标文件

PROCUREMENT DOCUMENTS PART 2
采购文件第 2 部分

OWNERS REQUIREMENTS
发包人要求

23/03/2018
2018 年 3 月 23 日

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REVISION
修订

1	23.03.2018	Adjusted according to Client's request	M.Fu J.Da	F.Zi	F.Zi
0	23.01.2018 2018 年 1 月 23 日	First Issue 第一版	J.Da M.Fu S.Da	M.Lo	F.Zi
Rev. 修订	Date 日期	Issue, Modification 发布、修改	Prepared 起草人	Checked 审核人	Approved 批准人

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ABBREVIATIONS
缩写

°C	Degrees Centigrade 摄氏度
A	Amp 安培
AC	Alternating Current 交流电
BIL	Basic Insulation Level 基本绝缘标准
CB	Circuit Breaker 断路器
CE	Conformité Européenne 欧洲合格评定
DC	Direct Current 直流电
ECT	Equivalent cell temperature 等效电池温度
ES	Earthing Switch 接地开关
FAT	Factory Acceptance Test 电站验收测试
HV	High Voltage 高压
IP	Internal Protection Rating 防护等级
ISC	Short-Circuit Current 短路电流
LBS	Load Break Switch 负载断连开关
LPS	Lightning Protection System 防雷系统
LV	Low Voltage 低压

MPP	Maximum Power Point 最大功率点
MDB	Main Distribution Board 主配电板
PID	Potential Induced Degradation 电势诱导衰退
PV	Photovoltaic 光伏
PCMS	Plant Control and Monitoring System 电站控制和监控系统
STC	Standard Test Conditions 标准测试条件
SAT	Site Acceptance Test 现场验收测试
THD	Total Harmonics Distortion 总谐波失真
TBD	To Be Discussed 待定
UPS	Uninterruptable Power Supply 不间断电源

SCOPE OF SUPPLY OF PLANT AND INSTALLATION SERVICES BY THE EPC CONTRACTOR
工程总承包承包人提供设备和安装服务的范围

1 GENERAL CHARACTERISTIC OF THE PROJECT
项目总体特点

1.1 Introduction
简介

The Contractor shall be responsible to provide full EPC Turn-Key Services. Moreover, the selected Contractor will also be responsible for the operation and maintenance of the PV power plant for at least 24 months after commissioning, during the Defect Liability Period (DLP).承包人应负责提供完整的 EPC 交钥匙服务。此外，承包人在试运行后的缺陷责任期（DLP）内应负责不少于 24 个月的电站运行和维护。

The Contractor shall design the project with the aim of maximizing the yield of the plant while keeping in mind the relevant design criteria of the respective utility.
承包人对项目的设计旨在最大限度地提高电站发电量，并牢记电站的相关设计标准。

1.2 Confidentiality
保密性

Information relating to the tender is treated as confidential during and after the tender period.
投标相关资料在投标期之后将视为保密。

1.3 PV Power Plant Overview
光伏电站概述

The particular requirements are given in APPENDIX 8.1:General.

光伏电站概述 (附件 8.1)

1.4 Site Location Information
现场位置信息

The information on the site location is provided in APPENDIX 8.3: Site Location Information
现场位置信息.（附件 8.3）

1.4.1 Site Location
现场位置

The information on the site location is provided in APPENDIX 8.4: Site Location
现场位置 （附件 8.4）

1.4.2 Site Conditions
现场条件

The information on the site conditions is provided in APPENDIX 8.5: Site Conditions
现场条件. （附件 8.5）

1.4.3 Weather and Climate Data
天气和气候资料

The weather and climate data is provided in APPENDIX 8.6: Weather and Climate Data
天气和气候资料. （附件 8.6）

1.4.4 Point of Connection
连接点

The information on the point of connection is provided in APPENDIX 8.7: Point of Connection
连接点 （附件 8.7）

The Contractor shall supply all equipment required for the connection of the PV power plant.
承包人应提供连接光伏电站所需的所有设备。

1.4.5 Additional important environmental conditions
其它重要环境条件

It shall be noted that different weather scenarios can take place at the project site. Among others, the Contractor shall seriously consider events of severe conditions in order to avoid any negative effect on the PV power plant or the personnel.
需指出的是：项目现场可能会出现其它天气情况。其中，承包人应认真考虑出现恶劣天气的情况，以免对光伏电站或工作人员造成不利影响。

2 SCOPE OF WORK
工作范围

2.1 Introduction
简介

The Contractor's scope of work shall include, but not be limited to all necessary engineering works, equipment, systems and services required to complete a fully functional, safe, reliable and easy maintainable PV power plant connected to the public grid.
承包人的工作范围应包括但不限于：完成连接公共电网的全功能、安全、可靠、易维护的光伏电站所必需的全部施工、设备、系统和服务。

The PV power plant shall be designed, manufactured, configured and installed in such a way that it will achieve high availability and reliability with minimum power generation costs. The configuration of the PV power plant shall be suitable for continuous operation at various conditions of the grid, and under the harsh operation and climatic conditions at the project site.
光伏电站的设计、制造、配置和安装应能够以最低发电成本实现高可用性和高可靠性。光伏电站的配置应适合在各类电网条件下以及工程现场的不利运行/气候条件下连续运行。

Any work not explicitly specified but necessary to complete the PV power plant in every respect, shall be provided by the Contractor. Proper Operation and maintenance during the lifecycle of all equipment supplied, shall be provided by the Contractor.but is subject to a separate O&M contract to be agreed upon.
承包人应负责提供文件未明确规定但必须完成的光伏电站建设工作，按另行签订的运维合同提供所交付内容生命周期内的正常运维工作。

The minimum contractual scope and extent are defined by the tender. The basic design and operation concept described shall be adhered to by the Contractor. It is the Contractor's responsibility to create and complete all necessary documents and drawings related to detailed engineering, the execution design, equipment and components procurement, installation and commissioning in order to achieve the specified performance and the technical requirements of the PV power plant. In case the Contractor identifies any changes necessary to improve specified design and performance of the PV power plant, the Contractor shall submit such proposal, proven to be satisfactory by previous experience for Owner approval prior to any execution.
标书给出了最小合同范围和工作内容。承包人应遵守所述的基本设计和运行概念。承包人有责任创建并完成与详细施工、执行设计、设备和部件采购、安装和调试有关的所有必要文件和图纸，以达到光伏电站的规定性能和技术要求。如果承包人发现需要改进光伏电站的规定设计和性能，应向发包人提交此前项目经验证明成功的方案，获批后实施。

The materials used in the construction of the PV power plant shall be of superior quality and shall be compliant with all applicable national and/or international norms and standards and selected particularly to withstand prevailing environmental conditions. Workmanship and general finishing works shall be of the superior class.

光伏电站建设应使用优质材料，符合所有适用的国家和/或国际规范与标准，特别是能够承受一般环境条件。建设材料应具有高水准的工艺和后期加工。

The design lifetime of the PV power plant shall be 25 years.
光伏电站的设计寿命为 25 年。

The Contractor shall also adhere to the applicable design standards, manufacturer recommendations for the installation and commissioning as well as all relevant local rules and regulations including health & safety and social & environmental requirements.
承包人还应遵循适用的设计标准、制造商对安装调试的建议以及所有相关的地方规章制度，包括健康、安全和社会环境要求。

2.2 Provision of Equipment and Installation
提供设备和安装

The scope of work shall consist of but not be limited to the provision and installation of the following systems and facilities:
工作范围包括但不限于提供并安装以下系统和设施：

- PV modules along with the mounting structures
  光伏组件及安装结构
- PV Inverters (String inverters or Central inverters)
  光伏逆变器（组串逆变器或集中式逆变器）
- LV Equipment
  低压设备
- MV Equipment
  中压设备
- Cabling systems (DC, AC, LV and MV)
  布线系统（直流、交流、低压和中压）
- UPS system to avoid data loss, if applicable or required by utility
  UPS 系统（以避免数据流失，或按当地电力公司规定）
- Earthing and lightning system
  接地和防雷击系统
- PV power plant control (if required by local utility) and monitoring system
  光伏电站控制与监测系统 （按当地电力公司规定）
- Meteorological measurement stations
  气象站
- Saftey and Security System (walkway, safe line, safety pole, CCTV (IP), optional motion detectors, etc.)
  安全系统（通道、护栏、爬升保护、闭路电视(IP)、可选活动探测器等）

- Necessary buildings and housings
  必要的建筑物和遮盖物
- HVAC (for buildings and containers, if applicable)
  暖通空调系统（适用于建筑物和集装箱）
- Fire detection and protection (if required by GB standard)
  火灾探测和防护设备（如按 GB 标准必须配置）
- All necessary Engineering works
  所有必要的工程
- All required interfaces with existing structure, systems and facilities
  与现有结构、系统和设施的接口

2.3 Power Supply
供电

A power supply system designed to provide power to all users within the PV Power Plant shall be provided either during site execution and operation.
现场施工和运行期间，要为光伏电站的所有用户提供供电系统。

2.4 Services
服务

The following services shall be included
应包括以下服务：

- Verification of roof structure conditions
  验证屋顶结构条件
- Verification of roofing conditions
  验证屋面条件
- Verification of shading objects or prohibitive areas existing on roofs
  验证屋顶现有的遮阳物体或禁用区域
- Detailed Engineering (layout definition, cable loss calculation, structural calculations, bill of materials, etc.)
  详细施工（布局定义、电缆损耗计算、结构计算、材料清单等）
- Engineering Works (i.e. buildings if necessary)
  工程（如有必要，建筑物）
- Electrical Works
  电气工程

- Mechanical Works
  机械工程
- Plant communication system
  电站通信系统
- Testing and Commissioning
  测试和试运行
- CCTV (if required)
  闭路电视（如要求提供）
- Site security and surveillance during construction and operation time
  施工和运行期间的现场安全和监督

2.5 Additional Services
其它服务

The Contractor's scope of work and obligations shall further consist of, but shall not be limited to, the following items:
承包人的工作范围和义务还包括但不限于以下内容：

- Staffing, installation, testing and commissioning of the PV power plant
  光伏电站的工作人员、安装、测试和调试
- Performance of all specified and necessary inspections and tests
  执行指定和必要的全部检验和试验
- Participation in design, site and progress meetings
  参与设计、现场和进度会议
- Preparation and submission of work, time schedules showing the critical path
  准备和提交工作，进度计划要显示关键路径
- Preparation and submission of weekly progress reports including site photos
  准备和提交每周进度报告，包括现场照片
- Providing final As-Built drawings
  提供最终竣工图
- Training of staff during the plant commissioning and DLP period
  在电站试运行和缺陷责任期内对员工进行培训

The Contractor is solely responsible for the appropriate storage and security for all equipment, tools and accessories of the plant.
承包人全权负责对电站所有设备、工具和附件进行适当的保管和安全保卫工作。

2.6 Initial Design
初始设计

For the initial project phase and in order to agree on the layout of the intended PV power plant, a layout similar to the example of the PV power plant shown in APPENDIX 7: is expected. However, the Contractor shall consider the information provided in the appendices and drawings only as a guidance. The Contractor's design will not need to strictly match with the mentioned examples.
对于最初的项目阶段，为了就规划的光伏电站布局达成一致，预计会采用类似于图纸（附件 7）中所示的光伏电站布局。但是，承包人应只考虑附录和图纸中提供的信息作为指导。承包人的设计无需严格遵循上述例子。

The initial design proposal will be provided by the Contractor and approved by the Owner. After the approval of the initial design documents the Contractor shall start with the detailed engineering and the procurement of the components to be used in the solar PV power plant.
初始设计方案应由承包人提供并由发包人批准。初始设计文件获批之后，承包人应开始进行太阳能光伏发电站的详细设计和部件采购。

It is necessary that the offer contains a preliminary layout of the plant and a preliminary single line diagram (SLD) reflecting the topology and layout offered by the Bidder.
报价应包含电站的初始布局和反映投标人提供的总线结构和布局的初始单线图（SLD）。

3 GENERAL SPECIFICATIONS
一般规格

3.1 Good Engineering Practice (GEP)
良好工程实践（GEP）

Good Engineering Practice (GEP) shall be applied by the contractor through the project . All works, such as – but not limited to – planning, procurement, construction, testing and operation shall be carried out by the contractor with diligence, respecting and complying to industry, country and/or international standards as well as observing strict health, safety and environmental impacts.
承包人应在工程施工过程中实施良好工程实践（GEP）。所有的工程，包括但不限于规划、采购、施工、测试和运营，应由承包人勤勉尽责，遵守行业、国家和/或国际标准，并遵守严格的健康、安全和环境影响。

3.2 Quality Assurance and Control
质量保证和控制

The Contractor shall operate a quality assurance system according to ISO 9001 Standard. The Contractor is expected to inform the Owner in advance through an invitation to Witness all inspections which require the Owner's approval/ witness.
承包人应遵守 ISO 9001 质量保证体系。承包人应邀请并通知发包人见证所有需发包人批准/见证的检验。

3.3 Unit System
单位制

The international SI-system of measures and weights shall exclusively be used for documents, correspondence, drawings, instrument scales, on workstation, printouts, etc.
项目文件、信函、图纸、仪表秤、工作站打印输出等一律使用国际度量衡单位制体系。

3.4 Site Procedures
现场流程

3.4.1 Site Regulations
现场条例

The Contractor and its sub-contractors shall be subject to such rules and regulations for the conduct of the work at the site as the Owner may establish. The Contractor shall be responsible for the implementation of all HSE requirements which the Owner may have. Highest priority is the safety of the staff involved i.e. Owner's staff, third parties' representatives, engineers, foremen, workers, etc.
承包人及分包商应遵守发包人制定的现场工作规章制度。承包人应负责执行发包人提出的

所有健康、安全与环境（HSE）要求。应将工作人员（发包人工作人员、第三方代表、工程师、工头、工人等）的安全放在首要位置。

The Contractor shall be responsible for the coordination of his work with the Owner's staff and its representatives. Therefore the Contractor shall, at all times during the progress of the work, keep at his field office all documents and data relative to the work and equipment.
承包人负责与发包人工作人员及其代表协调工作。因此，承包人在工程进行过程中，应始终在现场办公室保存与工程和设备相关的全部文件和数据。

3.4.1.1 Additional Requirements
其它要求

The Contractor shall provide an adequate number of supervisors to ensure safe, proper and timely completion of the work. The Contractor shall also nominate one responsible person who should act as a single point of contact to the Owner or its representatives on all matters, pertaining to the contract and who will be available at site all through the working hours.
承包人应提供足够数量的监管人员，确保安全、正确和及时地完成工程。承包人还应指派一名工作人员，负责与发包人或其代表就所有合同事宜进行单点接洽，工作时间段内该负责人必须在工程现场。

Before start of the Performance Ratio verification and the commissioning of the PV power plant starts, the place of work shall be cleaned in according to request of the Owner.
性能比验证和光伏电站试运行开始之前，应按发包人的要求清理工程现场。

In spite of all the care taken by the Contractor if any of the plant items are damaged or defaced or otherwise made non-operational by the Contractor, it shall be immediately reported to the Owner or its representatives. Both parties shall agree on the remedial action to be taken by the Contractor.
承包人应在工程进行过程中爱护设备，如导致电站设备污损或无法运行的，应立即向发包人或其代表报告。承包人应采取的补救措施需经过双方协商。

The Contractor is responsible for the transport of all the material, equipment and personnel to the project location. The transportation costs are part of the responsibility of the Contractor.
承包人负责将所有材料、设备和人员运送到项目现场。运输费用由承包人负担。

3.4.1.2 Packing and Shipping Requirements
包装和运输要求

The Contractor shall ensure that the packing, shipping, handling and logistic during transportation and on site of all components shall comply with the manufacturers requirements, Owner's requirement and national and/or international standards.
承包人应确保所有部件在运输过程中和到达现场之后的包装、运送、装卸和物流均符合制造商要求、发包人要求和国家或国际标准。

The Contractor shall ensure that the offer includes all the cost related to international and domestic transportation to site and insurances of all components.
承包人应确保报价涵盖所有部件运输到项目现场的国际/国内运输费和保险费。

3.4.1.3 Site Services during Construction
施工期间的现场服务

The Contractor shall seek for sufficient lay down areas, storage space etc. The effected on-site logistic, inclusive un-/uploading, lifts and intermediate storage shall be included in the offer. No extra charge for these transports will be accepted by the Owner.
承包人应获得足够的铺设面积和仓储空间。报价涵盖装卸、升降机和中间仓储等现场物流费用。发包人不会为上述运输过程支付其它费用。

The Contractor shall include for the supply of the total electricity and water demand for the Contract works. together with the supply to the Owner and Engineer's site office and meeting room. The Contractor shall provide all equipment required to provide the electricity and water supplies to the site.
承包人应负责满足合同工程项下的总供电和供水需求、以及发包人和工程师现场办公室和会议室的供电供水需求，为现场供电供水所需的所有设备由承包人提供。

3.4.1.4 Housekeeping
现场维护

The Contractor's personnel will keep the designated working area and surrounding area clean throughout the duration of the works. Housekeeping is required to maintain in daily basis which includes, but not limited to, keeping walkways clean and free from cables and hoses, putting all food and plastic waste into designated bins, keeping working materials clean and immediate removal of scrap materials.
承包人的工作人员应在整个工程施工期内保持指定工作区域及其周边地区的清洁。工程现场要每日进行维护，包括但不限于：保持行人通道干净且无电缆和软管、将所有食品和塑料废物投入指定垃圾箱、保持工作材料的清洁、随时清除废料。

3.4.1.5 Clearance of Work
清场

Upon completion of the works, the Contractor shall clear away and remove from the project site all construction equipment, temporary facilities surplus materials, rubbish etc., and leave the whole site clean and in perfect condition. Rubbish shall be professionally disposed to the designated waste disposal site. To burn or bury the rubbish on or close to the site is not permitted.
工程竣工后，承包人应移除工程现场的所有施工设备、临时设施剩余物料、垃圾等，并将整个现场清理干净。垃圾应由专人运至指定的垃圾处理场进行处理。禁止在工程现场或附近烧毁或掩埋垃圾。

If Antiques are found under or at the site after the site clearance, the Contractor shall inform the Owner immediately. The found Antiquities shall remain at their location until notice to proceed. The Contractor shall facilitate, if required by the Owner or related governmental agencies to identify the antiques. The Contractor shall keep and protect

the found Antiques with highest care until notice to proceed.
如果清场之后在现场或附近区域发现文物，承包人应立即通知发包人。被发现的文物应保留在原处，等待进一步通知。应发包人或政府有关部门要求，承包人应协助文物的鉴别工作。 承包人应以最高标准保管并保护被发现的文物，等待进一步通知。

3.4.1.6 Assembly of Components
部件安装

All work at the site shall be carried out in such a manner as not to obstruct the operations of other Contractors and the daily operations of the site factory. The Contractor shall cooperate with other entities and parties involved in this project to achieve a smooth implementation of the PV power plant.
现场施工不得妨碍其他承包人的工作及现场电站的日常运行。承包人应和参与本项目的其它单位及各方合作，确保光伏电站工程的顺利实施。

The Contractor shall ensure the correctness of electrical connections to all equipment supplied under the Contract before such equipment shall be commissioned.
设备投入使用之前，承包人应确保合同项下提供的所有设备均已获得正确的电气连接。

The personal safety must be afforded to personnel either directly engaged on this Contract or who in the normal course of their occupation find it necessary to utilize temporary works erected by the Contractor or personnel who frequently visit the working area.
对于直接参与合同工程、在其正常工作过程中需使用承包人修建的临时工程、或者需要经常进入工作区域的人员，其人身安全必须得到保证。

3.4.2 Quality Management Requirements
质量管理要求

The Contractor shall carry out the Contract works in accordance with sound quality management principles, which shall include such controls as necessary to ensure full compliance with requirements of the Specifications .The Contractor's activities will be monitored by the Owner or his representative to ensure that they are being implemented correctly.
承包人应根据完善质量管理原则开展合同工作，其中应包括用于确保工程完全符合规范要求的必要控制措施。承包人的活动应由发包人或其代表进行监督，确保获得正确执行。

The quality management requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, storage, site erection and commissioning as well as during the Defect Liability Period.
质量管理要求适用于设计、采购、制造、检验、测试、包装、运输、仓储、现场安装和调试以及缺陷责任期内的所有活动。

The Contractor shall have the sole responsibility to ensure compliance with all these requirements as applied to the whole of the contract and shall ensure that their subcontractors (if any) implement the quality control activities as appropriate to the extent of their supply. Therefore the Contractor shall designate one experienced engineer to be responsible for all Quality Management Requirements associated with the

contract.
承包人全权负责确保遵守适用于整个合同工程的全部要求，并确保分包商（如有）根据其职责范围适当地履行质量控制活动。因此，承包人应指派一名有经验的工程师，负责确保与合同有关的所有质量管理要求得到满足。

3.4.3 Warranty
保修

The general warranty period for installed equipment shall be 2 years. This excludes all equipment which has a separate specification for the warranty such as:

Inverters: 5 years

PV Modules: 10 years

Mounting Structure: 10 years

安装设备的常规保修期为 2 年。不包括发包人要求中单独规定保修期的设备, 如：

逆变器: 5 年

光伏组件: 10 年

结构: 10 年

3.4.4 ESHS Requirements
ESHS 要求

To follow the Environmental, Social, Health and Safety (ESHS) requirements are binding for the Contractor and his subcontractors for executing works at the project site. The Contractor has to provide an ESHS Management Plan. Following mandatory requirements have to be fulfilled:
承包人及分包商在工程现场施工过程中须遵守环境、社会、健康和安全（ESHS）要求。承包人要提供 ESHS 管理计划。计划应满足下列强制要求：

- The Contractor shall have a management team in place which is able to fulfil all requirements of the project.
  承包人应组建一支能满足项目所有要求的管理团队。
- The Contractor shall continuously monitor and improve health and safety at site.
  承包人应对项目现场的健康和安全状况进行连续监测和改善。
- The Contractor and sub-contractor’s proposal should clearly describe how it will achieve the Project’s ESHS Requirements and list the costs for providing related services.

承包人和分包商提交的方案应明确指出将如何满足项目的 ESHS 要求，并列出提供相关服务的成本。

The following operational requirements are mandatory:
以下运行要求属强制性质：

- The Contractor and sub-contractors shall be able to manage the ESHS risks of the project and to achieve requirements on ESHS in compliance with national regulations and in according to Owners' Requirements.
  承包人和分包商应管理项目的 ESHS 风险，并根据国家规定和发包人要求，满足 ESHS 要求。

- The Contractor (and sub-contractors depending on the extent of their scope of their work) will appoint an ESHS Manager and, if necessary, additional site personnel with the overall responsibility for ESHS achievement.
  承包人（以及分包商，根据工作范围而定）应任命一名 ESHS 经理，并在必要时委派其他现场工作人员全面负责达到 ESHS 要求。

- The Contractor (and sub-contractors depending on the extent of their scope of work) will carry out a risk assessment to identify ESHS priorities, and develop ESHS management plans to ensure achievement of the required standards.
  承包人（以及分包商，根据工作范围而定）应进行风险评估，确定 ESHS 的优先事项，并制定 ESHS 管理计划，确保达到所要求的标准。

- The Contractor will implement applicable ESHS Management Systems and procedures, and ensure that all staff are properly trained in the applicable procedures and management plans.
  承包人应执行适用的 ESHS 管理体系和流程，确保所有工作人员获得适用流程和管理计划方面的足够培训。

- The Contractor and sub-contractors will ensure that the necessary resources (e.g. budget, personnel, equipment, etc.) are available to achieve the required ESHS standards. Importantly, the Contractor shall provide suitable Personal Protective Equipment (PPE) for all site staff, and safety instruction signs at each area of construction site.
  承包人和分包商应确保提供工程达到 ESHS 标准所需要的全部资源（如预算、人员、设备等）。重要的是，承包人应为所有现场工作人员提供适当的个人防护装备（PPE），并在施工现场的每个区域安放安全指示标志。

The ESHS management plans shall be reviewed and approved by the Owner/Owner's Engineer before execution.
ESHS 管理计划执行前应由发包人/发包人工程师审查和批准。

The Contractor (and sub-contractors depending on the extent of their scope of work) will monitor and report ESHS performance; this will include monthly reporting to the Owner. Specific event reports will also be required outside of the normal reporting period if applicable (e.g. accidents shall be reported within 24 hours), and the Owner shall be given access (and information) to carry out an ESHS audit at the site if needed.

承包人（以及分包商，根据工作范围而定）应负责监测和报告 ESHS 达标情况；其中包括：每月向发包人提交报告。适用情况下，还需在正常报告期之外就特定事件报告（例如，所有事故应在 24 小时内报告）；如果必要，发包人应有权（并获得必要信息）进入工程现场进行 ESHS 合规审查。

3.5 Technical and Operational Requirements
技术和运行要求

The PV power plant shall be designed to allow full output over the full range of present ambient temperature and solar irradiation conditions at the Project site.
光伏电站的设计应允许在项目现场当前的环境温度和太阳辐射条件下，在全范围内实现全部输出。

The Contractor shall ensure that all systems, components and equipment of the PV power plant are designed, manufactured, installed, commissioned and operated in compliance with national and/or international standards and good engineering practice. When such standards and recommendations are not existing, best industry practise shall be applied.
承包人应确保光伏电站的所有系统、部件和设备根据国家和/或国际标准以及良好工程实践进行设计、制造、安装、调试和运行。如无相关标准和方案，应采用行业最佳工业惯例。

In addition to the below listed standards, all local rules and regulations shall be strictly adhered to in all respects.
除下列标准外，还应严格遵守各项当地规章制度。

In case of any conflict in the below listed codes, standards and regulations, local rules and regulations shall prevail.
与下列规范、标准和规定发生冲突的，应以当地规章制度为准。

Only as guidance and in order to elucidate what is mentioned above, the following table presents a list of information sources to follow (but not limited to).下表详细列出了应当遵循哪些组织规定的规范和标准（但不限于此）。

Table 1: Codes and Standards
表 1 规范和标准

批注 [1]: To be replaced by GB standards

Organisation 组织	Abbreviation 缩写	To be applied for
International Organization for Standardization 国际标准化组织	ISO	Pyranometer
Chinese Standards	GB (China Standard), JGJ (Technical Standard), NB (Energy Bureau Standard)	AC Connection, Mounting structure, Cabling, Transformer, Switchgear

Organisation 组织	Abbreviation 缩写	To be applied for
International Electrotechnical Commission 国际电工委员会	IEC	PV Modules and testing, Inverters,
Institute of Electrical and Electronics Engineers 电气和电子工程师协会	IEEE	
American Concrete Institution 美国混凝土学会	ACI	
American Society of Engineering Engineers 美国土木工程师学会	ASCE	
American Society of Mechanical Engineers 美国机械工程师协会	ASME	
American Welding Society 美国焊接学会	AMS	
American Water Work Association 美国水务协会	AWWA	
American Society for Testing and Materials 美国测试和材料协会	ASTM	

With regards to operational requirements all PV power plant facilities and equipment shall be arranged and spaced sufficiently to enable satisfactory operation and maintenance of all parts. In addition, all maintenance activities for the PV Power Plant shall be planned to take place outside the operational periods. The Contractor shall ensure that equipment used for ongoing plant performance monitoring shall at all times have a valid calibration certificate and shall provide the calibration certificates to the Owner/Owner's Engineer on demand.
在操作要求方面，所有光伏电站设施和设备的布置和间隔应足以使所有部件得到满意的运行和维护。此外，光伏电站的所有维护活动应在运营期以外进行。承包人应确保用于进行电站性能监测的设备始终具有有效的校准证书，并应按要求向发包人/发包人工程师提供校准证书。

3.6 Plant Identification and Numbering System
电站识别与编号系统

All installed equipment and components, most especially key components e.g., inverter, transformer, switchgear, Ring Main Units, main electrical devices, cables, , shall be provided with labels/tags to allow easy traceability, testing, correct operation and efficient maintenance.
所有安装的设备和部件，特别是逆变器、变压器、开关柜、环网柜、主要电气设备、电缆等关键部件均须贴上标记/标签，以便追踪、检测、正确操作和高效维护。

All tags shall be properly arranged duly sized and being produced in such a way that the intended purpose shall be made without getting faded or deteriorated for at least the PV power plant lifetime.
所有的标签均应大小合适，并至少在光伏电站的使用寿命内不会褪色或损坏，以确保满足其既定用途。

3.7 Additional General Design Criteria
其它通用设计标准

It is required that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. Equipment and selected components shall be of superior quality. Components and equipment of the same kind and type shall be selected for equivalent functions. The execution of works shall be of high industrial standard.
所有部件和设备应根据“易于维护、简单快速诊断和维护间隔较长”的标准进行选用。设备和部件应具有优良的品质。同等功能的部件和设备应选用相同类型和型号。工程施工应符合较高的工业标准。

Please note that the above mentioned applies in general for all equipment and components of the whole PV power plant.
请注意：通常情况下，上述内容适用于整个光伏电站的所有设备和组件。

4 MINIMUM TECHNICAL REQUIREMENTS
最低技术要求

The minimum technical requirements for the equipment and installation are defined in this section. Where the Owner has selected to choose one (1) or more items for the equipment's requirements, the Bidder is free to propose to the Owner the most economical and optimal technical solution.
本节定义了设备及安装应达到的最低技术要求。发包人为设备要求选择超过一（1）件设备的，投标人可根据自己的看法向发包人提出最经济、最优化的技术方案。

4.1 System Requirements
系统要求

System Requirements are listed in APPENDIX 9.1: System Requirements
系统要求 (附件 9.1)

4.2 Electrical Equipment
电气设备

4.2.1 Ingress Protection
防护等级

The ingress protection class for electrical installations shall be selected to the environmental conditions, and comply at least with the classes given in the table below according to GB 4208: Degrees of protection provided by enclosures (IP Code).
电气设备的防护等级应根据环境条件进行选择，并至少符合下表中给出的 GB 4208 防护等级：外壳防护等级（防护等级代码）。

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.1	Indoor w/o risk of vertically falling water 室内无垂直降水风险	IP41
1.2	Indoor with risk of splashing water from all directions 室内存在从各个方向喷水的风险	IP54
1.3	Outdoor w/o risk of vertically falling water 室外无垂直降水风险	IP54
1.4	Outdoor with risk of splashing water from all directions 室外存在从各个方向喷水的风险	IP65
1.5	Outdoor with risk of temporary immersion of water 室外存在临时浸水的风险	IP67

Deviations shall be communicated to and approved by the Owner.
如有偏差，应报发包人批准。

4.2.2 Photovoltaic Modules
光伏组件

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.6	Module Technology: 组件技术：	☒ Poly-Crystalline 多晶 ☒ Mono-Crystalline 单晶 ☐ Thin Film 薄膜 ☐ Double Glass 双层玻璃
1.7	Module Manufacturer: 组件制造商：	Tier One Manufacturer 一级制造商
1.8	Minimum Module efficiency (STC) 最低组件效率（标准测试条件）	16.0 %
1.9	Maximum temp. coefficient of P_{max} 最高温度 P_{max} 系数	-0.45 %/K
1.10	Power tolerance 功率容差	≥ 0W
1.11	Min. Operating Temp. Range 最低工作温度 范围	-5°C to +80°C -5°C 至 +80°C
1.12	Maximum Weight 最大重量	25 kg per module 每个组件 25 kg
1.13	Power output warranty 功率输出保证	80% after 25 years 25 年后为 80%

4.2.3 Inverters
逆变器

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.14	Technology 技术	☒ String Inverter 组串式逆变器 ☐ Central Inverter 集中式逆变器

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.15	Installation Type 安装类型	☒ String Inverter installed on rear of mounting structure with separate station composing of LV switchgear, transformer and MV switchgear (RMU) 组串式逆变器安装在安装结构背面，由低压开关柜、变压器和中压开关柜（RMU）组成独立的工作站， ☐ String Inverter Station composing of string inverters, LV switchgear, transformer and MV switchgear (RMU) 组串式逆变器由逆变器、低压开关柜、变压器和中压开关柜（RMU）组成 ☐ TBD 待定
1.16	Manufacturer 制造商	Tier One 一级制造商
1.17	Minimum product warranty 最短产品质量保修期	5 years (extensions will be acknowledged positively) 5 年（允许延保）
1.18	Min. temp. operating range 最低工作温度范围	-5°C to +55°C -5°C 至 +55°C
1.19	Functions 功能	☒ DC Disconnect 直流断开 ☒ DC Surge Protection (Type II) 直流浪涌保护（II 型） ☒ DC Ground-fault monitoring 直流接地故障监视 ☒ Remote ground-fault monitoring 远程接地故障监视 ☒ DC insulation monitoring / Residual Current Monitoring 直流绝缘监测/残余电流监测 ☐ AC Surge Arrestor (Type III) 交流电涌保护器（III 型） ☒ AC Surge Arrestor (Type II) 交流电涌保护器（II 型）

4.2.4 LV Switchgear
低压开关柜

LV Switchgear requirements are listed APPENDIX 9.2.1: LV Switchgear
低压开关柜 (附件 9.2.1)

4.2.5 Distribution Transformer
配电变压器

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.20	Required 要求	☐ Yes ☐ No ☐ 是☐ 否
1.21	Primary Voltage 初级电压	Please Mention 请具体指出
1.22	Secondary Voltage 次级电压	Same as inverter output 与逆变器输出相同
1.23	Rated power 额定功率	Defined by Bidder 由投标人定义
1.24	Number of windings 绕组数	2
1.25	Vector Group 矢量组	Defined by Bidder 由投标人定义
1.26	Type of cooling 冷却类型	Please Mention 请具体指出
1.27	Impedance voltage 阻抗电压	According to IEC 60076 根据 IEC 60076
1.28	Min. product warranty 最短产品质量保修期	5 years 5 年

4.2.6 Ring Main Unit (RMU)
环网柜（RMU）

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.29	Required 要求	☐ Yes ☐ No ☐ 是☐ 否
1.30	Rated Voltage 额定电压	☐ Please Mention ☐ 请具体指出

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.31	Nominal Voltage 标称电压	☐ Please Mention ☐ 请具体指出
1.32	Basic Insulation Level 基本绝缘标准	Please Mention 请具体指出
1.33	One minute power frequency withstand voltage 一分钟工频耐压	Please Mention 请具体指出
1.34	Rated Current (busbars / incoming / outgoing) 额定电流（母线/输入/输出）	Defined by Bidder 由投标人定义
1.35	Rated short time withstand current 额定短时耐受电流	Defined by Bidder 由投标人定义
1.36	Rated duration of short circuit 额定短路持续时间	1 second 1 秒
1.37	Rated peak withstand current 额定峰值耐受电流	Defined by Bidder 由投标人定义
1.38	Min. temp. operating range 最低工作温度范围	0°C to +55°C 0°C 至 +55°C
1.39	IP Class 防护等级	☐ IP41 ☐ IP54 ☐ IP65
1.40	Min. product warranty 最短产品质量保修期	5 years 5 年

4.2.7 Medium Voltage Switchgear
中压开关设备

The specific requirements for the medium voltage switchgear are listed in APPENDIX 9.2.2: Medium Voltage Switchgear
中压开关设备 (附件 9.2.2)

4.2.8 Step up Transformer
升压变压器

The specific requirements for the medium voltage switchgear are listed in APPENDIX 9.2.3: Step up Transformer
升压变压器 (附件 9.2.3)

4.2.9 LV Power Cables for DC String
直流串列使用的低压电力电缆

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.41	Required certificate 所需证书	GB 50217
1.42	Type certified cable 型号认证电缆	PV1-F
1.43	Conductor 导体	Bare copper, tinned, finely stranded annealed copper 裸铜，镀锡，细丝退火铜
1.44	Insulation properties 绝缘性能	Resistant of ozone, weather, UV, acid, base, hydrolysis and flame 耐臭氧、耐候性、耐紫外线、酸、碱、水解和火焰
1.45	Number of cores 核心数量	1
1.46	Minimum cross section 最小横截面	$4mm^2$
1.47	Insulation material 绝缘材料	Cross-Linked Poyethylene 交联聚乙烯
1.48	Sheath Material 护套材料	PVC
1.49	Rated Temperature 额定温度	-40^oC to $+90^oC$ $-40\ ^oC$ 到$+\ 90\ ^oC$
1.50	Min. product warranty 最短产品质量保修期	2 years 2 年

4.3 Monitoring System Equipment
监控系统设备

4.3.1 Control Unit (CU) Server
控制单元（CU）服务器

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.51	Processor 处理器	2 x Intel Xeon 4 cores, 32 bit, 2.4 GHz, 18 MB L3 Cache 2 个 Intel 至强 4 核处理器，32 位，2.4

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
		GHz，18 MB 三级缓存
1.52	Memory 内存	8 GB RAM, DDR3 ECC, 1333 MHz
1.53	RAID controller RAID 控制器	1 x RAID 5 controller, 6 Gb/s SAS, with 512 MB battery-backed cache 1 个 RAID 5 控制器，6 Gb/s SAS，带 512 MB 电池备份缓存
1.54	SATA controller SATA 控制器	1 x ICH10B SATA controller with two SATA channels for DVD RW and backup unit 1 个 ICH10B SATA 控制器，带两个用于 DVD RW 和备份单元的 SATA 通路
1.55	Lan controller 局域网控制器	4 x LAN-controllers Gbit/s Ethernet 4 个 LAN 控制器 Gbit/s 以太网
1.56	Graphic controller 图形控制器	1 x Graphic controller, dual ports (1920x1080, refresh rate 3ms, memory > 512 MB), VGA/DVI/HDMI outputs 1 个图形控制器，双端口（1920x1080，刷新率 3ms，内存> 512 MB），VGA/DVI/HDMI 输出
1.57	Interface 接口	1 x RS 232.C/V.24-port 1 个 RS 232.C/V.24 端口
1.58	Optical drive 光驱	DVD-RW DVD-RW
1.59	Cooling system 冷却系统	Monitored cooling fans 监控冷却风扇
1.60	Power supply 电源	Redundant monitored power supply; hot pluggable 冗余监控电源; 热插拔
1.61	Others 其它	• Standard Bus System with min. 3 free slots 标准总线系统，最少 3 个空闲插槽 • All interface as per specification requirement 所有接口按规格要求

4.3.2 Data Logger
数据记录仪

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
Communication 通信		
1.62	Inverter communication 逆变器通信	RS 486, 10/100 Mbit/s Ethernet RS 486,10/100Mbit/s 以太网
1.63	Workstation communication 工作站通信	10/100 Mbit/s Ethernet 10/100 Mbit/s 以太网
1.64	Data interface 数据接口	Modbus TCP
Memory 内存		
1.65	Internal 内部	8 MB
1.66	External 外部	1 GB (SD card) 1 GB (SD 卡)
Environmental conditions in an operation 运行环境条件		
1.67	Ambient temperature 环境温度	-20°C to 55°C -20°C 至 55°C
1.68	Relative humidity 相对湿度	5% to 95% (not condensate) 5%至 95%（不凝结）

4.3.3 Meteorological Equipment
气象设备

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.69	Weather Stations 气象站 - Measured data: 测得数据：	1 Pcs. （插入数量）台 ☒ Ambient temperature sensor 环境温度传感器 ☒ Rain sensor 雨量传感器 ☒ Air pressure sensor 气压传感器 ☒ Wind sensor 风力传感器

		☒ Relative humidity sensor 相对湿度传感器
1.70		
1.71		

批注 **[S2]:** Needs to be defined as per our discussions at least 2 pyranometers per site.

4.3.4 Weather Station
气象站

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.72	Ambient temperature sensor 环境温度传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。
1.73	Module temperature sensor 组件温度传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。
1.74	Rain sensor 雨量传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。
1.75	Air pressure sensor 气压传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。
1.76	Wind sensor 风力传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。
1.77	Humidity sensor 湿度传感器	INSERT No. SENSORS shall be installed at INSERT No. of weather stations 应在（插入气象站编号）气象站安装（传感器台数）。

4.3.5 Pyranometer
日射强度计

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.78	Classification	ISO-9060 certification “secondary standard”

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
	分类	ISO-9060 认证“二级标准”
1.79	Maximum operation irradiance 最大运行辐照度	4,000 W/m^2
1.80	Overall accuracy 总体准确度	±5% of metered value (daily average) 误差±5%（日均值）
1.81	Spectral range 光谱范围	285 to 2800 nm 285 至 2800 nm

批注 **[S3]:** No need to delete, can stay as option, just put required pcs. To zero

5 ENGINEERING TECHNICAL REQUIREMENTS
工程技术要求

All Engineering works shall be carried out to ensure a safe operation of the plant and a design lifetime of 25 years. The design shall ensure easy and low maintenance, hence, maintenance effort shall be reduced with Good Engineering Practice and Design (GEPaD).
所有工程均应确保电站的安全运行，设计寿命为 25 年。设计应确保工程便于维护，维护率低，采用良好工程实践与设计（GEPaD）减少维修工作量。

5.1 General Requirements
一般要求

Engineering works shall be based on existing building structures, roof structures including detailed design, shop drawing preparation and consist of procurement and construction of all Engineering works. The work shall include all necessary requirements for installation, commissioning, operation and maintenance of the PV Power Plant.
工程应以现有建筑结构、屋顶结构为基础，包括详细设计、施工图制作、以及所有工程采购和施工。工程应符合光伏电站安装、调试、运行和维护的所有必要要求。

The Contractor shall gather construction permission issued by the responsible authority. The Contractor’s engineers shall possess all necessary licenses for professional practice from appropriate institutions in the Peoples’ Republic of China. They shall also be required to give approval on calculation sheets and drawings and advise the supervisors on the construction work.
承包人应取得主管部门的施工许可。承包人工程师应拥有中华人民共和国有关机构的专业执业许可证。相关部门还应对计算书和图纸给予审批，并向监理人提出施工建议。

It is the responsibility of the Bidder to investigate the real site situation prior to submitting the Bid to ensure, that the Bidder thoroughly understands the site’s actual general condition and existing utilities.

投标人应负责在投标前勘察工程现场的真实情况，确保充分了解场地的实际情况和现有设施。

The Contractor shall completely accept the risk and all latent defects associated with the conditions on the site.
承包人应完全接受与现场条件相关的风险和所有潜在缺陷。

The scope of Engineering works shall include, but isn't limited to the following:
工程的范围包括但不限于：

- Building structure and roof structure survey.
  勘测建筑结构和屋顶结构
- Awareness of current conditions of the structures.
  掌握当前的结构情况
- Any reinforcements on the structures to ensure the safety of PV system.
  对结构进行加固，保证光伏系统安全
- Walkways
  通路
- Inverter stations
  逆变器站
- Inverter station protection
  逆变器站防护
- Water cleaning system
  水清洁系统
- Fall protection system
  防坠落系统

5.2 Design and General Criteria
设计和通用标准

The general requirements are, but not limited to:
一般要求如下，但不限于下文所述：

- All designs and calculations shall be submitted to the Owner or Owner's engineer for approval.
  应将所有设计和计算书提交给发包人或发包人工程师审批。
- If necessary, the Contractor shall submit drawings and design calculations to respective regulatory authorities whenever required prior to the construction.
  必要时，承包人应在施工前根据实际需要向相关监管机构提交图纸和设计计算书。

- Site execution shall follow local regulations regarding to construction standards and safety regulations.
  现场施工应遵守当地建设标准和安全规定。

The design of all structures and foundations shall be according to the limits given with the applicable codes, standards and manufacturer specification (GB 50009).
所有结构和基础的设计，均应确保其容差不超过适用规范、标准和制造商规范的限制(GB 50009)。

The dimension of PV inverter installations (prefabricated or built-onsite) and other facilities/ rooms shall be such as to provide adequate space for safe installation, proper operation, maintenance and repair works.
光伏逆变装置（预制或现场建设）及其它设施/房间的大小要为安全安装、正确操作、维护和修理工作提供足够的空间。

The work shall be carried out by competently trained skilled labour in their various trades. National and/or International aspects and codes of safety on the construction site shall be strictly observed.
工程建设应由经过资质培训的各专业熟练技工负责实施。严格遵守施工现场的国家或国际标准和安全规范。

Before starting with the design works, the Contractor shall submit to the Owner the project design manual containing the design data and the detailed design criteria for all Engineering works for approval. All tests and calculations shall be made available to the Owner or Owner´s Engineer.
设计工作开始之前，承包人应向发包人提交包含所有工程设计数据和详细设计标准的项目设计手册供审批。应向发包人或发包人工程师提供全部测试和计算书。

The Contractor shall comply with local rules and regulations applicable to the works. The investigation procedure shall be governed by international standards and codes, each in the latest edition.
承包人应遵守工程适用的当地规章制度。勘察程序应按照最新版本的国际标准和规范进行管理。

The Contractor shall design the Engineering works and prepare complete working drawings as necessary for the construction of the PV power plant. The Contractor shall produce sets of calculations and drawings in Chinese to include all sections of the Engineering and structural works. This may include the as-built-documentation in native formats (i.e. originals). The surveying, design, fabrication, materials and other components of the facilities shall be in accordance with the best current engineering practice or the latest edition and addenda of codes, standards and practices as appropriate. The design and specifications of work shall be in accordance with all applicable laws and regulations of the Peoples' Republic of China and with the applicable local codes and ordinances.
承包人应根据需要设计工程，并编制完整的施工图纸，供光伏电站施工使用。承包人应用中文制作成套计算书和图纸，包括工程和结构的所有部分。其中可能包括原始格式的初始文件（即原件）。设施的测量、设计、制造、材料和其它部件均应符合当前的最佳工程实

践或最新版本/增补的相关规范、标准和实践。工程设计与规格均应符合中华人民共和国所有适用法律法规以及所有适用的当地法规。

Where no code or standard covers a particular work, the local authority's requirements and the Owner's requirements shall be applied.
如对于特定工作无适用的规范或标准，应遵循当地管理机构和发包人的要求。

All constructions must comply with the requirements set out in the relevant local standards and practices for project in China. Other standards for some materials or applications regarding to a project shall be submitted prior to the Owner or Owner's engineer before implementation.
所有施工均应符合相关国内工程的本地标准和实践。应在工程实施前向发包人或发包人工程师提交工程部分材料或应用所适用的其它标准。

5.3 Technical Design Requirements
技术设计要求

All structures and their component parts shall be capable of withstanding the worst practicable components of dead loads, live loads, wind load, seismic and temperature effects (without exceeding the prescribed settlement), deflection and stress limits.
所有结构及其组成部分应能承受最差情况下的静载、活载、风载、地震和温度影响（不超过规定沉降）、挠度和应力限制。

The dimensions of all buildings shall provide adequate space for the safe installation and proper operation and maintenance of all plant and equipment.
所有建筑物的大小应为电站和设备的安全安装/正确运维提供足够的空间。

Table 2: Definition of Loads

表 2：负载的定义

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
Dead load 静载	Weights of the structures and of all equipment of a permanent or semi-permanent nature. Such as: 永久或半永久结构和所有设备的重量。如： -PV modules 光伏组件 -Mounting structures 安装结构 -Cable trays 电缆桥架 -DC cables 直流电缆 -Module cleaning system	Dead loads must be determined using the unit weights from GB 50009, Table 5.1.1. 静负荷必须使用 GB 50009 表 5.1.1 中的单位重量来确定。

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
	组件清洁系统 -Grounding system 接地系统	
Live loads 活载	**Uniform live loads** – these are assumed unit loads which are sufficient to provide for movable and transitory loads (such as the weight of people, portable equipment and tools, planking and small equipment, or parts which may be moved over or placed on roofs during construction and maintenance operations). These uniform live loads do not need to be applied to roof areas which will be permanently covered with equipment. 均匀活载 — 假定的单位载荷足以提供可移动和暂时载荷（如人的重量、便携式设备和工具、铺板和小型设备、或在施工和维护操作期间可能在屋顶上移动或放置的部件）。均匀活载无需施加到将被设备永久覆盖的屋顶区域。	Loading pattern must be taken into account for the most severe condition. Roofs and their supporting members which are subject to heavy equipment live loads must be designed on the basis of the weight of the equipment in addition to a uniform load of 15 kg/m^2 or specifically defined live loads, whichever is greater. Each supporting member in the floor which may carry these loads must be designed for the heaviest piece or pieces of equipment arranged in the most critical position. For loads caused by moving equipment over the roof for installation, consideration may be given to the purlins of roof. When moving equipment over roofs for installation, stress increases shall comply with national standards 装载模式必须考虑到最严峻的操作条件。除了均匀载荷为 15 kg/m2 或具体定义的活载荷（以较大者为准），承受重型设备活动荷载的屋顶及其支撑构件必须根据设备的重量进行设计。可承载上述载荷的地板支撑构件须被设计为可承载放置在最关键位置的最重的一件或多件设备。对于安装时在屋顶移动设备所造成的负载，可考虑由屋顶檩条来承担。当将设备移动到屋顶进行安装时，附加应力须符合国家标准。

Table 3: Loads for PV Rooftop Designs

表 9：光伏屋顶设计负荷

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
Roof load 屋顶荷载		All roof areas must be designed for wind load. All roof areas must be

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
		designed for a minimum of 30 kg/m2 live load in addition to calculated dead loads. 所有屋顶区域必须设计为可承受风荷载。除了计算的静载荷之外，所有屋顶面积必须设计为至少可承受 30 kg/m2 的活载荷。
Column load 柱负载		Live loads carried from the roofs to the columns must include 100% of the roof live load. In addition to the roof live loads, the columns must carry the load of PV system (dead loads). 从屋顶移动到柱子的活荷载必须包括屋顶活荷载的 100％。除了屋顶活荷载之外，柱子还必须承担光伏系统的负荷（静负荷）。
Module cleaning system load 组件清洁系统负载		Module cleaning system loads to account for miscellaneous piping systems may initially be estimated as uniform loads per unit along specific area as per design drawing. These loads must be carried to the purlins, trusses and columns as dead loads. After the piping systems have been routed and the piping analyses have been completed, the structural support system must be evaluated for the actual pipe hanger loads. 根据设计图纸，管道系统的组件清洗系统负应首先估计沿特定区域的单位均匀负荷。这些载荷必须作为静载荷传递到檩条、桁架和立柱上。在管道系统布置完成并完成管道分析之后，必须对结构支撑系统进行实际管架负载的评估。
Equipment load 设备负载		Equipment loads must be specifically determined and located. For major equipment, structural members and bases must be specifically located and designed to carry the equipment load into the structural system. For equipment weighing less than the live load, the structural system must be designed for the live load. Equipment

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
		loads must be noted in the design calculations to permit separation in the calculation of uplift and stability. 设备负荷必须具体确定和定位。对于主要设备，结构构件和基础必须仔细定位和设计，通过结构系统承载负荷。对于重量小于活载的设备，结构系统必须设计为活载。设计计算书中必须计算设备荷载，以便单独计算提升和稳定性。
Access walkways 通道		The walkways must be designed for the dead loads of the structure plus a Super imposed live load of 15 kg/m² uniformly distributed, or a concentrated load of 100 kg at any point, whichever produces the most severe effect. 通道必须设计为结构静载荷加 15kg/m² 以上的均匀活载荷，或在任何一点集中载荷 100 公斤，以产生最严重影响的情形为准。
Stair 楼梯	In case where the roof has no access point, temporary or permanent stair may be required in order to access during site execution and maintenance. 如果屋顶没有入口，可能需要修建临时或永久楼梯，以便在现场施工和维护期间进入。	Stair treads must be designed for a distributed load of 200 kg/linear meter of tread width or a concentrated load of 100 kg, whichever produces the most severe effect. 楼梯踏面必须设计为承受在踏板宽度上 200 公斤/线性米的分布载荷或 100 公斤的集中荷载，以产生最严重的影响为准。
Handrails 扶手		A 100 kg handrail force must be applied outward at the center of the span and vertical between posts. 在跨距中心和柱子之间向外垂直施加 100 公斤的扶手力量。
Ladders 梯子		Ladders must be designed to withstand a live load of 100 kg or, alternatively, a number of live load units of 100 kg, the number of units and their spacing being in accordance with the anticipated usage of the ladder. 梯子的设计必须能承受 100 公斤的活

Type of Load 负载类型	Description 描述	Minimum criteria applicable 最低适用标准
		荷载，或者总重 100 公斤的多个活荷载单位，负载单位的数量和间距应当符合梯子的预期用途。
Wind loads 风荷载		Wind loads for all structures must be based on the standard of wind load solution set by the department of public works and town & country, ministry of the interior or equivalent site-specific wind loads and building response to the load. 所有架构物的风荷载必须根据市政部门、城乡建设部门和民政部门设定的风荷载标准，或等效的工程现场风荷载和建筑物对荷载的承载力制定。
Seismic force 地震荷载		The seismic risk zone for the Site must be determined from the CodeGB 50010. Seismic loading must be used in the design of structures only when they are greater than the computed wind loads. 场地的地震风险区域必须根据 GB 50010 规范确定。当地震荷载大于计算得到的风力荷载时，必须用于结构设计。
Construction load 施工荷载		The integrity of the structures must be maintained without use of temporary framing struts of ties and cable bracing insofar as possible. However, construction or crane access considerations may dictate the use of temporary structural systems. Special studies must be made and documented to ensure the stability and integrity of the structures during any periods involving use of temporary bracing systems. 必须保持结构的完整性，尽可能不使用临时框架结构和电缆支撑。然而，如需进入施工现场或起重机，可能需要使用临时架构系统。必须进行专门研究并以文件形式记录，在任何涉及使用临时支撑系统的时间段内确保构筑物的稳定性和完整性。

5.4 Building and roof structure survey
建筑和屋顶结构测量

The Contractor shall be responsible for an appropriate design fitting the site conditions. Therefore the Contractor shall perform a site survey including existing building structure, existing roof structure, roof dimensions and other objects on roof as a basis for all design works.
承包人应负责根据现场条件进行适当的工程设计。因此，承包人应进行现场勘测（包括对现有建筑结构、现有屋顶结构、屋顶尺寸和屋顶上其它物体情况），作为所有设计工作的基础。

The Contractor shall make use of the existing structural calculations and shall carry out additional investigations if the existing information is deemed incomplete or insufficient. The Contractor shall be responsible for making all due allowance for constructions and services and for obtaining any permits, approvals and other information necessary for the satisfactory completion of the project and make such engineering works available to the Owner or Owner's Engineer.
承包人应充分利用现有的结构计算书，如现有信息不完整或不充分，应另外勘测。承包人应负责为施工和服务提供一切应有的资金补助，并获得项目圆满竣工所需的任何许可、批文和其它信息，也应向发包人或工程师提供上述材料。

Any reinforcement works on existing roof structures regarding to additional PV system load should be conducted, designed and submitted by the Contractor to the Owner or Owner's Engineer. The Contractor shall be aware of that the expense of the reinforcement work shall be included in the scope of work.
在现有屋顶结构上增加额外光伏系统负载所需的加固工作，应由承包人设计、实施并向发包人或发包人工程师提交。承包人应注意，加固工程的费用包含在工作范围内。

The Contractor shall make his own interpretation of subsurface information provided by the Owner or obtained on his own. The evaluation of the information and its effect on the design and engineering work will be entirely at the Contractor's expense.
承包人应负责对由发包人提供或承包人自行获得的地表下信息作出自己的判断。承包人应自费对此类信息及其对设计和工程的影响进行评估。

All investigations and tests carried out by the Contactor shall be in accordance with the relevant codes and standards.
承包人进行的所有勘测和测试均应符合相关规范和标准。

5.5 Roof survey
屋顶测量

The scope of work includes the available areas for PV applications, existing obstructions on roofs and other client's special requirements.
工作范围包括光伏应用的可用区域、屋顶上的障碍物及客户提出的其它特殊要求。

The Contractor shall survey the available areas of the roofs for PV system applications . Any obstructions on roofs such as skylights, chimneys and other shading objects shall be

observed and marked in the design drawings .The drawings must be submitted to the Owner or Owner's Engineer to obtain approvals before constructions.
承包人应勘测光伏系统安装屋顶的可用面积。设计图纸上应注明并标记屋顶上的任何障碍物，如天窗、烟囱和其它遮阳物。施工前应将图纸提交给发包人或工程师报批。

5.6 Roof preparation
屋顶准备工作

Before construction, safety equipment such as fall protections shall be installed. PV module locations shall be marked on the roof as per approved drawing. Access points to the roofs shall be prepared according to the standards. Access ways or openings for maintenance should have sufficient space to enable the installation and removal of the largest item of equipment.
施工前应安装防坠落安全设备。应根据获批的图纸在屋顶上标注光伏组件的位置。按照标准预备进入屋顶的入口点。进出通道或维护开口应预留足够空间，用于安装和拆除体积最大的设备。

5.7 Buildings and structures
房屋及构造

The Contractor shall provide all required buildings. All building structure designs are conducted in accordance with local statutory standards and requirements. The Contractor shall be responsible for all necessary local government approvals and permits for construction of the buildings and structures.
承包人应提供所有必要的建筑物。所有建筑物的结构设计均应符合当地法定标准和要求。承包人应负责获取所有必要的地方政府批文和建筑结构建设许可。

5.7.1 Inverter installations
逆变器安装

The design and constructions of inverter installations must follow the standards and regulations as listed below:
逆变装置的设计和施工须遵循以下标准和规定：

- Any terms of electrical requirements stated in local standards such as maintenance clearance area which should be considered in terms of inverter installations designs.
  逆变器装置的设计应考虑当地标准中规定的维修净距区域等电气要求条款。
- Must be tailored to the operational and technical requirements of the equipment installed there in.
  根据安装在逆变器装置中设备的操作和技术要求定制。
- In case the inverter installations are on roof, they must have permanent access ladders or stairways and platforms, wherever necessary, to permit the successful operation and maintenance of the facility.

如逆变器装置安装在屋顶上，必须配备永久性的梯子或楼梯和平台，以便在必要时对设备成功实施运维。

- Must be elevated above ground level or flooding level to avoid flooding issues.
  安装在地平面或淹没水位以上，避免洪水问题。

5.7.2 Module cleaning system
组件清洁系统

The Contractor may propose a fixed or portable module cleaning system which may interconnect with the site's water supply. The load of the system shall be considered for the roof structure calculation according to the Local standards. The water supply system shall be designed to provide an adequate pressure for modules cleaning purpose.
承包人可提议建设一个固定或便携式的组件清洁系统，与现场供水系统相连。根据当地标准，屋面结构计算应考虑系统荷载。 供水系统的设计应能为组件清洁提供足够的水压。

5.8 Mounting structure
安装结构

Since there are many different types of roofing meterials and profiles, appropriate attachment methods are needed for optimal connections. For trapezoidal profiles, penetrations should be made on the corrugations rather than the valleys of the sheet metal to minimize the possibility of leaks. For clip lock profiles, fastening methods shall be designed to not penetrate the roofs. The mounting structure shall be designed to withstand all environmental loads (wind, earthquake, etc.) and specified design loads as applicable. For minimum technical requirements reference shall be made to the manufacturer's requirements.屋面材料和型材类型多样，因此，需选用适当的方法获得最佳连接。对于梯形型材，应该对凸起处而非金属板的凹陷处进行穿孔，尽量减少泄漏的可能性。对于卡锁型材，紧固方法不得穿透屋顶。安装结构应设计为能承载适用的所有环境负荷（风、地震等）和规定的设计载荷。最低技术要求应参考制造商的要求。

The mounting structure shall be in conformity with the requirements from the solar module manufacturers for the installation of the solar modules. In case module manufacturers have elevated standards to mounting structures or fixture, the usage of such mounting structure shall be explicitly certified by the module manufacturer.
安装结构应符合太阳能组件制造商安装太阳能组件的要求。如组件制造商已将标准提升到安装结构或夹具，组件制造商应对使用这种安装结构给予明确认证。

The mounting structure and its components should be made of aluminium. All structural components and parts including connections (welding's, nuts, bolts, washers, lock washers, etc.) shall be sufficiently protected against corrosion, and shall ensure the lifetime of the plant (25 years).
安装结构及其部件应由铝制成。所有结构部件和部件连接（焊接、螺母、螺栓、垫圈、锁紧垫圈等）应受防腐保护，并确保设备的使用寿命（25 年）。

The Contractor shall ensure that the mounting structure size meets the recommendations of the PV module manufacturer (i.e. gap between the modules) and the roof conditions such as roofing materials and roof structures. The Contractor shall propose its mounting structure concept.
承包人应确保安装结构符合光伏组件制造商（如组件间距）和屋面材料/结构制造商的要求。承包人应提出安装结构概念的建议。

Between PV arrays or groups a minimum clearance of 0.40m for access, maintenance and installation shall be provided.
光伏阵列或组件之间至少应提供 0.40 米通路，作为接触、维护和安装的最小间隙。

The Contractor shall submit the intended module arrangement to the Owner/Owner's Engineer for approval.
承包人应将设计的组件方案提交给发包人/发包人工程师报批。

5.8.1 Azimuth and Inclination
方位角和倾角

5.8.1.1 Inclinded Rooftops
倾斜屋顶

The mounting structures shall be designed so that the PV modules are inclined at the same plane as the rooftop. The module azimuth shall be in the same direction of the rooftop slope. In general PV modules' inclination and their azimuth will depend on the installing roof to maximise the usage of roof area leading to maximum of energy production.
安装结构的设计应使光伏组件形成与屋顶相同的倾角。组件方位角应与屋顶斜坡的方向相同。一般而言，光伏组件的倾角和方位角取决于安装屋顶，以最大限度地利用屋顶面积，最大限度地增加发电量。

5.8.1.2 Flat Rooftops
平屋顶

For flat roofs PV modules shall be inclined at the optimal angle and an azimuth to optimize the annual energy production.
对于平屋顶，光伏组件应以最佳角度和方位角倾斜，以优化年度发电量。

5.8.2 Installation
安装

The clearance between modules shall be approx. 0.02 m, depending on the clamps to be used, the mounting structure and the clamps shall comply to the standards and requirements of the PV Module Manufacturer, for Thin Film or frameless solar modules, only clamps certified by the manufacturer shall be used. Grounding shall be implemented to ground the module frame towards the mounting structure, therefore grounding clips, washer or similar shall be installed based on the Module Manufacturers requirements.
组件之间的间隙应为约 0.02 米，取决于要使用的夹具；安装结构和夹具应符合光伏组件制

造商的标准和要求，对于薄膜或无框太阳能组件，只允许使用通过制造商认证的夹具。应实施接地，以将组件框架接地到安装结构，因此，接地夹、垫圈或类似物应根据组件制造商的要求进行安装。

5.8.3 Warranty
保修

A product warranty of a minimum ten (10) years for the substructure shall be provided. A warranty extension – if applicable – shall be offered.
底座应提供至少 十（10 ）年的产品保修。延保服务 - 如适用 – 也应提供。

5.9 Codes and standards
规范和标准

The major national and/or international codes and standards shall be obeyed. Nevertheless local standards and regulations shall be followed if permits are mandatory prior to the constructions.
应遵守主要的国家和/或国际规范和标准。尽管如此，如需获得施工许可，也须遵循当地标准和规定。

5.9.1 Design criteria for modules and mounting structure
组件和安装结构的设计标准

Dead loads: Modules and mounting structure 15 kg/m^2
静载荷：组件和安装结构 15 kg/m^2

Wind loads: Maximum negative and positive wind load calculated from wind load should comply with Chinese GB Satndard
风载荷：最大正负载荷计算应参照中国 GB 标准。

5.9.2 Material Specifications
材料规格

The allowable stresses listed below are maximum possible values, ignoring effects of lateral and/ or buckling.
下面列出的许用应力为可能的最大值，不计横向和/或屈曲影响。

Structural aluminium, steel, stainless steel sections & plates:
铝、钢、不锈钢构造剖面和板材：

Aluminium frame alloy （comply with GB 50429）:
铝合金框架：(满足 GB 50429)

Steel section and plates – Grade A36 (comply with GB 50017):
钢部分和板材 - A36 级：(符合 GB 50017)

5.10 Safety Requirements for Working on High Areas
高空作业的安全要求

According to Ministry of Labour regulations, the Contractor shall comply the following safety regulations:
根据劳动部规定，承包人应遵守以下安全作业规定：

- If the working area is larger than 2,000 sq.m., the Contractor shall propose a safety plan to the Owner or Owner Engineer.
  如果作业面积超过 2000 平方米，承包人应向发包人或发包人工程师提出安全计划。
- The Contractor shall have trained and certified safety offices available on site to observe and evaluate the safety of construction activities.
  承包人应在现场成立经培训和认证的安全办公室，对施工活动的安全性进行观察和评估。
- Working on high areas higher than 4 meters, fall protection systems shall be installed on the roofs or where the risks of falling are.
  在高于 4 米的高处作业时，应在屋顶或存在坠落危险处安装防坠落系统。
- Workers working on the high areas must wear a safety hardness or safety belt connecting to a life line installed on the roofs.
  高空作业人员必须佩戴安全带或与安装在屋顶上的救生绳相连接的安全带。
- Anti Fall structure should be installed at the edges of the roofs where the construction activities occur with a minimum height of 0.5 m.
  应在施工活动进行的屋顶边缘安装防坠落结构，最低高度为 0.5 米。
- The Contractor shall provide safety helmets, safety harness and rubber shoes to their workers who would work on high areas.
  承包人应为高空作业工人提供安全帽、安全吊带和橡胶鞋。

5.11 Animal-damage Protections
动物伤害防护

The Contractor shall provide protections against damages caused by animals if the damages have impact on safety and production of the PV system. If squirrels or birds nesting under PV modules are likely to cause any damages, the Contractor shall provide appropriate protections to the components.
动物可能造成光伏系统的安全和发电性能受损的，承包人应提高防护措施，防止动物造成的损害。如果光伏组件下方的松鼠窝或鸟巢可能造成破坏，承包人应向光伏组件提供适当防护。

5.12 Corrosion Protections of Dissimilar Materials
异种材料腐蚀防护

Galvanic effects can occur when different materials have directly contact to each other such as aluminium and copper leading to corrosion on the materials. The Contractor shall avoid any direct contacts of dissimilar materials and shall provide appropriate protections such as applying EPDM rubber in between the materials.
铝铜等不同材料直接接触时会产生电流效应，导致材料被腐蚀。承包人应避免不同材料直接接触，提供适当的保护措施（如在不同材料之间放置三元乙丙橡胶）。

6 ELECTRICAL TECHNICAL REQUIREMENTS
电气技术要求

The Contractor shall be responsible for selection, design, engineering, manufacture, testing at manufacturer's works/site, erection and commissioning of the system. The system must be reliable and safe in operation in accordance to the standard practices of China as stated in Section 4.1.承包人应在制造商的工程/现场进行选型、设计、工程施工、制造和测试，并负责系统安装和调试。系统须依照第 4.1 节所述的国内标准惯例可靠安全运行。

In this section, all main components of PV solar rooftop system are stated with regards to their individual technical requirements according to the standards and regulations.
本节对光伏太阳能屋顶系统的所有主要部件按照标准和规定分别作出了技术要求说明。

6.1 PV Modules
光伏组件

6.1.1 General
一般要求

This Section describes the requirements for design, manufacturing, installation, testing and commissioning of the PV modules to be provided for the PV power plant. Unless explicitly expressed in Section 4.2.2 in this document, the Bidder is free to propose to the Owner the most economical and optimal technical solution in the selection of the PV modules. The Bidder must meet all installed capacity, PPA and any other requirements as specified in Section 1.
本节介绍了光伏电站所使用的光伏组件的设计、制造、安装、测试和调试要求。除非第 4.2.2 节中作出明确规定，投标人可根据自己的看法地向发包人提出最经济、最优化的光伏组件选择技术方案。投标人须满足第 1 节规定的装机容量、PPA 和所有其它要求。

6.1.2 Codes and Standards
规范和标准

The PV Module shall be designed, manufactured and tested in full compliance with the latest edition of the following, but not limited to, standards, codes, rules and regulations:
光伏组件的设计、制造和测试应完全符合以下最新版本的标准、规范、规则和规定，但不限于以下所列内容：

- EN 50262 Cable glands for electrical installations
  EN 50262 电气装置的电缆密封套
- EN 50380 Datasheet and nameplate information for photovoltaic modules
  EN 50380 光伏组件的数据表和铭牌信息

- IEC 60068-2-68 Environmental testing - Part 2-68: Tests -Test L: Dust and sand
  IEC 60068-2-68 环境试验 - 第 2-68 部分：试验 - 试验 L：粉尘和沙子

- EN 60695-1-1 Fire hazard testing
  EN 60695-1-1 火灾危险测试

- IEC 60216-1 Electrical insulating materials - Properties of thermal endurance - Part 1: Ageing procedures and evaluating of test results
  IEC 60216-1 电绝缘材料-耐热性能-第 1 部分：老化程序和试验结果评估

- IEC 60529 Degrees of protection provided by enclosures (IP code)
  IEC 60529 外壳提供的防护等级（防护等级代码）

- IEC 60891 Procedures for temperature and irradiance corrections to measured I-V characteristics of photovoltaic devices
  IEC 60529 温度和辐照度校正程序，用于测量光电器件的 I-V 特性

- IEC 60904-1 Photovoltaic Device, Part 1: Measurement of Photovoltaic Current-Voltage Characteristics
  IEC 60904-1 光伏器件，第 1 部分：光伏电流 - 电压特性的测量

- IEC 60904-2 Part 2: Requirements for reference solar devices
  IEC 60904-2 第 2 部分：基准太阳能装置的要求

- IEC 60904-3 Measurement principles for terrestrial Photovoltaic (PV) solar devices with reference spectrum irradiance data
  IEC 60904-3 具有基准光谱辐照度数据的地面光伏（PV）太阳能装置的测量原理

- IEC 60904-4 Part 4: Reference solar devices – procedures for establishing calibration traceability
  IEC 60904-4 第 4 部分：基准太阳能装置 - 建立校准溯源性的流程

- IEC 60904-5 Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit
  IEC 60904-4 第 5 部分：通过开路确定光伏（PV）器件的等效电池温度（ECT）

- IEC 60904-7 Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices
  IEC 60904-7 第 7 部分：光电器件测量光谱失配校正的计算

- IEC 60904-8 Part 8: Measurement of spectral response of a photovoltaic (PV) device
  IEC 60904-8 第 8 部分：光伏（PV）器件光谱响应的测量

- IEC 60904-9 Part 9: Solar simulator performance requirements
  第 9 部分： 太阳模拟器性能要求

- IEC 60904-10 Part 10: Methods of linearity measurement
  第 10 部分： 线性测量方法
- IEC 60943 Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals
  IEC 60943 电气设备部件（特别是端子）允许温升的指导建议
- IEC 60990 Methods of measurement of touch current and protective conductor current
  IEC 60990 触摸电流和保护导体电流的测量方法
- IEC 61140 Protection against electric shock - Common aspects for installation and equipment
  IEC 61140 防触电保护 - 安装和设备的常见问题
- IEC 61215 Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval
  IEC 61215 晶体硅地面光伏（PV）组件 - 设计资格和型式审批
- IEC 61345 UV test for Photovoltaic (PV) modules
  IEC 61345 光伏（PV）组件的紫外线测试

IEC 61646 Thin film terrestrial photovoltaic (PV) modules – Design qualification and type approvalIEC 61646 薄膜地面光伏（PV）组件 - 设计资格和型式审批

- IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules
  IEC 61701 光伏（PV）组件的盐雾腐蚀测试
- **IEC 61730-1** Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
  IEC 61730-1 光伏（PV）组件安全认证 - 第 1 部分：施工要求
- IEC 61730-2 Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
  IEC 61730-2 光伏（PV）组件安全认证 - 第 2 部分：测试要求
- IEC 61853-1 Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating
  IEC 61853-1 光伏（PV）组件性能测试和能量等级 - 第 1 部分：辐照度和温度性能测量和额定功率
- IEC 62109-3 Safety of power converters for use in PV power systems – Part 3: Particular requirements for PV modules with integrated electronics
  IEC 62109-3 光伏发电系统电力转换器的安全 第 3 部分：集成电子电路光伏组件的特殊要求

- IEC 62716 Ammonia corrosion testing of PV modules
  光伏组件的氨腐蚀测试
- IEC 62759 Transportation Testing of PV Modules
  光伏组件的运输测试
- IEC 62775 Measurement of EVA crosslink density
  EVA 交联密度测量
- IEC 62782 Dynamic Mechanical Load Testing of PV Modules
  光伏组件的动态机械负载测试
- IEC 62788-1-2 Measurement of encapsulant and backsheet resistivity
  密封剂和背板电阻率的测量
- IEC 62788-1-4 Measurement of encapsulant optical transmission
  密封剂光学传输的测量
- IEC 62788-1-5 Measurement of encapsulant shrinkage during processing
  测量密封剂在加工过程中的收缩率
- IEC 62790 Junction Boxes for PV modules – safety requirement and tests
  光伏组件接线盒 - 安全要求和测试
- IEC 62804 System Voltage durability test for crystalline silicon modules
  晶体硅组件的系统电压耐久性测试
- IEC 62805-1 Measurement of haze of TCO glass
  测量 TCO 玻璃的雾度
- IEC 62805-2 Measurement of transmittance and reflectance of TCO glass
  IEC 62805-2 测量 TCO 玻璃的透光率和反射率
- IEC 62804 System Voltage durability test for crystalline silicon modules
  IEC 62804 晶体硅组件的系统电压耐久性测试
- CE Certification The Certification product conforms to the European Union (EU) health, safety, and environmental requirements.
  CE 认证 认证产品符合欧盟（EU）健康、安全和环境要求。

In case international standards are not existing or inapplicable, recognized national standards accepted by the Owner/Owner's Engineer shall be used.
如果无相关或可用的国际标准，应使用由发包人/发包人工程师采纳的公认国家标准。

6.1.3 Quality
质量

The Owner expects mature module technology with a proven track record in large- scale rooftop mounted PV installations. References for the module technology are of significant importance. Modules which run the risk of developing degradation effects over a 25

years period, such as corrosion and de-lamination from electrochemical activity, will be viewed unfavorably.
发包人希望使用在大型屋顶安装光伏设备方面具有良好记录的成熟组件技术。组件技术的证明文件是非常重要的。存在 25 年内发生电化学活性引起的腐蚀和分层等退变影响风险的组件不被看好。

For the PV modules, the quality certificates of following standards listed below shall be provided and they shall be certified by qualified accredited independent third party. The flash data of each PV module shall be submitted to the Owner/Owner's Engineer in Excel format before each shipment.The encapsulation used shall be formulated and produced by a known manufacturer who has been operating for more than 7 years in the PV industry. The Bidder may consider using glass–glass technology.
对于光伏组件，应提供符合下列标准的质量证书，并由具有合格资质的独立第三方认证。应在每次发货前以 Excel 格式向发包人/发包人工程师提交每个光伏组件的击穿测试数据。使用的封装剂应由在光伏行业经营 7 年以上的知名生产商家研制并生产。投标人可考虑使用双层玻璃技术。

- IEC 60068-2-68 Dust and Sand Environmental Testing
  IEC 60068-2-68 粉尘和沙环境测试
- IEC 61730 Construction requirements for PV modules
  IEC 61730 光伏组件施工要求
- IEC 61215 Test Requirements for PV modules
  IEC 61215 光伏组件测试要求
- IEC 62804 PID Testing (For c-Si modules)
  IEC 62804 PID 测试（对于 c-Si 组件）
- IEC 61701 Salt Mist Corrosion Testing
  IEC 61701 盐雾腐蚀测试
- IEC 62716 Ammonia Corrosion Testing
  IEC 62716 氨腐蚀测试
- UL 1703 Standard for Flat-Plate PV Modules
  UL 1703 平板型光伏组件标准

PV modules shall be free from Potential Induced Degradation (PID). Tests from an accredited independent third party shall be required. Where IEC 62804 does not apply to certain modules (Thin Film / Glass Glass) Tests from an accredited independent third party shall be required.
光伏组件应不受电势诱导衰减（PID）的影响。应由公认的独立第三方进行测试。如 IEC 62804 不适用于某些组件（薄膜/双层玻璃）时，需由被公认的独立第三方进行测试。

The Quality Management System of the PV module manufacturer's factory shall be certified according to ISO 9001 and ISO 14001 by an internationally recognized Certification Authority.

光伏组件制造商的质量管理体系应由国际公认的认证机构按照 ISO 9001 和 ISO 14001 标准进行认证。

The PV modules shall be safely packed in upright position ready for marine freight and domestic transportation.
光伏组件应安全直立包装，以备海运和国内运输。

The Contractor has to deliver a quality control report before the commissioning period.
承包人必须在调试前提交质量控制报告。

The Owner reserves the right to visit the PV module factory at any time during the manufacturing process to verify quality and timely of the production.
发包人保留在制造过程中随时探访光伏组件工厂、查验生产质量和进度的权力。

6.1.4 Quality assurance for PV modules (Certification provided by suppliers)
光伏组件的质量保证（由组件厂家提供相关证明）

批注 [S4]: Please do not confuse this with the testing of modules when arriving on site. These are standard tests that the suppliers are doing regularly and for which they have certified test reports available. We have to keep this in, please.

The PV modules standard certifications need to be provided by suppliers, the Owner need to inform the special requirement before signing the contract. Testing shall be performed by an accredited independent certified third party. The test report shall be submitted to the Owner/Owner's Engineer for approval. The Contractor shall organize and facilitate the Owner/Owner's Engineer visit and/or testing at the factory, if required by the Owner.
光伏组件的标准测试报告应由厂家提供，发包人需在合同签署前明确有无其他特殊需求。应由公认的独立认证第三方进行。测试报告应提交给发包人/发包人工程师审批。如果发包人要求，承包人应组织并协助发包人/发包人工程师在工厂进行参观和/或测试。

The following tests shall be carried out, but not limit to, as listed below:
需进行以下测试，但不限于如下所列内容：

- UV light exposure from module front and back
  组件正面和背面的紫外线照射
- Module behavior test (irradiation and temperature)
  组件行为测试（辐照和温度）
- Module performance tests (I-V curve)
  组件性能测试（I-V 曲线）
- Module electroluminescence tests
  组件电致发光测试
- Module thermography tests
  组件热成像测试
- Temperature coefficient
  温度系数

- Power at STC
  标准测试条件下电源
- Backsheet test (according to type of module)
  底片测试（根据组件类型）
- Gel content of EVA layer (≤70 % after polymerization)
  EVA 层凝胶含量（聚合后≤70％）
- Flash test with the testing report shall be provided for each PV module. The sun simulator must meet the class AAA requirements as specified in IEC 60904-9 standard. The sun simulator must be calibrated with a reference cell, with a maximum uncertainty 1% of ISC. The flash test report shall contain the unique barcode number with performance parameters (maximum power, short-circuit current, open-circuit voltage, maximum current, maximum voltage) of the module. The flash-test results must be equal or higher than the nameplate rating of the module.
  应为每个光伏组件提供闪光测试并出具测试报告。太阳模拟器必须达到 IEC 60904-9 标准中规定的 AAA 级要求。太阳模拟器必须用参比池进行校准，ISC 的最大不确定度为 1％。闪光测试报告应包含组件的性能参数（最大功率、短路电流、开路电压、最大电流、最大电压）的唯一条形码。闪光测试结果必须大于或高于组件铭牌额定值。
- The barcode shall be on the nameplate of the modules, on the side of the aluminum frame (if any) and on the front side of the solar module in permanent lasting technology, e.g. laser-engraved.
  条形码应位于组件的铭牌上、铝框架侧面（如有）和采用永久固定技术（如激光雕刻）的太阳能组件正面。
- Visual inspection is required for defects of scratched front surface, misaligned cells, poor labelling and poor sealing.
  对于前表面划、电池不对齐、标签不良和密封性差等缺陷，需要目视检查。
- Modules must undergo Electroluminescence (EL) inspection with a resolution of minimum 12 MPixel with the testing report provided for each individual shipment. The EL pictures must be in focus. A maximum of 5 minor defects and no major defects per module are allowed.
  组件须进行电致发光（EL）检测，分辨率至少为 12 万像素，并提供针对每批货物的检测报告。 EL 照片必须清晰。每个组件最多可以有 5 个小缺陷，无重大缺陷。
- EVA cross linking has to be verified per production line through a gel content test supervised by an accredited (IEC 17025 or national pendant) independent certified module testing agency. The Testing Certificate should be submitted during Bidding stage.
  EVA 交叉连接必须通过有资质的(IEC 17025 或国家)独立认证组件检测机构的凝胶含量测试。测试证书应在投标阶段提交。

- Damp Heat Testing for a duration of minimum 2,000 h, certified by an independent 3rd party performed for the selected module type within the last 3 years is a critical selection criteria for the Owner. Testing procedure including certificate is required to be provided during Bidding stage.
  湿热试验至少持续 2000 小时，特定组件类型必须在最近 3 年内经过独立第三方认证。投标阶段需要提供包括证书在内的测试流程。

- Thermal cycling test for a minimum of 400 cycles in accordance to IEC 61215 is required. The testing certificate shall be provided during Bidding stage.
  需要根据 IEC 61215 进行至少 400 次循环的热循环试验。测试证书在投标阶段提供。

6.1.5 Quality assurance for PV modules (pre-shipment by manufacturer)
光伏组件的质量保证（制造商发货之前）

Prior to the shipment, 100% of the finished PV modules shall be tested by manufacturer to ensure that PV modules are sufficiently qualified.
出货之前制造商要对成品光伏组件进行测试，确保 100％合格。

The following tests shall be carried out, but not limited to, as listed below:
须进行但不限于以下测试：

- Flash test with the test report shall be provided for each PV module. The sun simulator must meet the class AAA requirements as specified in IEC 60904-9 standard. The sun simulator must be calibrated with a reference cell, with a maximum uncertainty 1% of ISC. The flash test report shall contain the unique barcode number with performance parameters (maximum power, short-circuit current, open-circuit voltage, maximum current, maximum voltage) of the module. The flash-test results must be equal or higher than the nameplate rating of the module.
  应为每个光伏组件提供闪光测试并出具测试报告。太阳模拟器必须达到 IEC 60904-9 标准中规定的 AAA 级要求。太阳模拟器必须用参比池进行校准，ISC 的最大不确定度为 1％。闪光测试报告应包含组件的性能参数（最大功率、短路电流、开路电压、最大电流、最大电压）的唯一条形码。闪光测试结果必须大于或高于组件铭牌额定值。

- The barcode shall be on the nameplate of each module, on the side of the aluminum frame (if any) and on the front side of the solar module in permanent lasting technology, e.g. laser-engraved.
  条形码应位于组件的铭牌上、铝框架侧面（如有）和采用永久固定技术（如激光雕刻）的太阳能组件正面。

- A narrow range of module power tolerances is expected. Pre-sorting of solar modules according to actual IMPP in minimum 3 classes shall be conducted, with one IMPP-class per container.
  发包人期望光伏组件的功率容差在较窄范围之内。应根据实际 IMPP 对光伏组件进行至少 3 个级别的预先分选，每个集装箱中配置 1 种 IMPP 级别的组件。

- Visual inspection is required for defects of scratched front surface, misaligned cells, poor labelling and poor sealing.
  对于前表面划、电池不对齐、标签不良和密封性差等缺陷，需要目视检查。

6.1.6 Quality assurance for PV modules (on-site)
光伏组件的质量保证（现场）

Modules delivered to site shall undergo testing prior to release for installation of the contents of each container with following minimum testing being required.
交付到现场的组件应在使用之前进行测试，以便安装每个集装箱内的设备，并要求至少进行以下测试。

The delivered PV modules shall be tested on site to ensure performance during:
交付的光伏组件应在现场进行测试，以确保性能:

- Incoming goods inspection (after shipping):
  入场检验(发货后):

  1. Modules site shall undergo visual testing prior to release for installation of the contents of each container with following additionaltesting being required.
     安装每个集装箱内的设备之前，组件现场应进行可视化测试，并要求另外进行以下测试。

  2. Modules shall undergo an inspection of 4 modules per MW_p for Electroluminescence and PID Testing by an independent testing agency.
     应由独立测试机构按每 MW_p 进行 4 个组件一组的电致发光和 PID 测试的检测。

  3. Modules shall undergo an incoming inspection at a rate of 4 modules per MWp by an independent testing agency. The test include Flash test, Insulation Test, Low Irradiance Test, Wet Leakage Test.
     组件应以每 MWp 容量以 4 个组件一组由独立测试机构进行检测。检测包括闪光测试、绝缘测试、低照度测试、湿漏测试。

- Commissioning and test on completion
  试运行和竣工试验

The site tests shall be witnessed by the Owner/Owner's Engineer. The commissioning test program shall be submitted by the Contractor at least two weeks prior to start of the tests. All relevant costs for the above tests shall be borne by the Contractor.
现场试验应由发包人/发包人工程师见证。承包人在开始测试前至少提前两周提交试运行测试程序。上述测试的所有费用由承包人承担。

6.1.7 PV Module tests by independent test agency
由独立测试机构进行的光伏组件测试

Independent tests shall be performed to guarantee high quality of PV modules. The number of photovoltaic modules for non-destructive tests, tested by an independent third party shall be 4pcs of modules. The modules shall be selected according to the

instructions of the Owner/Owner's Engineer from different delivery lots. The independent tests shall include as a minimum the following measurements.
应进行独立测试以保证光伏组件的高质量。由独立第三方进行非破坏性检测的光伏组件数量为 4 个组件。应根据发包人/发包人工程师的指示，选择从不同地点交付的组件。独立测试应至少包含以下项目，

批注 [5]: Please Hally to confirm the test items

批注 [S6]: Agreed tests are: Power at STC, IV curve, Insulation, low irradiance, wet leakage, PID and EL, LID, 2*Mono and 2*Poly

Electroluminescence and PID Testing by an independent testing agency.
由独立测试机构进行电致发光和 PID 测试。

- Power at STC (Flash Test)
  标准测试条件下的功率测试（闪光测试）
- Irradiation performance (I-V Curve)
  辐照性能（I-V 曲线）
- LID
  温度系数
- Bypass Diode Test
  旁路二极管测试
- Insulation Test, Low Irradiance Test, Wet Leakage
  绝缘测试、低照度测试、湿漏

Details of each test:
测试细节：

Electroluminescence Testing:
电致发光测试：

The modules shall undergo EL-inspection. A major defect shall be defined as:
组件应进行 EL 检查。重大缺陷定义为：

- a crack, causing an inactive area of any cell (as seen in black color of the cell in the EL picture); or
  导致电池不工作的裂缝（如在 EL 照片中电池出现黑色所示）; 或
- interruption 5 or more cell fingers in any areas of the cell; or
  电池区域 5 个以上电池板不工作；
- interruption of 3 or more cell fingers in the outer areas of the cell (between busbar and edge cell).
  电池外部区域（母线和边缘电池之间）3 个以上电池板不工作。

In case one or more major defects in one of the modules is reported, the Contractor shall inspect all modules of the shipment within three (3) days and remove the modules with defects and replace them with new modules prior to installation.
如果其中一个组件出现一个或多个重大缺陷，承包人应在三（3）天内检查货物的所有组件，在安装之前拆除有缺陷的组件并更换新组件。

PID Testing:

PID 测试：

PID test according to IEC 62804: The maximum accepted power loss is 5%; the test shall comply with the applicable version of tests offered by IEC 62804.
根据 IEC 62804 进行 PID 测试：最大可接受的功率损耗为 5％; 测试应符合 IEC 62804 提供的适用版本。

Bypass Diode Test

旁路二极管测试

The temperature of the bypass diodes under hot-spot conditions shall be tested and evaluated according to IEC 61215. Therefore the module shall be heated up to 75°C and a current equal to the short circuit current measured at STC shall be applied for 1 hour. Thereafter, the current shall be increased to 1.25 times the short-circuit current of the module for another hour, maintaining the module temperature at the said temperature level. The diode shall be still operational.
热点条件下，旁路二极管的温度应根据 IEC 61215 进行测试和评估。因此，组件应加热到 75°C，并应在标准测试条件下测量短路电流 1 小时。此后，将电流增加到组件短路电流的 1.25 倍再测试一个小时，使组件温度保持在所述温度水平。二极管应当仍然可以工作。

Flash Test:

闪光测试：

Actual power: The MW_p-DC-STC is the flash-tested DC power capacity of the installed modules at Standard Testing Conditions. The module shall be flash tested for STC-power after arrival on site. The STC-power shall be measured on a class AAA simulator (IEC 60904) which is calibrated with a primary calibrated reference module by an independent laboratory (reference module for example calibrated by NREL/USA or AIST/Japan or comparable institution providing first level calibration with an uncertainty of I_{sc} max. 1%).
实际功率：MW_p-DC-STC 是指在标准测试条件下安装组件经过闪光测试的直流功率容量。到达现场后，组件将进行标准测试条件下功率的闪光测试。标准测试条件下功率应在 AAA 级仿真器（IEC 60904）上进行测量，仿真器应当通过独立实验室（例如，由 NREL/美国或 AIST/日本或具有一级校准标准 I_{sc} 最大不确定度为 1％的同类机构）进行校准。

Low Irradiance Testing:

低照度测试：

Power at 200 W/m²: For the 2nd real power sample the efficiency at 200 W/m² shall be measured with the test procedure similar to Flash Test and must be equal or more than 95% of the efficiency at STC for more than 90% of the samples.
200W /m²的功率：对于第二个有功功率样品，采用类似于击穿测试的测试流程应当测得样本效率为 200 W/m²，标准测试条件下 90%以上的样本应测得效率大于或等于 95％。

Insulation Test:

绝缘测试：

According to IEC61215: Minimum insulation shall not be less than 40 MOhm for every square meter.
根据 IEC61215：每平方米最小绝缘不得低于 40 MOhm。

Wet Leakage Test:
湿漏测试：

According to IEC 61215: In wet condition, minimum insulation shall not be less than 40 MOhm for every square meter.
根据 IEC 61215：潮湿条件下，每平方米最小绝缘不得低于 40 MOhm。

6.1.8 Cost of the Quality assurance
质保成本

Cost of the Quality assurance for PV modules in laboratory will be borne by the awardedContractor.
实验室光伏组件质保测试的所有成本应由投标成功的承包人承担。

6.1.9 Installation Requirements
安装要求

The PV modules shall be installed according to the manufacturer's standards and guidelines using only components approved by the module manufacturer.
光伏组件应按照制造商规定的标准和指导方针安装，仅允许使用制造商认可的元件。

6.1.10 Other Obligations
其它义务

The Contractor shall sort and install the modules according to the Power and Current Classes. The Classes categories shall be approved by the Owner's Engineer prior modules installation.
承包人应根据功率和电流等级对组件进行分类和安装。等级类别应由发包人工程师在安装前批准。

6.1.11 Warranties
保修

A product warranty of minimum ten (10) years shall be provided and a linear power output warranty of 80% after 25 years.
应提供至少十（10）年的产品保修，25 年后，产品的线性功率输出应保证在目前水平的 80％以上。

6.1.12 Required Documentation
所需文件

A complete set of following documents shall be submitted to the Owner/Owner's Engineer in the Bid documents as listed below.
下列文件应在投标文件中整体提交给发包人/发包人工程师。

- Module data sheet
  组件数据表
- IEC, ISO and PID certificates as stated above
  IEC、ISO 和 PID 证书，如上所述
- EVA cross link testing certificates as stated above
  EVA 交叉链接测试证书，如上所述
- Minimum efficiency curve at 200 W/m² (25°C, AM 1.5)
  200 W/m² (25°C, AM 1.5)条件下的最小效率曲线
- Degradation curve and table from manufacturer
  制造商提供的衰减曲线和表格
- Provide guaranteed power output 25 years
  提供 25 年的功率输出保证
- Relative power conversion efficiency reduction and I-V curves for different light intensities
  相对功率转换效率的降低和不同光强的 I-V 曲线
- Manufacturers confirmation for the suitability of module for specific weather conditions and the high UV-radiation
  制造商确认组件是否适合特定天气条件和高紫外线辐射
- Damp heat test and Thermal cycling certificate
  湿热测试和热循环证书
- Sample Flash report of modules
  组件样本击穿测试报告
- Installation and maintenance manual
  安装和维护手册
- Factory testing quality protocol
  电站测试质量协议
- CE Conformity Declaration
  CE 符合性声明

6.2 Inverter Concepts
逆变器概念

Only a single inverter concept shall be submitted by the Bidder, multiple inverter concepts is not prefered.
投标人只能提交一个逆变器概念，多个逆变器概念将不被优先考虑。

6.2.1 General
一般要求

This Section describes the requirements for the design, manufacturing, installation, testing and commissioning of the inverter to be provided for the PV power plant. The minimum technical requirements are described in Section 4.2.3.本节介绍了光伏电站所使用逆变器的设计、制造、安装、测试和调试的要求。第 4.2.3 节介绍了最低技术要求。

The cumulative installed nominal AC output power of the inverters shall be suitable for PV module output in all ambient conditions without clipping of plant output.
逆变器的累计安装额定交流输出功率应适合所有环境条件下的光伏组件输出，不得减少电站输出。

The inverters shall be selected and sized by the Bidder to ensure a safe and efficient functioning together with the PV field electrical characteristics (among others for the Maximum Power Point (MPP) range in accordance to the climatic conditions prevailing on site).
投标人应根据现场气候条件选择和确定逆变器的尺寸，确保符合光伏电站工程现场的特点（其中包括最大功率点（MPP）范围）。

The inverter should be equipped with all necessary protections on the DC and AC side as per the international norms, Local standards and electrical authority's requirements as stated in Section 4.1.
逆变器应按照第 4.1 节所述的国际规范、地方标准和电力局的要求，为直流和交流侧配备所有必要的保护装置。

Generally the inverters should be manufactured to a high standard by a single reputable manufacturer be on the Electrical Authority's approved list.
一般而言，逆变器应由电气管理局批准名单上的有信誉的制造商按照高标准进行生产。

6.2.2 Codes and Standards
规范和标准

The inverter shall be designed, manufactured and tested in full compliance with the latest edition of the following, but not limited to, standards, codes, rules and regulations:
逆变器的设计、制造和试验应完全符合但不限于下列最新版本的标准、规范、规定和条例：

- DIN / VDE 0126-1-1 Automatic disconnection device between a generator and the public low-voltage grid
  DIN / VDE 0126-1-1 发电机与公共低压电网之间的自动断开装置

- DIN EN 50178 Electronic equipment for use in power installations
  DIN EN 50178 供电设施用电子设备

- DIN EN 50524 Data sheet and name plate for photovoltaic inverters
  DIN EN 50524 光伏逆变器数据表和铭牌

- EN 50530 Overall efficiency of photovoltaic inverters
  EN 50530 光伏逆变器总效率

- EN 55022 Information technology equipment. Radio disturbance characteristics. Limits and methods of measurements
  EN 55022 信息技术设备的无线电干扰限值和测量方法

- IEC/EN 61000-3-11 Electromagnetic compatibility (EMC) - Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection
  IEC / EN 61000-3-11 电磁兼容性（EMC） - 第 3-11 部分：限值 - 公共低压电源系统中电压变化、电压波动和闪烁限制 - 额定电流≤75 A 且受连接条件限制的设备

- IEC/EN 61000-3-12 Electromagnetic compatibility (EMC) - Part 3-12: Limits – Limit's for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase
  IEC/EN 61000-3-12 电磁兼容性(EMC).- 第 3-12 部分: 限值.- 与输入电流每相>16 A 和≤ 75A 的公共低压系统连接的设备产生的谐波电流的限值

- IEC/EN 61000-6-1 Electromagnetic compatibility (EMC) – Part 6-1: Generic standard – Immunity for residential, commercial and light – industrial environments
  IEC/EN 61000-6-1 电磁兼容性. (EMC) - 第 6-1 部分: 通用标准.- 住宅、商业和轻工业环境抗扰度

- IEC/EN 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
  IEC/EN 61000-6-2 电磁兼容性(EMC)-第 6-2 部分:通用标准 - .工业环境中的抗扰度

- IEC/EN 61000-6-3 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
  IEC/EN 61000-6-3 电磁兼容性(EMC) - .第 6-3 部分: 通用标准.- 住宅、商业和轻工业环境用辐射标准

- EN 61000-6-4 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
  EN 61000-6-4 电磁兼容性(EMC)-第 6-4 部分: 通用标准.- 工业环境的辐射标准

- EN IEC 60068 Environmental testing
  EN IEC 60068 环境测试

- IEC 60146-1-1 Semiconductor convertors - General requirements and line-commutated convertors - Part 1-1: Specifications of basic requirements
  IEC 60146-1-1 半导体变流器. - 总体要求和线路整流转换器.- 第 1-1 部分: 基本要求规范
- IEC 60529 Degrees of protection provided by enclosures (IP code)
  IEC 60529 由外壳提供的防护等级(防护等级代码)
- IEC 61140 Protection against electric shock - Common aspects for installation and equipment
  IEC 61140 触电防护 - .装置和设备的共同问题
- IEC 61183 Electroacoustics - Random-incidence and diffuse-field calibration of sound level meters
  IEC 61183 电声学.- 声级计无规入射声场及扩散声场校正
- IEC 61683 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
  IEC 61683 光伏系统 - 功率调节器. - 效率测量程序
- IEC 62093 Balance-of-system components for photovoltaic systems - Design qualification natural environments
  IEC 62093 光伏系统的系统平衡部件 - .设计资质自然环境
- IEC 61721 Photovoltaic (PV) systems - Characteristics of the utility interface
  IEC 61721 光伏系统 – 电网界面的特征
- IEC/EN 62109-1 Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
  IEC/EN 62109-1 光伏发电系统电力转换设备的安全 - .第 1 部分: 一般要求
- IEC 62109-2 Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
  IEC 62109-2 光伏发电系统电力转换设备的安全.- 第 2 部分: 逆变器的特殊要求
- IEC 62116 Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters
  IEC 62116 通用互联光伏逆变器孤岛效应预防措施测试规程
- IEC 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
  IEC 61000-6-2 电磁兼容性(EMC)-第 6-2 部分:通用标准.-工业环境中的抗扰度
- NB/T32004-2013 HarmonicsNB/T32004-2013 谐波
- IEC 61727:2004 Photovoltaic (PV) systems - Characteristics of the utility interface
  IEC 61727：2004 光伏（PV）系统 – 电网接口的特性

6.2.3 Operating Conditions
运行环境

The inverters shall be designed and constructed for continuous operation under the climatic and environmental conditions. Additional requirements defined by other chapters of the request for proposal document and the Electrical Authority's Interconnection Code shall be considered.
逆变器的设计和构造应能在气候和环境条件下连续运行。应考虑征求建议书文件和电气管理局互连规范的其它章节所规定的附加要求。

The system of protection shall be selected and coordinated in line with the feeding network data and the connected component requirements:
保护系统应根据馈电网络数据和连接元件的要求进行选择和协调：

- To guarantee personnel and plant safety.
  保证人员和电站的安全。
- To ensure a sufficient protection against damages of the components, that might arise from the internal and external short circuits as well as from possible atmospheric discharges.
  确保有足够的防护，防止内部/外部短路以及可能的大气放电引起的部件损坏。
- To ensure as far as possible the continuity of operation for those parts not concerned by the fault. This will be achieved by selecting the setting in a way such that in case of a fault the closest protection device to the fault trips first.
  尽可能确保未受故障影响的部件连续运行，即：通过适当的设置，实现"只有故障设备跳闸"的选择性跳闸。
- Overvoltage protection devices / function shall be included.
  应包含过压保护装置/功能。

All components and devices shall have a high durability, long term stability, and high quality protection coating in order to withstand the site environment. Damages due to transportation, installation, or commissioning shall be repaired to ensure that the inverter can fully perform as specified in the datasheet.
所有组件和设备应具有高耐久性、长期稳定性和高质量的保护涂层，以承受现场环境。运输、安装或调试造成的损坏应予以修理，确保逆变器能完全按照数据表中的规定运行。

6.2.4 Technical Concept
技术概念

The Bidder shall propose the technically and economically most suitable concept that the PV system designed by the Contractor shall be able to supply the electricity at the lowest inventory cost and maintenance cost in the long-run with the highest reliability, availability and performance while meeting the Owner's Requirements in respect of ensuring health and safety to the staff and compliance with agreed standards and regulations over the PV Power Plant life time.
投标人应提出技术上和经济上最合适的方案，即：承包人设计的光伏系统能够以最低的库

存成本和最低的维护成本长期提供具有最高可靠性、可用性和性能的电力，同时满足发包人要求中确保员工的健康和安全的规定，并遵守商定的光伏电站生命周期标准和规定。

6.2.5 Axuiliary Power Supply
辅助电源

Necessary auxiliary power supply shall be provided by the Contractor.
承包人应提供必要的辅助电源。

6.2.6 Cable Connections
电缆连接

Necessary cable connection arrangement for incoming and outgoing cables shall be provided.
应提供进出电缆的必要电缆连接装置。

6.2.7 Communication Protocol
通信协议

A proven communication protocol such as Profibus, Modbus, Ethernet, and so on shall be provided by Contractor.
承包人应提供经过验证的 Profibus、Modbus、以太网等通信协议。

Operation
运行

Synchronisation
同步

Under normal operation, inverters shall be capable of automatically synchronizing with the grid supply. All required functions shall be provided in the inverter for safe and reliable auto synchronization.
正常运行时，逆变器应能自动与电网同步。逆变器应提供所有必需的功能，实现安全可靠的自动同步。

The Contractor shall submit an overall overvoltage and over current protection design for Owner/Owner's Engineer's approval. All inverters may have built-in overvoltage and over current protection devices / functions, otherwise, the protection devices shall be separately provided with appropriate enclosures and installation according to Local standards.
承包人应提交总体过电压和过电流保护设计，报发包人/发包人工程师批准。所有逆变器应内置过压和过流保护装置/功能，否则，保护装置应分别按照当地标准提供适当的外壳和装置。

Groundings
接地

Each inverter shall be connected to the grounding system with a cable of adequate diameter. Manufacturer requirements shall be followed by the Contractor.
每台逆变器应使用适当直径的电缆连接到接地系统。承包人应遵循制造商的要求。

Electromagnetic Compatibility (EMC)
电磁兼容性（EMC）

The inverter shall be tested for electromagnetic compatibility in accordance with standards EN 61000-6-2 (interference immunity) and EN 61000-6-4 (interference emission).
逆变器应根据 EN 61000-6-2（抗干扰）和 EN 61000-6-4（干扰发射）标准进行电磁兼容性测试。

Earthing of DC Cables
直流电缆的接地

According to module manufacturer requirements the grounding of negative/positive pole shall be provided. The Contractor shall follow the requirements defined by inverter manufacturer.
根据组件制造商的要求，应提供负极/正极接地。承包人应遵守逆变器制造商规定的要求。

6.2.8 Quality assurance for Inverters
逆变器质保

Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) to be carried out by the manufacturer or manufacturer's certified party and appointed Contractor. The Inverters shall be completely tested in the manufacture's workshop in accordance with applicable codes and standards. The tests shall at a minimum include:
电站验收测试（FAT）和现场验收测试（SAT）由制造商或制造商认可的机构和指定承包人进行。逆变器应在制造车间按照适用的规范和标准进行全面测试。测试应至少包括：

- Check of protection against overload, short-circuit, grid-failure, internal failure, over-temperature (de-rating), surge protection, detection of insulation faults of AC cables. Contractor shall firmly specify the manufacturer, types and length of cables to be installed.
  检查过载、短路、电网故障、内部故障、过温（降额）、浪涌保护、检测交流电缆绝缘故障的保护措施。承包人应明确指出所需安装电缆的制造商、类型和长度。
- Test run in the field for maximum and Max-efficiency of all Inverters
  实施现场试运行，获得所有逆变器的最大效率。
- Test run and check of MPP tracking of all inverters
  试运行并检查所有逆变器的 MPP 跟踪记录。
- The Contractor shall deliver detailed protocols of performance test run (warm power test) for every single inverter.
  承包人应为每台逆变器提供详细的性能试运行协议（温功率测试）。

The inverters shall be tested at site to ensure proper functionality during e.g.
逆变器应在现场测试，以确保其在下列情况下正常运行：

- Visual inspection after delivery on-site
  现场交货后目测检查
- Pre-commissioning (including “loop testing”)
  预调试（包括“循环测试”）
- Commissioning and test on completion as per suppliers installation and commissioning manual
  按供应商安装调试手册进行的试运行和竣工试验

All costs associated with the quality assurance tests of the inverters shall be carried out by the Contractor.
逆变器质保试验的所有费用应由承包人承担。

The site tests may be witnessed by the Owner/Owner’s Engineer. The commissioning test program shall be submitted at least two(2) weeks prior to the tests for approval.
现场试验可以由发包人/发包人工程师见证。试验开始前至少提前两（2）周提交试运行试验流程供批复。

6.2.9 Required Documents
所需文件

Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the Inverters and their components.
应提供完整的文件，用于逆变器及其部件的设计、制造、测试、调试、启动、操作、维护和修理。

The Contractor shall provide as minimum the following documentation:
承包人至少应提供以下文件：

- Technical data sheets
  技术数据表
- Inverter installation manual
  逆变器安装手册
- Layout drawings for all devices
  所有设备的布局图
- Single line diagrams
  单线图
- Wiring diagrams
  接线图

- Spare parts list (only for central inverter)
  备件清单（仅集中式逆变器）
- Operation and maintenance manual
  运维手册
- Reports of tests and commissioning with protocols
  协议试验和调试报告
- Inverter track record
  逆变器跟踪记录
- Electrical Authority's approval certificate
  电气管理局批文

The Bidder shall deliver a manufacturer's confirmation in his Bid for the suitability of the inverter for the specific weather conditions.
投标人标书应提供制造商确认函，保证逆变器适合在特定天气条件下使用。

6.3 LV Switchgear
低压开关柜

6.3.1 General
一般要求

This Section describes the requirements for design, manufacturing, installation, testing and commissioning of the LV Switchgear to be provided for the PV power plant .The minimal technical requirements are described in APPENDIX 9.2.1 of this document.
本节介绍了光伏电站所使用的低压开关柜的设计、制造、安装、测试和调试要求。本文件附件 9.2.1 节介绍了最低技术要求。

The switchgear design shall allow for future extension on either end without modifications to existing cubicles.
开关柜设计应允许在任何一端的扩展，而无需修改现有的机柜。

The Contractor shall complete in every respect of all components and necessary accessories for reliable continuous operation, even if not all details are expressively stated in these specification.
即使本文件未明确规定全部细节，承包人也应提供设备可靠连续运行所必需的全部部件和必要附件。

All components, equipment and installations shall receive the respective tagging plates, nameplates, labels, etc., which have to be of extremely durable material resistant against the environmental conditions. Tagging plates or labels on fronts of enclosures shall be fixed with screws.
所有部件、设备和装置应附有相应标牌、铭牌，标签等，此类标识必须使用非常耐用的耐环境条件材料。外壳上的标牌或标签应用螺钉固定。

All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components of tier one manufacturers shall be used. The Contractor shall provide the spare parts of LV switchgear in case of replacements of defects, damages or faults. The Contractor shall also provide the suppliers list to procure the equivalent components to be replaced in the LV switchgear which are available in the country where the site located. The interchangeability must be guaranteed.
所有组件和设备应设计为在额定负载和特定气候条件下持续工作。应使用一级制造商生产的具有标准工业高性能的系统和部件。承包人应提供低压开关柜的备件，以更换缺陷、损坏或故障。承包人还应提供供应商名单，以便在工程现场所在国家采购低压开关柜需要替换的等效部件。须确保互换性。

6.3.2 Codes and Standards
规范与标准

- GB 14048 Low-voltage switchgear and control gear assemblies
  GB 14048 低压开关设备和控制设备
- GB 50054 Low-Voltage switchgear and controlgear
  GB 50054 低压开关柜和控制柜。
- GB 18802 SPD's connected to LV power Systems
  GB 18802 低压浪涌保护器（SPD）
- GB 4208 Ingress Protection
  GB 4208 外壳防护等级

6.3.3 Enclosure
外壳

The switchgears shall be of a type tested, factory assembled, standardized metal-clad design for freestanding / wall mounted installation. All panels (outdoor, indoor or enclosure) shall be constructed to a suitable IP rating (GB 4208) for the environment and installation type. Each switchgear cubicle shall be completely wired with all instruments and equipment installed and tested at the factory.
开关柜应为经过型式试验并在工厂装配的标准化金属铠装设计，用独立式/壁挂式安装。对于环境和安装类型，所有的面板（室外、室内或外壳）的结构应实现合适的防护等级（GB 4208）。每个开关柜应具备其内部所有工厂安装和测试的仪器和设备的完整接线。

6.3.4 Circuit Breaker
断路器

All switches, circuit breakers and connectors shall confirm to GB 50054. The panelboard shall consist of molded case breaker or fusible switches for incoming feeders (string inverters) and a main molded case circuit breaker or fusible switch for outgoing feeders (Transformer). An additional two (2) spare incoming feeders shall be provided as part of

the panelboard.
所有的开关、断路器和连接器都应符合 GB 50054 标准。配电板由进线侧（组串逆变器侧）的塑壳断路器/熔断器，和出线侧（变压器侧）的一台主塑壳断路器或熔断器组成。应另外提供两（2）路备用进线开关，作为配电板的一部分。

6.3.5 Surge Arrestor
避雷器

At a minimum, type II surge arresters of the metal oxide (Zn0) type equipped with surge counters shall be provided. The arresters shall comply with GB 50057. They shall be capable of resealing against the maximum (TOV).
应至少配备带浪涌计数的金属氧化物（Zn0）型 II 型避雷器。避雷器应符合 GB 50057。应能重新封装以承受最大（暂态过电压）。

The surge arresters shall be modular in type, both varistor based protection and spark-gap based protection, or a combination of both and, may be utilized to limit the voltage on the AC power circuit. The surge arrester shall be correctly configured to the grounding system type proposed by the Contractor.
避雷器应为组件化类型，基于压敏电阻的保护和基于火花间隙的保护，或两者的组合，可用于限制交流电源电路的电压。避雷器应按承包人提出的接地系统类型正确配置。

6.3.6 Busbar System
母线系统

The main and branch busbars shall be of high conductivity drawn electrolytic copper. Busbars shall have high dynamic and dielectric strength with good heat dissipation.
主分支母线应采用高导电率的电解铜。母线应具有较高的动态绝缘强度，散热良好。

Busbars shall be arranged throughout A-B-C left to right, top to bottom, and front to rear. Bus bars shall be permanently labelled by phase. Bus joints shall be bolted with high tensile steel bolts with spring loaded Belleville type washers.
母线应当按照 A-B-C 从左到右，从上到下，从前到后排列。母线应按照阶段作永久性标记。母排接头应用带有弹簧加载式 Belleville 型垫圈的高强度钢螺栓栓接。

Bus bars shall be at least 98 % conductivity copper. Bus bars shall be of the current rating (continuous [A]) shown on the Drawings. All bus bars and connections, except as noted herein, shall be applied on the basis of the minimum cross-sections required for the circuit current rating. Bus bar strength shall withstand strains imposed by starting and short-circuit current. Connections between horizontal and vertical runs of bus bars shall be made with the same size bars as the vertical run bars. Neutral bus shall be full size. A minimum ground bus of 25% (with a cross-section equal to at least 25% of the capacity of the main bus rating) shall be provided, extending along the full length of the switchboard.
母线应至少含有 98％的导电率铜。母线应符合图纸上显示的额定电流（连续[A]）。除本文所述外，所有母线和连接均应根据电路额定电流所要求的最小横截面积来确定。母线强度应能承受起动和短路电流所造成的应变。水平和垂直运行母线之间的连接应使用与垂直

运行电线相同尺寸的电线。中性母线应全尺寸。应提供 25％的最小接地母线（横截面至少等于主母线容量的 25％），沿配电盘的全长延伸。

Horizontal bus shall be full size, tapered bus is not permitted. Bolt holes drilled and tapped for future extension shall be provided at the end of bus bars including neutral and ground bus, so that the addition of a future section would require only the installation of standard bolted splice plates.
水平母线应为全尺寸，不得使用锥形母线。应在母线末端（包括中性母线和接地母线）设置螺栓孔，以便将来扩展，以便今后增加一个部分只需要安装标准的螺栓拼接板。

Bus-duct terminating at switchboard shall be bus connection (Flange-End). Cable connections are unacceptable.
配电盘终端的总线管应是总线连接（法兰端）。不接受电缆连接。

Busbar support shall be halogen free.
母线支撑应不含有卤素。

Ampere ratings for rectangular bus bars shall be in accordance with the temperature rise standard of GB 50149 and UL. Bus size shall not be smaller than the main circuit breaker frame size.
矩形母线的安培额定值应符合 GB 50149 和 UL 的温升标准。总线尺寸不得小于主断路器的框架尺寸。

All connections between bus bars shall be of a bolted-type. Clamps will not be accepted. All bus bars shall be accurately formed, and all holes shall be made in a manner which will permit bus bars and connections to be fitted into place without being forced.
母线之间的所有连接应采用螺栓连接。夹子不被接受。所有的母线应精确布置，所有孔应能使母线和连接在不受力的情况下安装到位。

Bolts, nuts and washers used to maintain contact on bus and connection bars shall be non-ferrous material, zinc-electroplated steel, or of other corrosion resistant processed steel.
用于保持母线和连接杆接触的螺栓、螺母和垫圈应为有色金属材料，镀锌钢或其它耐腐蚀处理钢。

Current carrying nuts shall be made of copper alloy having adequate conductivity and shall be of size to carry the circuit current without exceeding the temperature rise normally specified for copper. Current carrying nuts shall be silver-plated when they are used with connections that are silver-plated.
载流螺母应由具有足够导电性的铜合金制成，其尺寸应足以承载电路电流，而不超过通常规定的铜温升。带电螺母与镀银连接使用时应镀银。

A ground bus, with a cross-section equal to at least 25% of the capacity of the main bus rating, shall be located in the back of the switchboard assembly. Each housing of the assembly shall be grounded directly to this bus.
接地母线的横截面至少等于主母线额定容量的 25％，应位于配电板组件的后部。组件的每个外壳应直接接地到总线上

All connections between bus bars shall be made by drilling and tapping the bus bars and attaching the breakers or jumper bars with cap screws.
母线之间的所有连接应通过钻孔和攻丝母线并用螺钉连接断路器或跨接线完成。

All bus and connection bars and current potential transformers shall be rigidly supported. No magnetic material shall be located between phase conductors.
所有母线和连接杆以及电流互感器应严格支持。相导体之间不应有磁性材料。

All nuts and connections shall be fitted with locking devices to prevent loosening.
所有的螺母和连接都应安装锁定装置以防止松动。

Connections to current transformers, breakers or other devices or equipment in the panel and connected to the bus shall not be used for bus supports.
与电流互感器、断路器或面板上的其它设施或设备的连接不得用于支撑母线。

6.3.7 Indication Instrument and Measuring Transducer
指示仪表和测量变送器

All indicating instruments shall be included and installed in the instrument.
所有指示仪器应包括在仪器中并安装。

The digital multi-meter shall be supplied for each feeder and complete with following functions:
应为每根馈线提供具有以下功能的数字多功能表：

- Voltage measurement
  电压测量
- Current measurement
  电流测量
- Kilo-Watt measurement
  有功功率测量
- Kilo-Var measurement
  无功功率测量
- PF measurement
  功率因数测量
- Kilo-Watt-hour measurement
  有功电能测量
- Kilo-Var-hour measurement
  无功电能测量

All indicating shall be provided for remote indication sending by communication port to control center.
所有指示应提供通过通信端口发送到控制中心的远程指示。

6.3.8 Tests
试验

A comprehensive SAT and FAT (tests according to IEC 61439) has to be conducted. The SAT has to be witnessed by the Owner/Owner's Engineer and the Contractor. The Contractor shall carry the costs for all testing. Prior to the tests 30 days, a test procedure shall be submitted to the Owner/Owner's Engineer for the approval.
发包人/发包人工程师和承包人必须进行并见证综合性 SAT 和 FAT 测试（按照 IEC 60076 进行测试）。承包人应承担全部测试费用。测试之前 30 天，测试流程应报发包人/发包人工程师批准。

A full protocol and test results shall be submitted to the Owner's Engineer after the testing.
测试结束后，应将完整的协议和测试结果提交给发包人工程师。

6.3.9 Warranties
保修

A minimum product warranty as stated in APPENDIX 9.2.1 shall be provided.
应提供附件 9.2.1 项所述的最短产品保修期。

6.3.10 Required Documents
所需文件

The Contractor shall provide the following documents for the LV Switchgear:
承包人应为低压开关柜提供以下文件：

- Technical data sheets
  技术数据表
- Layout drawings of the switchgear
  开关柜的布局图
- Single Line Diagrams and Wiring Diagrams incl. termination drawings
  单线图和接线图 竣工图纸
- Warranty
  保修
- Protection relay schedule
  保护继电器整定表
- Spare parts list
  备件清单

- Operation and maintenance manual including component list with manufacturer information e.g. catalogue, etc.
  运维手册，包括（产品目录等）制造商信息的组件列表

- Reports of tests and commissioning with protocols Tests
  包含协议测试的测试和调试报告

6.4 Medium Voltage Switchgear
中压开关柜

(Optional in case of multiple transformer / inverter stations)
（当存在多个变压器/逆变器站时，此部分为可选）

6.4.1 General
一般要求

The Contractor is responsible to supply the necessary main MV Switchgear for the grid or utility MV connection of the PV power plant. The main MV Switchgear shall be located in the MV Room of the control building of the PV power plant and shall include all necessary protection and communication devices as well as the required energy meters.
承包人负责为光伏电站的电网或公用设施中压电网提供必要的主要中压开关柜。主中压开关柜应位于光伏电站控制室的中压室，并应包括所有必要的保护和通信设备以及所需的电表。

The switchgears shall be of a type tested, factory assembled, standardized metal-clad design for freestanding indoor installation. Each switchgear cubicle shall be completely wired with all instruments, relay and equipment installed and tested at the factory. The cubicles shall be lined up side by side and be individually separable.
开关柜应为经过型式试验并在工厂装配的标准化金属铠装设计，用于独立式室内安装。每个开关柜均应与所有在工厂安装和测试的仪表、继电器和设备完全连接。柜体间应并排排列，可单独分开。

The switchgear design shall allow for future extension on either end without modifications to existing cubicles and shall be mounted on base frames specially provided for this purpose.
开关设计应允许在任何一端扩展，而不改变现有机柜，并应安装在专门为此目的提供的底座上。

All operations of the truck/rack, circuit breaker and earthing switch for cable earthing shall be executed from outside of the cubicle without the need to open any cubicle door.
用于电缆接地的搬运车/机架、断路器和接地开关的所有操作均应从柜外进行，无需打开隔间门。

Complete in every respect of all components and necessary accessories for reliable continuous operation, even if not all details are expressively stated in these specification.
即便本规范中未明确规定所有细节，承包人仍应为设备的可靠连续运行提供必需的部件和必要的附件。

All components, equipment and installations shall receive the respective tagging plates, nameplates, labels, etc., which have to be of extremely durable material resistant against the environmental conditions. Tagging plates or labels on fronts of enclosures shall be fixed with screws.
所有部件、设备和装置应附有耐用、耐环境条件的材料制成的标牌、铭牌、标签等。外壳上的标牌或标签应用螺钉固定。

All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components of tier one manufacturers shall be used. The Bidder shall provide the spare parts of MV switchgear in case of replacements of defects, damages or faults. The Bidder shall also provide the suppliers list to procure the equivalent components to be replaced in the MV switchgear which are available in the country where the site located. The interchangeability must be guaranteed.
所有部件和设备应设计为在额定负载和特定气候条件下持续工作。应使用一级制造商的标准工业高性能系统和组件。投标人应提供中压开关柜备件，以更换缺陷、损坏或故障。投标人还应提供供应商名单，以便在工程现场所在国采购中压开关柜需要替换的等效部件。互换性必须得到保证。

On the switchgear doors a mimic diagram with position indication of switching devices shall be tagged.
开关柜门上应标注带有开关柜位置指示的模拟图。

6.4.2 Codes and Standards
规范和标准

All design, calculations, materials, equipment required within the scope of works, manufacture, construction and testing shall conform as a basic requirement with the latest edition of the following standards:
工程、制造、施工和试验范围内所需的所有设计、计算、材料和设备，均应符合下列最新版本的基本要求：

- GB 4208 Degrees of protection provided by enclosures (IP Code)
  GB 4208 外壳提供的防护等级（防护等级代码）
- GB 4205 Basic and safety principles for man-machine interface, marking and identification – actuating principles
  GB 4205 人机界面的基本和安全原则，标记与识别 —— 工作原理
- GB 11022 High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear
  GB 11022 高压开关设备和控制设备标准的共用技术要求——第 1 部分：交流开关柜和控制柜的通用规范
- GB16935-1 Insulation co-ordination - Part 1: Definitions, principles and rules
  GB 16935-1 低压系统内设备的绝缘配合 第一部分：原理、要求和实验

- GB 20840-1 Instrument transformers - Part 1: General requirements
  GB 20840-1 互感器 - 第 1 部分：通用技术要求
- GB 20840-2 Instrument transformers - Part 2: Additional requirements for current transformers
  GB 20840-2 互感器-第 2 部分：电流互感器的补充技术要求
- GB 20840-3 Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
  GB 20840-3 互感器 - 第 3 部分：电磁式电压互感器的补充技术要求
- GB 14598 Electrical relays
  GB 14598 电气继电器

6.4.3 Minimum Requirements
最低要求

The product shall comply with the minimum requirements described in APPENDIX 9.2.2.
产品应符合附件 9.2.2 节所述的最低要求。

6.4.4 Enclosure
外壳

The individual panels shall be of self-supporting, freestanding, and metal-clad type. They shall be assembled of steel members and steel sheets and equipped with bottom frames suitable for bolting to the concrete floor.
各面板应为自承、独立、金属包覆类型。应由钢构件和钢板组装而成，并配备适合用螺栓连接到混凝土地面的底部框架。

The enclosure of each panel shall be divided into several compartments.
每面盘柜的外壳应分成几个隔室。

Each panel shall be segregated into compartments by steel sheets for at least the following:
每面盘柜应由钢板分隔成至少以下几个部分：

- Circuit breaker (draw-out type)
  断路器（抽出式）
- Bus bars
  母线
- Current transformers, grounding switch, and cable termination
  电流互感器、接地开关和电缆终端
- Voltage transformers
  电压互感器

- Low voltage equipment
  低压设备

6.4.5 Circuit Breaker
断路器

The circuit breakers (CB) shall be of vacuum or SF6 type and draw-out type on sliding rack. The circuit breakers shall have the following accessories (per Local Grid Standard) as a minimum:
断路器（CB）应为真空或 SF6 型，滑动架上抽出式。断路器应至少具有以下附件（按照本地电网标准）：

- Two (2) Tripping Coil
  两（2）个脱扣线圈
- Two (2) Trip Circuit Supervision relay
  两（2）个跳闸电路监控继电器

The drive system shall be supplied by the $110V_{DC}$ system. Manual operation must also be provided. A suitable spring energy storage system shall ensure uniform and reliable closing. The spring shall be automatically recharged by an electric motor, and manually recharged if the power supply shall fail. The mechanism shall be trip-free.
驱动系统应采用 110VDC 系统进行供电。必须提供手动操作功能。适用弹簧储能系统应确保关闭过程的一致性和可靠性。弹簧应该可自动地由电机自动进行加载；且电源故障时，应可手动加载。机械机构应有自动解扣功能。

The circuit breaker shall be fitted with mechanical position indicators to indicate:
断路器应配备机械式位置指示器，以指示：

- Spring charged or discharged
  弹簧已加载或除载
- Circuit breaker open or closed
  断路器已断开或闭合
- Operate Counter
  操作台

The circuit breakers shall be provided for local and remote control. The selection of control shall be by means of a key operated selector switch installed on the circuit breaker panel.
应提供用于本地和远程控制的断路器。可通过键控选择开关选择控制方式（键控选择开关装在断路器面板上）。

To ensure the personal safety of the operator it shall only be possible to operate the circuit breaker from outside of the closed cubicle front door by direct acting mechanical linkages.
为了保证操作员人身安全，应该只能从关闭的控制柜前门外侧，通过直接操作机械联运装置操作断路器。

6.4.6 Main and Branch Busbar
主母线和分支母线

The main and branch busbar shall be of high conductivity drawn electrolytic copper.
主母线和分支母线应采用高导电率电解析铜制成。

Busbars shall have high dynamic and dielectric strength with good heat dissipation. The busbar shall be extendable at both ends; such extension shall be easily done with the minimum possible disturbance to the existing busbars.
母线应具备高动态性、高绝缘强度和良好的热损耗性能。母线应可在两端方便地延长；其延长过程对现有母线的影响应尽可能地小。

6.4.7 Earthing Busbar
接地母线

Each switchgear cubicle shall be provided with an earthing bus, copper flat bar of not less than 125 sq. mm. cross-sectional area, running through the length of the switchgear with connecting points in each cubicle for earthing leads. This earthing bus shall be connected to the main grounding system at both ends.
每个开关柜应配接地母线；接地母线的横截面积不应小于 125 平方毫米，贯穿整个开关柜长度方向，且在每个柜内均安排有连接点，用来连接接地线。接地母线的两端应连接至主接地系统。

6.4.8 Earthing Switch
接地开关

Each incoming feeder and each outgoing (transformer) feeder shall be equipped with a hand operated earthing switch.
每根馈入线和馈出线（变压器的）均应配手动接地开关。

An interlock shall be provided to enable closing if the relevant MV circuit breaker is in the service position and the remote feeding circuit breakers or LBS are open. Moreover, it shall not be possible to move in a circuit breaker rack when the earthing switch is closed.
应提供有联锁装置，以在相关中压断路器进入工作状态、远程馈电断路器或 LBS 断开的情况下可执行闭合操作。此外，接地开关闭合后，不得可以进入断路器支架。

Incoming feeder from Local Grid shall be provided with the interlock to enable closing if the Local Grid circuit breaker or Local Grid LBS are open.
从本地电网引出的进线馈电器应配联锁装置，以在本地电网断路器或本电电网 LBS 断开的情况下可执行闭合操作。

6.4.9 Instrument Transformer
仪表互感器

The instrument transformers shall be of cast resin insulated, dry type. All instrument transformers of the feeder cubicles shall be mounted on the fixed part of the switchgear and correspond to the design short circuit level of the switchgear.

仪表互感器应采用干式浇铸树脂绝缘变压器。馈线柜的全部仪表互感器都应安装在开关柜的固定部件上，且与开关柜的设计短路电平相吻合。

The rating of each instrument transformer shall comply with the requirements, in particular as far as adequate accuracy, saturation factor, rated burden and insulation levels are concerned.
每个仪表互感器的额定参数应符合相关要求，尤其是与足够的精度、饱和因数、额定负载和绝缘电平有关的要求。

Particular reference is made to the relevant protection specifications.
特别提到的相关保护规范。

Current transformers shall be designed for continuous thermal current rating equal to the current rating of the associated switchgear plus 20% over-load as well as for a short time current rating corresponding to the relevant fault level of the circuit.
设计电流互感器时，应使其连续热电流额定值等于相关开关柜的电流额定值加上 20% 的过载值；且其短时额定电流与电路的相关故障水平相一致。

Current transformers shall not be mounted on the CB truck but in the fixed portion of the relevant compartment.
电流互感器不应安装在 CB 车上，而应安装在相关柜室中的固定位置。

6.4.10 Protection Equipment
保护设备

The minimum protection functions supplied shall be as defined in the **electrical authority's (as stated in APPENDIX 9.1)** power network systems interconnection code. The protection function 59N Zero sequence over voltage shall be provided for detecting internal ground fault at system voltage (delta vector group).
提供的最小保护功能需与电力安全局（如附件 9.1 节描述）电网系统连接规范中的定义相一致。应提供保护功能 59N 零序过压，以检测系统电压中的内部接地故障（三角向量组）。

The Bidder shall provide and adjust the design until getting Local Grid approval for the protection logic diagrams, interlocing logic diagrams, tripping and control logic diagrams of MV CB according to regulations issued by the Local Grid.
投标人应提供其设计，并调整其设计，直到中压控制开关柜的保护逻辑图、联锁逻辑图、脱扣与控制逻辑图遵照本地电网发布的法规获得了本地电网审批。

Electronic relays shall be of the programmable microprocessor type incorporating fault and transient measurement memories, matrices for programming tripping sequences with continuous self-monitoring. The relay manufacturer shall be revised and approved by the Owner or Owner's Engineers prior to implementation.
电子继电器应采用可编程微处理器型产品，应带故障和瞬态测量记忆体和用于对脱扣序列和连续监控功能进行编程的矩阵。实施前，应由拥有人或拥有人的工程师完成继电器制造商的调整和批准。

All Numerical relays and schemes provided shall all be suitable for connection to a local communication network, and provided with an integral local user interface. The

Numerical Relays shall comply with IEC 61850.
所有数字式继电器及其配供方案必须适用于连接本地通信网络且提供有内置式本地用户接口。数字式继电器必须符合 IEC 61850 标准。

Adequate test facilities shall be provided at the front of each relay panel to enable the protection equipment to be tested whilst the primary circuit is on load, without having to disturb any wiring, with test points clearly labeled.
每个继电器前侧均应提供合适的测试装置，以在主电路加载期间可对保护设备进行测试；这些测试装置应该不影响任何接线连接，且清晰标记相应测试点。

Adequate facilities shall be provided to isolate all DC and AC incoming and outgoing circuits so that work may be carried out on the equipment with complete safety to personnel and without loss of security in the operation of the plant.
应该提供用来隔离全部直流和交流进线和出线回路的合适装置，以便可在电站运行期间能够确保人员完全安全且不影响安全性的提前下对设备展开相关工作。

All test equipment required for commissioning and routing testing of the offered protection equipment shall be provided by the Bidder. This shall include at least one portable PC with relevant software programming tool for each protection relay and one connection wire.
对所提供保护设备进行调试和例行测试的全部测试设备都由投标人提供。这些测试设备应至少包括一台便携式电脑和相关安全编程工具（用于每一个保护继电器和连接导线）。

6.4.11 MV Surge Arresters
中压避雷器

Surge arresters of the metal oxide (Zn0) type equipped with surge counters shall be provided. The arresters shall comply withGB 50057. They shall be capable of resealing against the maximum (TOV).
应提供配有浪涌计数器的金属氧化物 (Zn0) 型中压避雷器。避雷器必须符合 GB 50057 标准。它们应具备再封装功能以承受最大(暂态过电压)。

The surge arresters shall be built-up from hermetically sealed units, each containing valve resistor blocks. They shall be provided with nonlinear characteristic but without spark gaps, designed to limit the voltage on AC power circuits.
避雷器应采用密封装置制成，每个密封装置均有阀电阻器。它们应具备非线性特性，无火花间隙，设计可以限制交流电源电路的电压。

6.4.12 Interlocking
联锁

Electrical ON/OFF interlocks of incoming (or transformer) feeders and outgoing feeders shall be realized in the relevant switchboards. The basic interlocking principles that shall be followed are listed below:
相关开关板上，应该为进线（或变压器）馈电和出线馈电实现电子式开关联锁功能。基本联锁原理应如下所述：

- For auxiliary transformer feeder: LV circuit breaker cannot be closed unless the MV circuit breaker is closed. If the MV breaker is tripped manually or automatically the LV breaker shall also be tripped automatically.
  辅助变压器馈线：低压断路器在中压断路器闭合前不得闭合。如果中压断路器手动或自动脱扣，低压断路器应自动脱扣。

- For transformer feeder: earthing switch at unit substation transformer cannot be closed unless the MV circuit breaker is out service position.
  变压器馈线：单位变电所变压器上的接地开关在中压断路器脱离工作位置前不得闭合。

- For transformer feeder: MV circuit breaker cannot be in-service unless the earthing switch (ES) at unit substation transformer is opened.
  变压器馈线：中压断路器在单位变电所变压器上的接地开关（ES）断开前不得进入工作位置。

- For transformer feeder: the earthing at MV switchgear cannot be closed unless the Load Breaking Switches (LBS) at unit substation transformer are opened.
  变压器馈线：中压开关柜接地装置在单位变电所变压器上的负荷开关 (LBS) 断开前不得闭合。

- For transformer feeder: LBS at unit substation transformer cannot close unless the ES at MV switchgear is opened.
  变压器馈线：单位变电所变压器上的负荷开关 (LBS)在中压开关柜上的接地开关断开前不得闭合。

- Any other interlocking required against unauthorized switching and safe operation.
  防止未经批准的开关操作和安全操作所需要的其它所有联锁功能。

6.4.13 Indication Instrument and Measuring Transducer
指示仪表和测量变送器

All indicating instruments shall be included and installed in the instrument.
全部指示仪表应包含并安装在仪器内部。

The digital multi-meter shall be supplied for each feeder and complete with following functions:
对于每一个馈电器，应提供数字多功能表，其功能如下：

- Voltage measurement
  电压测量

- Current measurement
  电流测量

- Kilo-Watt measurement 有功功率测量

- Kilo-Var measurement 无功功率测量

- PF measurement
  PF 测量
- Kilo-Watt-hour measurement 有功电能测量
- Kilo-Var-hour measurement 无功电能测量

All indicating shall be provided for remote indication sending by communication port to control center.
应提供通过通信端口将远程指示内容发送至控制中心的功能。

6.4.14 Warranties
质量保证

A minimum product warranty as stated in APPENDIX 9.2.2 shall be provided.
应按附件 9.2.2 中的描述提供最基本产品质保服务。

6.4.15 Required Documents
需要的文档

The Bidder shall provide the following documents for the MV Main Switchgear:
投标人应为中压电源开关柜提供以下文档：

- Technical data sheets
  技术数据表
- Layout drawings of the switchgear including all cubicles
  开关柜（含全部配电盘）布局图
- Single Line Diagrams and Wiring Diagrams incl. termination drawings
  单线图和接线图，含端接图
- Warranty
  合格证
- Protection relay schedule
  保护继电器一览表
- Spare parts list
  备件表
- Operation and maintenance manual including component list with manufacturer information e.g. catalogue, etc.
  操作和维护手册，含带制造商信息的零件表（例如，产品目录等）
- Reports of tests and commissioning with protocols Tests
  测试和调试报告（含协议测试报告）

6.5 Step-up Transformer
升压变压器

6.5.1 General
一般性说明

The transformer shall be designed highly efficient and reliable performance under the system and climatic conditions.
变压器应采用高效设计，在本系统及其气候条件下可以可靠地运行。

The step-up transformer will be used to transform voltage to higher level for connecting to the grid and shall be certified according to GB 1094 for the power transformer, GB 4208 for electrical insulation and DL 574 for tap changers, and have an efficiency of 98% or higher.
升压变压器用于将电压变换成电网接入电压，其应符合电力变压器 GB 1094 标准，电气绝缘 GB 4208 标准，分接开关 DL 574 标准，效率不低于 98% 。

The factory tested oil-filled transformers shall be free of PCB and PCT and hermetically sealed.
经出厂测试的油浸式变压器应该不带 PCB 和 PCT 且经过了密封。

6.5.2 Codes and Standards
规范和标准

The Step-up Transformer shall be designed, manufactured and tested in full compliance with the latest edition of the following, but not limited to, standards, codes, rules and regulations:
升压变压器的设计、制造和测试应完全符合，且不限于，以下标准、规范、规定和法规：

- GB 1094 Power Transformers
  电力变压器
- GB 50064 Insulation co-ordination
  交流电气装置的过压保护和绝缘配合
- GB 50060 Power Installation exceeding 1 kV a.c.
  3~110KV 高压配电装置设计规范
- GB 4797 Classification of environmental conditions
  环境条件分类
- DL 574 Tap Changers
  变压器分接开关运行维修导则
- DL 1094 Specification for unused mineral insulating oils for transformer and switchgear.
  电力变压器用绝缘油选用指南

6.5.3 Minimum Requirements
最低要求

The Step-up Transformer shall comply with the minimum requirements described in APPENDIX 9.2.3.
升压变压器应符合附件 9.2.3 节描述的最低要求。

6.5.4 Materials and Construction
材料和施工

The windings shall be made of high conductivity copper. The windings shall be uniformly insulated and the LV neutral point shall be insulated for full voltage. The insulation material of windings and connections shall be high quality, free from softening, shrinking or collapsing during service. Moreover none of the material used shall disintegrate, carbonize or become brittle under the action of hot oil, under all load conditions.
线圈应采用高导电性铜材料制成。线圈应具备良好绝缘一致性；低压中性点应具备全电压绝缘性能。线圈绝缘材料和连接件应品质优异，使用期间不软化、收缩或断裂。此外，在各个负荷条件下，所用材料都不得因高温油的作用而碎裂、碳化或脆化。

The core shall be built-up from high-grade, low-loss steel of high permeability.
铁芯应采用高性能、低损耗、高导磁率钢制成。

The complete core and coil assembly shall be dried in a vacuum sufficient to ensure the removal of air and moisture within the insulating structure. The complete assembly shall be readily removable from the tank for repairs.
整个铁芯和线圈总成的真空干燥处理应足以确保排净绝缘结构内部的空气和水份。整个总成应可方便地从油箱中拆卸下来，以进行修理。

The corrugated transformer tank shall be of all welded construction, fabricated from high tensile strength steel plate and shall be designed to withstand short cir-cuit impacts without distortion.
变压器波纹油箱应采用全焊接结构，利用高强度钢板制成，且应设计为可以承受短路影响，不会出现变形。

6.5.5 Tank Fittings and Attachments
油箱配件和附件

The transformer tank shall be of all welded construction, fabricated from high tensile strength steel plate and shall be designed to withstand full vacuum.
变压器波纹油箱应采用全焊接结构，利用高强度钢板制成，应该可以承受全真空。

The tank shall be completed with:
油箱应配有：

- Tap changer
  分接开关

- MV and LV bushings assembly
  中压和低压套管总成
- Oil drain valves and filling plug
  泄油阀和注油塞
- Oil check valves
  单向油阀
- Gas formation indicator (trip)
  气体形成指示器（脱扣装置）
- Main earthing terminal
  主接地端子
- Pressure relief device
  减压装置
- Stainless steel engraved rating and connection plate in English
  不锈钢额定参数牌和连接板，英文
- Thermometer pockets
  温度计插孔
- Oil level indicator (Alarm & trip)
  油位指示器（报警和脱扣）
- Oil temp. indicator (Alarm & trip)
  油温指示器（报警和脱扣）
- All necessary lugs and shackles, pulling eyes, etc.
  必要的全部吊耳、吊环和吊孔等。
- All necessary protection devices
  所有必要的保护装置

6.5.6 Transformer Oil
变压器油

The transformer shall be supplied filled with class 1 mineral oil confirming to DL 1094. The Bidder shall submit a detailed specification for the type of oil proposed. The oil shall not contain polychlorinated biphenyls (PCB). The Employer may require evidence that the oil is not contaminated by PCB. If an anti-oxidant is recommended, its used shall be subject to the Employer's approval.
交付时，变压器应灌装符合 DL 1094 标准的 1 类矿物油。对于采用的油型号，投标人应提供详细的技术规格说明。油不得含多氯化联苯 (PCB)。雇主可能要求提供油未受 PCB 污染的相关证明。如果推荐采用抗氧化剂，则其使用应经雇主同意。

6.5.7 Transformer Losses
变压器损耗

The Contractor shall state the guaranteed losses. No positive tolerance is allowable on the guaranteed values. Transformers supplied with losses exceeding the guaranteed values will be rejected.
承包人应就损耗担保予以描述。保证值不允许有正容差。损耗超出保证值的变压器将会拒收。

The Contractor shall also state the value of guaranteed magnetizing current, subject to the tolerance specified in GB 1094.
承包人还应按 GB 1094 标准给出的容许偏差给出励磁电流保证值。

6.5.8 Tests
测试

A comprehensive Factory (Shipment) Acceptance Test (tests according to GB 1094) has to be conducted and witnessed by the Owner/Owner's Engineer and the Contractor. On site installation and commissioning testing will be required according to manufaturers installation manual. The Contractor shall carry the costs for all testing. Prior to the tests 30 days, a test procedure shall be submitted to the Owner/Owner's Engineer for the approval.必须由发包人/发包人工程师及承包人共同进行和见证完整的（发货前）出厂测试（按 GB 1094）。需按制造商安装手册进行现场安装及调试测试。全部测试费用由承包人承担。测试前 30 天，应向发包人/发包人工程师提供测试程序，以供审批。

A full protocol and test results shall be submitted to the Employer's Engineer after the testing.
测试结束后，应将完整协议和测试结果提交给雇主的工程师。

6.5.9 Warranties
质量保证

A minimum product warranty as stated in APPENDIX 9.2.3 shall be provided.
应按附件 4.2.3 中的描述提供最基本产品担保服务。

6.5.10 Required Documents
需要的文档

The Contractor shall provide the following documents for the transformer:
承包人应提供以下变压器文档：

- Technical data sheets
  技术数据表
- Transformer layout drawings showing all installed components
  描述全部已安装组件的变压器配线图

- Single line diagrams
  单线图
- Warranty
  合格证
- Spare parts list
  备件表
- Operation and maintenance manual including component list with manufacturer information e.g. catalogue, etc.
  操作和维护手册，含带制造商信息的零件表（例如，产品目录等）
- Reports of tests and commissioning with protocols Tests
  测试和调试报告（含协议测试报告）

6.6 Cables, Cable Tray, Conduits and Accessories
电缆、电缆槽、导线管和附件

6.6.1 General Requirements
一般性要求

This section defines the technical requirements for insulated low and high voltage power cables, control and instrumentation cables, telephone cables, cable trays and conduits with all necessary accessories. Caution shall be made during the engineering design stage to select proper routing when installing cables, cable trays and conduits in any circumstances.The cables and the equipment mentioned above shall be furnished in quantities sufficient for a complete installation.
本节描述高低压绝缘电源电缆、控制和仪表电缆、电话电缆、电缆槽、导线管和各种附件的技术要求。工程设计阶段，应注意在不同环境下安装电缆、电缆槽和导管时应选择合适布线方式。上述电缆和设备的配供数量应满足整个设施的要求。

The cabling shall be carried out safely. Terminals shall be labelled by durable material, tagged readable tags and correspond to the applicable drawings. Wires shall be marked on the termination of each wire with the number of the corresponding connection points. All armored cables shall be grounded on both ends with suitable termination kits or metallic cable glands.
电缆敷设应安全地完成。端子应采用耐用材料的醒目标签予以标记，且与适用图纸相一致。每根电线的端头应标记上相应连接点的编号。所有铠装电缆的两个端头应采用合适的终端盒或金属电缆头进行接地。

Cable schedule of the project for the entire plant shall be provided.
应提供整个电站项目的电缆一览表。

Codes and Standards
规范和标准

- GB 50217 Standard for Electrical enginerring cable deisgn
  GB 50217 电力工程电缆设计规范
- DL 5161 electrical installations standard
  DL 5161 电气装置安装工程
- BG 18380.31 Tests on electric and optical fibre cables under fire conditions
  GB 18380.31 电缆和光缆在火焰条件下的燃烧实验
- GB 3956 Conductors of insulated cables
  GB 3956 电缆的导体
- 04DX101-1 Electric cables - Calculation of the current rating
  04DX101-1 建筑电气常用数据
- local standards
  本地 标准
- Other applicable standards
  其它适用标准

6.6.2 Minimum Requirements
最低要求

The cables shall comply with the minimum requirements described in **Section 4.2.9**.
电缆应符合附件 4.2.9 节描述的最低要求。

6.6.3 Voltage Drops
电压降

The voltage drop for the various parts of the electrical system shall be within the value indicated below. The value is referred to the nominal voltage of the system and the cable shall be sized according to the worst operation conditions.
电气系统不同部分的电压降应不超过以下给出值。该值被称之为系统的标称电压；电缆选型应根据最坏工作条件进行。

The permissible maximum overall worst case power cable voltage drop shall be as follows:
最坏情况下容许的电源电缆压降应如下：

- Maximum allowed DC voltage drop from PV modules to the inverter is 1.5%
  PV 模块至逆变器的最大容许直流压降为 1.5%
- Maximum allowed AC voltage drop from inverter to grid connection point is 0.5%
  逆变器至电网连接点的最大容许交流压降为 0.5%

6.6.4 DC Cable
直流电缆

The conductors for all photovoltaic system wiring shall be copper type. DC cabling shall be optimized by the Bidder to be within the voltage drop limitation as specified.
光伏系统的全部接线连接应采用铜导线。投标人应对直流电缆敷设进行优化，使其压降位于规定限值范围内。

All DC cables shall be installed to provide as short runs as possible. Moreover, positive and negative cables of the same string or main DC supply shall be bundled together to avoid the creation of loops in the system (reduction of the induced voltage surge due to lightning). Looping beneath the PV modules shall be minimized.
全部直流电缆的安装应使其布线长度尽可能地短。此外，同一组电源或主直流电源的正负极性电缆应束在一起，以免在系统中形成回路 （减小与雷击而产生的浪涌电压）。PV 模块以下的回路应最小化。

The cable sheaths shall be of flame retardant material and of a low smoke/fume type complying with GB 50217 The sheath shall contain the manufacturer's name, the voltage levels U_0/U in kV and the cable type.
电缆护套应采用阻燃材料，且属于符合 GB 50217 标准的低烟/烟雾型产品。护套上应标记制造商名称、电压等级 U_0/U（单位：kV）和电缆型号。

Additionally, LV cables shall comply with GB 50217.
此外，低压电缆必须符合 GB 50217 标准。

The recommended bending radius for the cables shall be according to the manufacturer's specifications or industrial best practice.
电缆弯曲半径建议值应符合制造商的技术规范或最佳行业经验。

6.6.5 AC Cable
交流电缆

Insulated cable, conductors, and conductor accessories shall be furnished in compliance with the required standards having quantities sufficient for a complete installation. The insulation of AC power cable routed in cable tray, conduit, and cable duct shall be XLPE type. All conductor accessories including connectors, terminations, insulating materials, support grips, markers and cable ties shall be furnished and installed.
绝缘电缆、导体和导体附件的配供应符合必要的标准，且其数量足够整个设施的要求。电缆槽、导线管和电缆管道中敷设的交流电缆电缆的绝缘层应为 XLPE 型。应该提供并安装好全部导线附件，包括连接器、终端器、绝缘材料、支架、标签和扎线带。

The recommended bending radius for the cable shall be according to the manufacturer's specifications or industrial best practice.
电缆弯曲半径建议值应符合制造商的技术规范或最佳行业经验。

The power cables shall be designed for the thermal and short-circuit characteristics of the electrical systems.
电源电缆应按照电气系统的热特性和短路特性进行设计。

The conductor shall be annealed copper or aluminum in accordance with GB 50217.

导体应采用符合 GB 50217 标准的退火铜或铝制成。

6.6.5.1 Low Voltage Cable
低压电缆

The LV cable shall be according to GB 50217:

低压电缆应符合 GB 50217 标准：

- Copper conductor
  铜导体
- XLPE insulation
  XLPE 绝缘
- Common core covering
  普通包芯
- Black PVC outer sheath
  黑色 PVC 外护套

6.6.5.2 Medium Voltage Cable (if any)
中压电缆（若采用的话）

The MV power cable from the RMU to the Main MV switchgear shall be installed below ground at an appropriate depth (buried cable).
RMU 至中压主开关柜的中压电源电缆应安装在地下合适深度处(埋地电缆)。

Design of the medium voltage cables shall be with copper or aluminum screened, stranded and single or three cores according to GB 50217:

中压电缆应设计采用符合 GB 50217 标准的铜或铝屏蔽层、多股绞合芯线或单/三根芯线：

- Copper or aluminum conductor
  铜或铝导线
- Inner semi-conducting layer
  内部半导电层
- XLPE insulation
  XLPE 绝缘
- Outer semi-conducting swelling tape
  外部半导电膨胀带
- Copper wire screen
  钢丝网
- Outer sheath PVC)PE sheath and fire retardant(
  PVC 外护套(PE 护套和阻燃剂)

6.6.6 Cable Connections
电缆连接

DC cable connections on string level and module level shall be realized with connectors MC4, TYCO or equivalent quality of the same type and same manufacturer. No mix of module and string connector types or brands is allowed. The same is true for String and DC junction box. Both shall be from the same manufacturer.
串联级和模块级直流电缆连接应采用同一型号和同一制造商同等质量的 MC4、TYCO 或连接器。不允许混用不同型号或品牌的模块或串联连接器。对于串联和直流接线盒，也同样如此。排线和直流接线盒的制造商应相同。

6.6.7 Cable Trays and Conduits
电缆槽和电缆导管

The raceway system shall be designed generally so that the separation is maintained as follows.
电缆通道系统通常应设计成可以保持以下隔离。

Power cables rated over 600 V_{AC} shall not occupy a raceway with conductors of less than or equal to 600 V_{AC}. Providing all conductors are insulated for the maximum voltage of any conductors within the raceway, power cables of 600 V_{AC} or less may occupy the same raceway, without regard to voltage level of the individual circuits or whether the individual circuits are alternating or direct current.
额定电压高于 600 VAC 的电源电缆不得占用小于或等于 600 VAC 的导线的通路。在全部导线都针对电缆通路中的全部导线的最高电压实现了绝缘， 则 600 VAC 或低于该值的电源电缆可以占用同一电缆通路，且无需考虑单个电路的电压大小或各个电路是直流的还是交流的。

All trays shall be hot-dip galvanized steel except where unsuitable because of corrosive atmosphere. The hanger clamps, fastening hardware and pins shall be of highly corrosion-resistant metals. Steel accessories shall be hot-dip galvanized. In any corrosive atmosphere (e.g. battery room, chemical treatment areas), trays of other approved suitable material (e.g. reinforced polyester) shall be used.
全部电缆槽都应采用热浸镀锌钢制成，除非因腐蚀性气候而不能采用。吊夹、紧固件和销钉应采用高抗腐蚀性金属制成。钢质附件应经过热浸镀锌处理。对于各种腐蚀性大气环境(例如 蓄电池室、化学处理区), 应该采用批准使用的其它合适材料电缆槽 (例如 增强聚酯) 。

Cable trays with perforated bottom and covers, as well as horizontal and vertical cable ladders suitable for covering, shall be supplied. Trays and fittings shall be free of sharp edges or projections. Bolts or rivets for connecting sections or fittings together shall have carriage-type heads. The bolt and rivet heads shall be placed on the inside of the trays. Prefabricated connection pieces such as T-pieces, crossing pieces, 90 elbows etc. shall be supplied.
应该提供底和盖带孔电缆槽，和适用于加盖的水平和垂直电缆桥架。电缆槽和紧固件不得有锐边或凸起。连接螺栓或铆钉应带鞍型头。螺栓和铆钉头应在电缆槽内侧。预制型连接件，例如 T 型件、十字型件和 90 度弯头等 ，均应提供。

The side channels of cable trays shall allow fastening of conduits for cables leaving the tray (solid side channels preferred). In addition, wiring accessories shall be provided adequately such as cable ties, tapes, cable tags, fire barriers, etc.
电缆槽的侧槽，应可用来紧固 离开该电缆槽的电缆的导线(首选硬质侧槽)。此外，应提供数量足够的接线附件，例如线扎、胶带、电缆标签、防火隔板等。

In general, the minimum vertical clearance between cables trays shall be 300 mm, measured from the bottom of the upper tray support to the top of the lower tray. Solid covers shall be used on all instrumentation trays, vertical trays and, all outdoor trays.
电缆槽之间的最小垂直间隙通常应为 300 mm（从上电缆槽支架底部至下电缆槽顶部的测量值）。全部仪表电缆槽、直槽和全部户外电缆槽均应采用实心盖。

All conduits shall comply concerning sizes and thread with JGJ 16 standard. Conduit fill shall be in accordance localstandards.
全部导线槽的规格和穿线都应符合 JGJ 16 标准。导线槽的填充应符合本地标准。

All rigid steel conduit and accessories shall be hot-dip galvanized.
全部硬质钢导线管和附件都应进行热浸镀锌处理。

All flexible conduits shall be of the galvanized-steel and liquid-tight type, equipped with a plastic jacket and shall be suited for application in high temperature areas. The corresponding conduit fittings shall be galvanized steel.
全部软导线管都应采用镀锌钢管或不透液型管、带塑料罩，且适用高温环境。相应的导线管紧固件应采用镀锌钢材料。

Materials associated with the conduits shall consist of elbows, conduit couplings and thread protectors, conduit bodies, bushings, locknuts, flexible conduit fittings, conduit clamps and all other accessories needed for their installation and fixing. Outlet boxes and junction boxes shall be supplied, if necessary.
导线管的相关材料应包括弯头、管接头和螺纹护箍、管体、套管、锁紧螺母、软管坚固件、导管夹和用于安装和固定的各种其它附件。必要时，应提供出线盒和接线盒。

An individual conduit system is required for communication and fire alarm systems. Where numbers of conduit used, cable tray shall be utilized. Suitable materials shall be chosen in a specific environment such as explosion proof fittings.
通信和消防报警系统需要采用单独的电缆导管系统。需要采用多个导线管的场合，应该使用电缆槽。在例如防爆管件等的特定场合，应选用合适的材料。

6.6.8 Cable Installation
电缆安装

Power cables shall be separated from control / communication cables to eliminate potential electrical interference.
电源电缆与控制 / 通信电缆实现分离，以消除可能的电气干扰。

Telecommunication, control and signaling cables have to be laid without splicing.
敷设遥控、控制和信号电缆时，不允许拼接。

DC cables from modules to ground shall be protected by an UV-resistant conduits or laid in cable trays and cable ladders following the Local standards.
从模块至地的直流电缆应采用 抗紫外线导管进行保护，或者，敷设在电缆槽和电缆桥架内（遵照本地标准的规定）。

For DC cable conduit fixing, hot-dip galvanized clamps at least for every 0.8 meter of vertical installation and for DC cable horizontal installation at least in distances of 1 to 1.2 m shall be used. For horizontal and vertical installation of LV DC cables, the use of UV and weather resistant cable binder for fixation is allowed, too.
对直流电缆导管进行固定时，对于垂直安装导管，每隔 0.8 米至少安装一个热浸镀锌夹；对于水平安装导管，每 1 至 1.2 米 应安装一个热浸镀锌夹。固定水平和垂直安装的低压直流电缆时，可以采用抗紫外线和抗大气腐蚀的电缆夹。

Cables are not permitted to run over head on roads, unless explicitly expressed by the Owner and/or Owner's Engineers. Consideration in the design must account for the minimum amount of earth works to cross roads, such that the construction of the PV Power Plant has limited impact on the daily operations of any exiting Facility.
除非拥有人和/或拥有人的工程明确声明，不得在道路上架空敷设电缆。设计时，应考虑将跨路土方工作降低至最小程度，以减小光伏电厂施工对现有设施日常运行的影响。

The underground cables shall be laid in HDPE conduits, the detail installation shall be complied with Local standards If cable routes are arranged in two levels, another 15 cm sand layer is placed on top of the first cable level. Cover plates (protection bricks) shall be suitably placed on top of the 15 cm sand cover so that they cover the cable layers sufficiently on all sides.
地下电缆应敷设在 HDPE 导管内，其安装应遵循当地标准 安排两层电缆线路时，第一层电缆的上部应安排一个 15 cm 厚的沙层。盖板 (护砖) 应合适地置于 15 cm 沙层上部，以使可以有效地盖住电缆层的全部侧面。

For cable lying under the roads, foundations, etc. heavy duty PVC conduits, embedded in concrete shall be provided. Such shall be implemented preferably prior to the road construction.
当电缆敷设在路面、地基下时，应提供大负荷、混凝土埋入型 PVC 导管。这类 PVC 导管的施工应优先在道路施工前完成。

All cable terminations shall be carried out by qualified personnel according to the manufacturer's recommendations.
所有电缆端接工作应由专业人员遵照制造商的建议完成。

Cables of different voltage level shall be laid in separate raceways or conduits. The low voltage power cable of different voltage may be laid in same cable trays or cable ladders or cable ducts with separated metal partition.
不同电压等级的电缆应铺设在单独的电缆通路或导线管内。不同电压的低压电源电缆可以敷设在带分离式金属隔断的同一电缆槽、电缆桥架或电缆导管内。

The separation of phase conductors in individual ducts and conduits shall be avoided.
应该避免将相线分离敷设到不同导管或导线管内。

The insulation shall be tested and cables shall be visually inspected for damage to the outer sheath before covering them with sand. Damaged cables shall be properly repaired or replaced immediately.
盖上沙前，应检测绝缘性能，并目视检查电缆外护套是否受损。对于损坏的电缆，应进行合适修理或立即更换。

Electrical control cables such as instrumentation, communications, and remote-control cables must be run in separate trenches of HV power cable routing.
电气控制电缆，例如仪表电缆、通信电缆和遥控电缆，必须敷设在高压电源电缆通路的单独电缆沟中。

Whenever cable ends cannot be run into the consumer's terminal connection compartment immediately after installation they shall be protected against mechanical damage and moisture.
如果电缆端头在安装结束后不能立即引入用户端接盒，则应防止它们受到机械损伤或受潮。

After the cables depart from common cable routes (trenches, trays, ducts) they shall be suitably installed to protect them against chemical and mechanical influence. Conduits or metal plates shall be used for protection where the cables emerge from protective walls, floors or steel sections.
电缆从公用电缆通道引出 (电缆沟、电缆槽和电缆管道） 后，应对它们进行合适的安装，以防受到化学或机械影响。从护壁、地板或金属件引出的电缆，应采用电缆导管或金属板对其进行保护。

The covers shall be safely fixed, in particular, if they are fitted in equipment maintenance areas to protect the cables against damage.
电缆盖应可靠固定，尤其是安装在设备维护区时，以防电缆受损。

6.6.9 Route and Cable Markings
线路和电缆标记

Underground cable routes shall be marked by concrete poles above cable on ground; separate marker shall be provided at every change of direction.
地下电缆线路应采用混凝土柱进行标记。每个换向处，应安排一个单独的标记柱 。

Underground cable routes shall be marked by suitable plastic tape with suitable inscription for electrical cable routes placed underground at 15 cm depth.
对于敷设在地下 15 cm 深的电气电缆线路，应采用带合适铭文的合适塑料带对其进行标记。

Cables shall be marked at both ends and, if laid underground, at branches and cable sleeves.
电缆两端均应进行标记；若敷设在地下，则在电缆分支和电缆护套上进行标记。

UV resistant plastic markers with durable inscription or in special case punched heavy lead markers tied to the cable by means of suitable plastic tapes shall be used for identification.
制作标记时，应采用带长寿命铭文的抗紫外线塑料标记条；特殊情况下，应采用合适塑料带将穿孔重型铅标记板捆在电缆上。

The cable ends on the switchgear side shall be marked by suitable plastic tape with inscriptions.
开关柜侧的电缆端头，应采用合适的铭文塑料带进行标记。

6.6.10 Required Documents
需要的文档

The Bidder shall provide at least the following documents:
投标人应至少提供以下文档：

- Cable lists
  电缆列表
- Technical datasheets for each cable type
  各个电缆型号的技术数据表
- Block diagrams
  方框图
- Cables sizing and voltage drop guideline
  电缆选型方法和电压降计算准则

For the DC Cabling the Bidder shall provide at least the datasheets of the following cables:
对于直流电缆敷设，投标人应至少提供以下电缆的数据表：

- End of string to DC junction box
  机组末端至直流接线盒
- DC junction box to inverter
  直流接线盒至逆变器
- DC cable
  直流电缆

6.7 Receptacles
插座

The number of single phase sockets and location of sockets shall be suitable for easy connection where required. The minimum current rating for single phase sockets is 10 A.
单相插座的数量和插座的位置应适合在需要时方便连接。单相插座的最小额定电流是 10A.

6.8 Uninterruptible Power Supply

An uninterruptible Power Supply (UPS) to avoid data loss, if applicable or required by utility
不间断电源 (UPS) （以避免数据流失，或按当地电力公司规定）

批注 [S7]: How do you ensure uninterrupted working of the communication and monitoring system?

6.8.1 General
概述

These specifications cover furnishing and erection of an uninterruptible power system to provide for continuous supply of electric power to critical AC loads including Control computers, annunciators, 10% of emergency lighting and other critical services.
这些规范涵盖了不间断电源系统的供应和安装，以便为关键的交流负载提供连续电源，包括控制计算机、警报器、10% 的应急照明和其他关键设备。

6.9 Earthing System
接地系统

6.9.1 General Design Requirement
总体设计要求

The earthing system is calculated to withstand the maximum fault current, the time needed to cancel the associated earth fault and also designed and arranged to prevent dangerous step and touch voltage, which shall be limited to safe values.
计算的接地系统应能够在消除相关接地故障所需的时间内承受最大故障电流，而且设计和布置还能防止危险的阶跃电压和接触电压，这些电压应限制为安全值。

If building earth resistance is above 4 Ohm, earth rods shall be copper clad rods of 16 mm diameter and 2.5 m in length. If it is necessary to form extended lengths of rod, stranded sections shall be welded together. Rods shall be fitted with hardened steel tips, caps and coupling pieces to facilitate driving the power hammer.
如建筑物的接地电阻超过 4 欧姆，接地棒应是直径为 16 mm、长度为 2.5 m 的包铜接地棒。如果需要延长接地棒的长度，则应将绞线部分焊接在一起。接地棒应安装硬化钢头、钢帽和联结器以方便驱动动力锤。

批注 **[S8]:** This may be required if building ground cannot be used, please explain your grounding concept.

To achieve equipotential bonding, the PV power plant shall be equipotential bonded to the existing earthing network. All exposed conductive parts or elements of the PV power plant systems shall be connected to this network.
为了实现等电位接地，光伏电站应与现有接地网进行等电位连接。光伏电站系统的所有暴露的导电部件或元件应连接到该网络。

Additional earthing requirements shall be provided at inverter and control building in the form of a grounding ring and an equipotential bond shall be formed to the entire earthing system.
应在逆变器和控制室以接地环的形式满足其他接地要求，整个接地系统应形成等电位接地。

The earthing system consists of the main earthing grid (existing grounding at factory), the containers and building foundations earthing/grounding rings and the equipment earthing. The mounting structure shall be a part of the earthing system. Each module mounting substructure shall be conductively connected to the neighboring substructure(s).
接地系统由主接地网（电站现有接地）、集装箱和建筑物基础接地环以及设备接地组成。安装结构应是接地系统的一部分。每个模块安装子结构应与邻近的子结构进行导电连接。

The resistance limit of less than 4 Ohms of the earthing grid should meet the requirements of applicable norms and standards at any point of the earthing system.. Each module, substructure and all other components in the PV power plant shall be on the same potential.
接地网的电阻限值应满足适用规范和标准的在任何一处少于 4 欧姆的要求。光伏电站的每个模块、子结构和其他所有组件应具有相同的电位。

The Grounding and Earthing arrangements testing shall be according to GB 50057.
接地布置测试应符合 GB 50057 的要求。

The Contractor shall be responsible for ensuring that the earthing system meets the specified requirements. Full design shall be submitted for approval.
承包商应负责确保接地系统满足规定的要求。应提交完整的设计以供批准。。

6.9.2 Scope of Supply
供货范围

The scope of supply shall include all required copper conductors and earth rods, connecting material, and all attachment material to make up a complete, safe and reliable system. Lead up earthing points from lightning/earth rods shall be connected to earth bars located inside control rooms and all inverter stations. All electrical equipment such as, switchboards, control boards and desks, relay boards, and all other subsidiary electrical equipment, as well as all metal parts of Engineering structure and mechanical equipment which might be subject to earth fault currents shall be connected to earth.
供货范围应包括构成完整、安全和可靠的系统所需的所有铜导线和接地棒、连接材料和所有附件材料。从避雷针/接地棒引入的接地点应连接到位于控制室和所有换流站内的接地棒。所有电气设备（例如：配电盘、控制盘和控制台、继电器盘）和其他所有附属电气设备，以及可能出现接地故障电流的所有工程结构和机械设备的所有金属部件都应接地。

6.9.3 Installation
安装

The earth electrode systems and the bonding of equipment enclosures, structures, etc to earth shall be installed with the utmost care to ensure that, during the life of the plant, all components shall be capable of carrying the prescribed earth fault currents.
在安装接地电极系统以及设备外壳、结构等的接地时应极其小心，以在电厂的使用寿命期间确保所有组件均能承载规定的接地故障电流。

Where joints are buried, the preferred method of jointing is by crimped connector or by welding process. Bolted connections shall be avoided as far as possible.
接头埋地时，首选的连接方法是采用压接连接器或焊接工艺。应尽可能避免螺栓连接。

Connections between exposed earth conductors shall be made using welding
暴露的接地导线之间的连接应使用焊接工艺。

Connections to the earth terminals of equipment, structures etc. shall be made using a bolted connection.
连接设备、结构等的接地端子应使用螺栓连接。

Surfaces of current carrying connections and joints shall be thoroughly cleaned immediately before connection/jointing. Paint, scale and other deleterious materials shall be removed.
在连接之前，应立即彻底清洁载流接头的表面。应清除油漆、氧化层和其他有害物质。

All joints and connections shall be low resistance, fully rated, mechanically sound, secured against loosening and protected against electrolytic action. Buried joints shall be encapsulated in epoxy as a protection against ingress of moisture of corrosive elements.
所有接头应为低电阻、全额定、机械性能可靠、防止松动并防止电解作用。埋地接头应密封在环氧树脂中，以防腐蚀性元素的水分进入。

When a copper earth conductor is run on galvanized steel work, contact between the two shall be avoided. Contact may be avoided by using "stand-off" plastic saddles or by running the earth conductor through short lengths for rigid PVC pipes which are secured to the steel by plastic clips or saddles. All connectors in contact with galvanized steel shall be tinned and if possible, the earth connection shall be made to a vertical face.
当铜接地导线在镀锌钢结构上通过时，应避免二者接触。使用“相隔一定距离”的塑料鞍座或将接地导线穿过使用塑料夹或鞍座固定在钢结构上的刚性 PVC 短管可以避免接触。所有与镀锌钢结构接触的连接器都应进行镀锡处理，若可能，应将接地连接器做成垂直面。

Earth conductors in proximity of control cables, cable sheaths and other buried services shall be PVC insulated and there shall be adequate physical separation of the earth conductor from these services.
控制电缆、电缆护套和其他埋地设施附近的接地导线应为 PVC 绝缘，接地导线与这些设施之间应进行充分的物理隔离。

All miscellaneous steelwork including cable trays, support brackets, corner angles on cable ducts etc. shall be bonded to earth.
包括电缆桥架、支撑托架、电缆导管上的边角钢等在内的其他所有钢结构均应接地。

Where welded joints are proposed they shall be executed in accordance with an approved process. The manufacturer's instructions shall be followed in every detail. Welds shall not be porous or deformed. Worn, damaged or incorrectly sized molds shall not be used.
提出使用焊接接头时，应根据批准的工艺进行。每个细节都应遵循制造商的说明。焊缝不应有气孔或变形。不得使用磨损、损坏或尺寸不正确的模具。

6.9.4 PV Array Earthing
光伏阵列接地

Special attention should be paid to grounding of the module frame. Earthing requirements should be as a minimum in line with module supplier requirements. In case framed solar modules are offered, their frames shall be grounded, preferably by grounding middle-clamps, earthing plates between middle clamps or by applying the grounding hole using self-tapping screws. The system shall be rated to at a minimum to GB 50057 for electrical bonding and grounding, and a preference will be taken to components rated to GB 50057.
应特别注意组件框架的接地。接地要求应至少符合组件供应商的要求。如果提供了框架式

太阳能组件，它们的框架应接地，首选方法是使用接地中间夹、中间夹之间的接地板或使用自攻螺钉钻接地孔。系统的额定值应至少达到 GB 50057 以便进行电气连接和接地，优先选择额定值为 GB 50057 的组件。

6.10 Lightning Protection
雷电防护

6.10.1 General
概述

This section covers the design, connectivity testing, supply, erection and commissioning into service of the PV power plant Lightning Protection System (LPS). The lightning protection system shall also cover all PV module, DC, AC and signal/measurement circuits within or connected to the PV power plant.
本部分涵盖了光伏电站防雷系统 (LPS) 的设计、测试、供货、安装和投入使用。防雷系统还应包括光伏电站内部或与之连接的所有光伏组件、直流、交流和信号/测量电路。

The Contractor shall provide a lightning protection design for direct and indirect effects as per GB 50057 to demonstrate the lightning protection design. The Contractor may utilize the existing LPS as far as possible but shall provide sufficient evidenceand required additions to the system to cover all areas of the PV Power Plant.
承包商应根据 GB 50057 提供直接和间接影响的雷电防护设计，以证明雷电防护设计。承包商可以尽可能利用现有的防雷系统，但应提供充足的证据和系统所需的附加物，以覆盖光伏电站的所有区域。

Each building roof or Engineering work protective cover shall receive a lightning protection system composed of roof and down conductors, sufficiently sized and spaced connected to the earthing electrode.
每个建筑物屋顶或工程防护罩应将由屋顶和引下线组成的尺寸和间距足够大的防雷系统连接到接地电极。

The distance crossed by lightning protection conductors to the earthing electrode shall be as short as possible. The distance between down conductors shall meet the requirement of the GB 50057.
防雷导线穿过接地电极的距离应尽可能短。引下线之间的距离应满足 GB 50057 的要求。

Metallic structures or equipment housing located on the roof of buildings shall be connected to the lightning protection conductors.
位于建筑物屋顶的金属结构或设备外壳应连接到防雷导线。

The early streamer shall be allowed for PV area. Contrator should provide the design radius to cover all of the PV panels and electrical component.
光伏区域应允许提前放电。承包方应提供设计半径以涵盖所有光伏板和电气组件。

The Contractor shall minimize the shadow effect from the lightning masts / rods as much as possible.
承包方应尽可能减少避雷杆/避雷针的阴影效应。

Resistance of the lightning ground rod system shall be 4 ohm.
防雷接地棒系统的电阻应为 4 欧姆。

The PV module structures and all metal components should be connected to earth to provide equipotential bonding and connect to earthing rods.
光伏组件结构和所有金属部件应接地以提供等电位连接，并应连接到接地棒。

The PV array wiring should be laid in such a manner that the area of conductive loops is minimized.
光伏阵列接线的铺设方式应使导电回路的面积最小。

All incoming services lines (power, telecommunication) shall be protected by installing the appropriate surge protective devices of Class I at all entry points of these lines. The power lines type should be taken into account in the selection of surge protective devices.
所有引入线（电力和电信）应通过在这些线路的所有入口点安装合适的一级电涌保护器加以保护。在选择电涌保护器时应考虑电力线的类型。

6.10.2 Codes and Standards
规范和标准

- GB 50057 Protection against lightning
  GB 50057 建筑物防雷设计规范

6.10.3 Surge Arresters
避雷器

If required by national standards, surge arresters shall be earthed by a direct run of fully rated conductor from the diverter earth terminal to an earth rod. At each location the rods associated with the three phase arresters shall be connected together and shall be connected to the earth electrode system at two points. In order to get minimum surge impedance the earth conductor shall be kept short and free from bends. The conductor shall be fastened to its supporting surface in order to withstand any electrodynamic forces and shall be protected against mechanical damage.
如国家规定，避雷器应通过从避雷针接地端子到接地棒直接连接全额定导线进行接地。在每个位置，与三相避雷器有关的接地棒应连接在一起，并应在两点连接到接地电极系统。为了获得最小电涌阻抗，接地导线应较短且无弯曲。导线应固定在支撑表面上以承受任何电动力，并应防止机械损坏。

6.10.4 Installation
安装

This section of the specification shall be applicable to the installation of internal and external lightning protection of buildings and outdoor plant areas.
规范的本部分适用于建筑物和户外电厂区域的内部和外部防雷系统的安装。

The connection with the earthing system shall be established in conformity with the respective provisions outlined in the section on earthing installation.
应按照接地安装部分中的相应规定与接地系统进行连接。

The external lightning protection systems shall be provided to arrest lightning and discharge it safely to earth. The system consists of the earthing system. The internal lightning protection shall be provided to protect electrical equipment e.g. electronic components, computers, field instruments, etc, against damage resulting from voltage generated by lightning. Internal lightning protection systems include equipotential bonding valve-type arrestors and isolating gaps or other devices to bypass voltage surges to ground as well as measures to maintain safe distance.
应提供外部防雷系统以避雷并将其安全地释放到地上。该系统由接地系统组成。应提供内部防雷系统以保护电气设备，例如：电子元件、计算机、现场仪表等，防止雷电产生的电压造成损坏。内部防雷系统包括等电位连接阀式避雷器和隔离隙或将电压浪涌送至地面的其他装置以及保持安全距离的措施。

Metal roofing, steel frames and all metal parts on the roof shall be used as lightning system in addition to lightning rods and arrestor conductors.
除避雷针和避雷器导线外，屋顶上的金属屋面、钢框架和所有金属部件应用作避雷系统。

Lightning conductors should be the shortest possible connections between the lightning arrestor network and the earthing system.
避雷器网络与接地系统之间的避雷导线应尽可能短。

The conductors should be a natural continuation of the lightning arrestor network and as far as possible should be continuous. They shall be suitably fixed to withstand mechanical stresses due to storm and lightning currents.
这些导线应是避雷器网络的自然延续，并应尽可能连续。它们应适当固定以承受风暴和雷电流引起的机械应力。

7 MECHANICAL TECHNICAL REQUIREMENTS
机械技术要求

7.1 General
概述

The mechanical works shall include the design, details, procurement and construction of all mechanical systems and all equipment associated with the PV power plant.
机械工作应包括与光伏电站有关的所有机械系统和所有设备的设计、细节、采购和施工。

The scope of works for mechanical systems shall be complete in every aspect, equipped and fitted out, tested, commission and ready for use.
机械系统工作范围的各个方面应完整，包括装配和安装、测试、调试和准备使用。

The scope of mechanical works shall include, but is not limited to the following:
机械工作的范围应包括但不限于以下内容：

- Cleaning water system
  清洗用水系统
- HVAC system
  HVAC 系统
- Fire protection system
  消防系统

7.2 Cleaning Water System
清洗用水系统

The cleaning water system shall be designed to connect to existing domestic water system of the industrial plant and pumped to rooftop area. The water pressure shall be sufficient to deliver the cleaning water to the module area on the roof, otherwise, high-pressure water pumps shall be required. To avoid damaging the modules, the cleaning water shall be filtered and tested to achieve clean and particle free water. The Contractor shall provide the specification and design of the water treatment to the Owner and/or Owner's Engineers for approval before installation.
清洗用水系统应设计为与现有厂区供水系统连接并将水引至屋顶固定区域，水压应足以将清洗用水输送到屋顶上的组件区域，否则，需要使用高压水泵。为了避免损坏组件，应过滤并测试清洗用水以获得干净、无颗粒的水。承包商应在安装前向业主和/或业主的工程师提供水处理系统的规格和设计以供批准。

7.2.1 Scope of work
工作范围

Contractor shall be responsible for all costs related to water supply application and connection works e.g., fees, piping and valve to PV module areas. All costs shall be included in the Contract.

承包商应负责与供水应用和连接工作相关的所有费用，例如：光伏组件区域的管道和阀门的费用。所有费用都应包括在合同中。

A package booster pump is required to ensure sufficient pressure to deliver domestic water to the point of use.
需要整体式增压泵来确保足够的压力，以将生活用水输送到使用点。

The pump head and the pipe size shall be sufficient to deliver the cleaning water to the farthest point of the PV module area with an adequate pressure.
泵压头和管道尺寸应足以将清洗用水以足够的压力输送到光伏组件区域的最远点。

7.2.2 Material and Construction Standards
材料和施工标准

The pipelines shall be of proper material to withstand the working pressures, temperatures, weather conditions and the physical and chemical conditions of material being transported. Any plastic material, PVC, rubber lining or otherwise used for piping shall withstand the local ambient temperature and the material shall pass an ageing test.
管路应采用合适的材料以承受工作压力、温度、天气条件以及运输材料的物理和化学条件。任何塑性材料、PVC、橡胶衬里或其他用于管道的材料应能承受当地的环境温度，材料应通过老化试验。

Bolts, nuts, etc. for steel work including supporting steel structures, etc. as well as for flanges for outdoor installation shall be at least of suitable steel, hot dipped galvanized in accordance to GB 50017 for galvanizing or equivalent.
用于钢结构（包括支撑钢结构等）以及户外安装法兰的螺栓、螺母等应至少采用根据用于镀锌的 GB 50017 或同等标准进行热浸镀锌的合适钢。

7.3 HVAC System
HVAC 系统

The control room shall be provided with all necessary HVAC equipment including pipe works, control, instrumentation, interlocking and cabling systems designed to maintain appropriate environmental conditions for equipment and personnel.
控制室应配备专为设备和人员保持合适的环境条件而设计的所有必要设备包括管道工程、控制、仪表、联锁和布线系统。

The outdoor ambient temperature for design shall be based on typical local weather with the effects of solar gain being accounted in the design of the HVAC system.
设计的户外环境温度应基于典型的当地天气同时在系统设计中考虑太阳能获得量的影响。

Air conditioning system shall be, as a minimum, provided for the following areas:
应至少为以下区域配备空调系统：

- Control Room
  控制室

Air conditioning room shall be installed as per the regulation and building codes of China.
空调室应按照中国的法规和建筑规范进行安装。

7.4 Fire Protection System
消防系统

The scope of supply for the Fire Protection System covers all buildings.
消防系统的供货范围涵盖所有建筑物。

The Contractor shall propose a Fire Fighting System including fire alarms and portable fire extinguishers. The type and number of the alarms and extinguishers shall be suitable to the nature of the buildings and comply with China laws, codes, standards and regulations.
承包商应建议消防系统，包括火灾警报器和手提式灭火器。警报器和灭火器的类型和数量应适合建筑物的性质，并符合中国的法律、规范、标准和法规。

8 PLANT MONITORING SYSTEM
光伏监测系统

8.1 General
概述

The PVMS optimizes the operation status of the terminal equipment by collection, monitoring and analysis of operational data of PV power plants, thereby reducing the resource consumption and waste as well as construction and operating costs. The PVMS can provide effective data integration and analysis and historical data report managementas the basis for palnt decision-making and development to improve the operation and management level. The PVMS also can can efficiently and conveniently coordinate the internal plant interaction via remote monitoring and service management functions in order to improve the efficiency of PV power plants and reduce operation and maintenance cost.

本系统通过对光伏电站运行数据的采集监测分析，优化终端硬件设备的运行状态，从而减少因光伏发电生产及管理中的资源消耗与浪费，降低建站投资及运行成本。平台提供有效的数据整合与分析，历史数据报表管理，作为电站制定计划与发展日常工作的基础决策依据，提升电站运营管理水平；平台通过远程监测及运维管理功能，高效便携的协调电站内部互动，做到“事件及时掌握，故障及时处理”，在降低运维成本的同时提高光伏电站的发电效率。

8.2 Overall Design Principles

总体设计原则

In view of the construction complexity, difficulty and breadth of the energy measurement and acquisition system, the following principles are followed during equipment selection and application software design, and the functions and performanceof hardware and software must be integrated fully to achieve the overall objectives of system construction.

鉴于“能源计量采集系统建设”的复杂度、难度以及设计面的广度，欲取得系统建设的总体目标，在设备选型与应用软件设计过程中遵循以下原则，并须把硬件和软件的功能、性能充分结合。

8.2.1 High Performance 高性能

- The core system equipment and link layout should be future-proof to meet the growing requirements, extend the life cycle of the system and protect investment.

- The application software supports parallel communication acquisition of multiple devices, automatic distribution and real-time equalization of the collection tasks among multiple communication servers as well as manual distribution.
- Memory sharing of data collection, important parameter data and operating status parameters to improve operating efficiency.
- Supports real-time calculation and processing of raw data in the real-time library to improve data analysis performance.

- 系统核心设备选用和链路布设应有一定的超前性，以满足不断增长的需要，尽可能延长系统的生命周期，保护投资。
- 应用软件的通信采集支持并行处理，可以同时对多个设备进行数据采集。可以实现采集任务在多台通信服务器之间的自动分配、实时均衡，也可以实现手动分配。
- 采集数据、重要参数数据、运行状态参数的内存共享，提高运行效率。
- 支持生数据在实时库中的实时计算处理，提高数据分析性能。

8.2.2 Scalability 可扩展性

- The system's scalability includes hardware and software to fully protect existing investment.
- The communication server supports distributed acquisition of any number of devices as well as automatic, real-time and balanced collection tasks.
- The master system software is equipped with secondary development interface, which can be used for bidirectional data exchange with the existing management system.

- 系统的可扩展性包括硬件的扩展能力和系统软件扩展能力。能不断地延伸和扩充，充分保护现有投资利益。
- 通信服务器支持任意台数的分布式采集、采集任务自动、实时、均衡负载。
- 主站系统软件提供二次开发接口，可与原有的管理系统进行双向数据交换开发。

8.2.3 Security 安全性

- A reasonably and sound security control mechanism can effectively protect data resources in the application environment and prevent data loss, theft and destruction.
- Full range of authority management and security audit functions for the operating system, database and applications
- The system authorities cover function items, menu items, WEB links and multi-level authority management to ensure the security of important data, supporting all-round authority management of function, equipment and data.

- 合理完善的安全控制机制，可以使应用环境中的信息资源得到有效地保护，防止信息的丢失、失窃和破坏。

- 系统具备操作系统、数据库、应用软件全方位的权限管理及安全审计功能。
- 系统的权限不仅可以细化到功能项、菜单项、WEB 链接，多级权限管理，确保重要数据的安全性，是功能、设备、数据三维一体的全方位权限管理。

8.2.4 Manageability 可管理性

- Any device in the system should be controlled via the PVMS toimprove system processing and management efficiency, and support remote management.

- 系统中的任何设备应均可以通过管理平台进行控制。提高系统处理能力和管理效率，并可实现远程管理。

8.2.5 High Reliability and Ease-to-Use 高可靠性和简单易用性

The PVMS ensures the high equipment reliability through strict hardware selection and high system availability and reliability through optimal system software design and architecture.

- Convenient later expansion with new acquisition gateway or metering devices: only simply configure the new device information in the master system.
- Redundant operation of all key components of the system center's information processing equipment (data acquisition servers, web servers, and database servers): the failure of any single point does not affect the normal operation of the entire system, thereby improving system availability.
- Off-databaseoperation of the communication server and commercial database:acquisition possible in case of database offline and automatic data synchronizationin case of database online.
- Hot standby design for communication task machine and communication work database.
- Perfect multi-level data backup system, preventing the system impact caused by unexpected situations such as power outage and system failure.

系统从硬件选型上充分保证了设备的高可靠性，同时通过良好的系统软件设计及架构实现了系统的高可用性、高可靠性。

- 客户以后要接入新采集网关或计量设备，只需将新设备档案信息在主站系统配置即可，简单方便；
- 数据采集端所选用的 WEGW-1000S 智能化能源采集网关是长沙威胜能源自主研发的新一代数据采集设备配置有 4 路 RS-485 接口每一路接口可接 32 块 485 接口水、电、汽等计量设备；
- 系统中心信息处理设备(数据采集服务器、web 服务器、数据库服务器)的所有关键部件可以实现冗余工作，使任何单点故障不影响整个系统的正常运行，从而提高系统的可用性。

- 支持通信服务器与商用数据库的脱库运行。在采集程序正在运行的时候，数据库离线的情况下，采集能够正常运行，并在数据库联线后，能够自动同步数据。
- 支持通信任务机、通信工作数据库的双机热备。
- 系统具备完善的多级数据备份体系，可防止断电、系统故障等意外情况对系统的影响。

8.3 Technical Standards 系统技术标准

The EPC Contractor shall ensure the availability of the firmware and software upgrades are free of charge for the lifetime of the system.
EPC 承包商应确保在系统的整个生命周期内免费提供固件和软件升级。

8.3.1 Standards for Metering Instruments 计量器具标准

- GB17167 — 2006 Mandatory National Standard for General Principle for Equipping and Managing of the Measuring Instrument of Energy in Organization of Energy Using 强制性国家标准用能单位能源计量器具配备和管理通则
- HG20507—92 Design Code for Instrument Selection 自动化仪表选型规定

8.3.2 Communication Protocol Standards 通信协议标准

- Certification Specificationfor Userside PV Plant Online Monitoring System 用户侧光伏电站在线监测系统认证技术规范

8.3.3 Master System Standard 主站系统标准

- GB8566-88 Computer Software Development Specifications 计算机软件开发规范
- GB8567-88 Computer Product Development Documentation Guide 计算机产品开发文件编制指南

8.3.4 Equipment Installation Standards 设备安装标准

- GB 4943 — 95 Installation of information computing equipment including electrical equipment 信息计算设备包括电气设备的安装
- ISO11801 International Wiring Standards 国际布线标准

8.4 Data collection Gateway 数据采集网关

批注 [S9]: Please propose

8.4.1 Main Features 主要特点

- Communication Port: 1x 10/100M (RJ45); 3x passive RS485; 4x active RS-485; 1x GPRS, CDMA as option. Each loop of RS-485 is capable of connecting 32 pieces of metering devices with different protocols. Communication speed at 1200bps-9600bps.

通讯接口：1 路 10/100M 网卡（RJ45）；3 路无源 485、4 路有源 RS-485；1 路 GPRS、CDMA（可选配）。每路 RS-485 最大可接 32 块计量设备，支持每个计量设备独立不同的规约，通讯速率 1200bps-9600bps。

- Collection features: support real-time and periodic collection configurable with 1 minute to 24 hours. Data of power meter, water meter, gas meter, thermal meter, flow meter can be collected. Protocal is designed by dynamic connection library and easy for extension. The guideline of construction ministry is followed, which transmit sorted energy consumption data to central system or others. High data storage capacity ensures up to 128 meters record in 3 months, and provide data service to external systems. Cold storage of 10 years can be realized.
采集特点： 支持实时采集和周期采集并存，周期采集 1 分钟～24 小时可设。可采集常见的各种电表、水表、气表、冷热量表、流量计等计量装置的数据。规约采用动态连接库方式设计，方便规约扩展。支持建设部导则要求，将分类、分项的能耗数据上传至中心系统或者其他的系统。大存贮容量，可支持 128 块表计至少 3 个月的历史数据存储要求，并对外可提供实时数据和历史数据服务。数据断电可保存 10 年。

- Electrical performance: high-frequency resistence according to IEC255-22-1 Class III; electrostatic discharge, transient disturbance, elec-magnetic induction, surge are according to IEC 61000-4 Class III
电气性能：高频干扰达到 IEC255-22-1 标准 III 级要求；静电放电、快速瞬变干扰、电磁场感应、雷击浪涌等达到 IEC61000-4 系列标准 III 级要求。

- Environment requirement: operation at -20 ℃+55 ℃,relative humidity≤95%; air pressure 86～106kPa
环境要求：工作温度：-20 ℃+55 ℃相对湿度：≤95%；大气压力：86～106kPa。

- Power consumption :＜10W (max configuration); MTBF >100000 hours. Apart from LCD operation interface, embedded web can be used for device management and data review. Upstreaming communication channel is capable to support Ethernet, GPRS/CDMA(optional), PPPoE, etc.
整机功耗：＜10W（最大配置）。MTBF＞100000 小时。产品除自带 LCD 操作界面外，还可通过嵌入式 web 进行设备管理及数据浏览。上行通道丰富，除标准以太网外，还可根据需求自由选配 GPRS/CDMA、有线拨号等各种上行通信模块。

- Timing: support remote synchronizing.
系统对时：支持远程对时。
- Abnormalities recording: event recording during equipment fault, and upload related information as required by main console.
异常情况记录：当设备本身出现故障时，可自动产生记录并保存，并可以根据主台的需要上传相关信息。
- Security: password and authorization, prevention of invalid operation.
安全功能：具有密码设置和权限管理，防止非法操作。

8.4.2 **Main Function 主要功能**

- Government office building energy consumption monitor
  国家机关办公建筑能耗监测
- Large-scale public building energy consumption monitor
  大型公共建筑能耗监测
- Campus building energy consumption monitor
  校园建筑能耗监测
- Industries and mining energy consumption monitor
  工矿企业能耗监测

8.4.3 **Major Complied Standards 主要遵循标准**

- Technical guidelines of subentry energy consumption data collection of national institutions building and large-scale public building
  《国家机关办公建筑和大型公共建筑能耗监测系统分项能耗数据采集技术导则》
- Technical guidelines of subentry energy consumption data transmission of national institutions building and large-scale public building
  《国家机关办公建筑及大型公共建筑分项能耗数据传输技术导则》
- Technical guidelines of design and installation of subentry energy consumption data metering of national institutions building and large-scale public building
  《国家机关办公建筑及大型公共建筑楼宇分项计量设计安装技术导则》
- Guidelines of construction, acceptance and operation management of national institutions building and large-scale public building
  《国家机关办公建筑及大型公共建筑建设、验收与运行管理规范》

8.5 Meteorological Measurement Stations
气象测量站

The meteorological measurement stations shall be installed in PV power plant to monitor ambient temperature, module temperature and the irradiation via pyranometer with respect to the below mentioned meteorological parameters.
气象测量站应安装在光伏电站内，以通过与下述气象参数相关的日射强度计监测环境温度、模块温度和辐射。

The Contractor is responsible for the installation of the weather stations with a minimum timeframe of one (1) weeks before commissioning (to ensure correct calibration and operation of the system) of the PV power plant.
承包商负责在调试光伏电站前至少一 (1) 周的时间框架内安装气象站（以确保正确校准和运行系统）。

The weather stations shall be installed in a location where no shading is expected from any building, light pole or any other obstacles on the pyranometer or from the

meteorological station on the modules of the PV field.
气象站应安装在任何建筑物、灯杆或日射强度计上的其他任何障碍物或光伏电场组件上的气象站不会产生阴影的位置。

批注 [S10]: What is your problem with that?

All stations shall be connected to the PCMS and shall be made available in PCMS Web Portal to download collected weather data.
所有气象站应连接至 PCMS，并在 PCMS 门户网站上提供已下载收集的气象数据。

The system shall be designed in a way that the data from the pyranometer will be consistently recorded without any data loss caused by power failure. If during any year of operation the data loss exceeds 4 events and a maximum of 2 days per event then this shall be considered as a defect and corrected during the defect period.
系统设计应考虑到如何持之有效的记录气象站的数据以确保不会因电力中断而出现数据丢失。如在缺陷责任期内任何一年中的数据丢失超过 4 次，每次事件影响最多 2 天下，承包商应采取修正措施。

批注 [S11]: Essential requirement by owner not accepted by EPC – to be discussed

The Contractor shall provide the specified amount of sensing equipment as per **Section 4.3.3**.
承包商应根据**章节 4.3.3** 提供规定数量的传感设备。

8.6 Asset Management Requirements
资产管理要求

The system shall provide a solution that needs to be flexible for Owner's requirements in terms of asset management and O&M supervision.
系统应提供一个能够在资产管理和运维管理方面灵活满足业主要求的解决方案。

Archive information can be flexibly configured and stored, and adjusted according to the archive attributedifference of various. Default assets at present: power plant, inverters, combiner boxes, DC power distribution cabinets, electricity meters, and gateways.档案信息可灵活配置存储，可根据各类设备档案属性的差异进行调整，以适应多种变化，目前系统默认：电站、逆变器、汇流箱、直流配电柜、电表、网关等。

8.7 Alarm and Event Requirements
报警和事件要求

批注 [S12]: Siemens System not able to meet this requirement.

批注 [13]: 请请施维确定能否满足，建议采用现有软件所能提供的方式定义要求

All alarm information will be displayed through this screen. The user can query the information that has not been processed recently, and perform corresponding processing. The system will save the processing opinions and later view it as a follow-up archive.
Users with different rights can view the alarm events they care about, and set SMS and email notifications for the alarm events under their jurisdiction.
The PVMS provides the following alarm information, supporting customization of alarm threshold:

- Inverter events, combiner events, meter data events, etc.
- Other events

各类告警信息将通过此界面进行分类展示，用户可对最近未处理的信息进行查询，并进行相应的处理，系统将对处理意见进行保存，以后作为后续存档查看。
不同权限的用户可查看到自己关心的告警事件，并可对自己所辖管理范围的报警事件进行短信和邮件通知的设置。
本系统提供以下告警信息，对各类告警类型可自定义告警阀值：

- 逆变器事件、汇流箱事件、表计数据事件等
- 其他事件；

8.8 Fire Alarm System
火灾报警系统

批注 [S14]: Please refer to above: optional if required by hinese building codes or building owner

批注 [15]: 没有建议删除

8.8.1 General Requirements
一般要求

This shall be supplied if required by building owner or by Chinese standards.

The scope of supply covers all buildings. The detection system will have sensors such as heat and smoke detectors for both locations, with fire alarm control panel located in the control room. The fire alarm system will be completed with light and paging system to alert the operator as well as maintenance staff or interface with existing fire alarm systems
如建筑物业主或国家有相关要求，承包商应提供火灾报警系统。

供货范围涵盖所有建筑物。探测系统将在两个位置安装传感器，例如：感温探测器和感烟探测器，火灾报警控制面板位于控制室内。火灾报警系统将配备灯光和寻呼系统或连接到原有系统，以提醒操作人员和维护人员。

The local alarm should be sound and light of both building type, to notify on site personnel of a potential fire hazard. The fire alarm system shall be provided with uninterruptible power supply (UPS).
两种建筑物的本地报警应为声光报警，以通知现场人员有潜在的火灾危险。火灾报警系统应配备不间断电源 (UPS)。

The manual pull box shall be provided at the inverter station and control room.
换流站和控制室应配备手动分线盒。

The fire resistance cabling shall be used for alarm signal as per Local standards.
根据当地标准，报警信号应使用耐火布线。

- GB 50016 National Fire Alarm Code
  GB 50016 建筑设计防火规范
- GB 50870 Construction safety technical standard
  GB 50870 建筑施工安全技术统一标准

8.9 CCTV System
CCTV 系统

CCTV system will preferably be fixed position type (IP camera) with optional motion detect sensors. The intent of the specification is to define the functional & design requirements for the CCTV system meant for gathering video information from the various operational areas of the plant. The Contractor shall be responsible for selection among top 3 suppliers, design, engineering, manufacture, testing at manufacturer's works/site, installation and commissioning of the system to the satisfaction of the requirement.
CCTV 系统首选带可选运动检测传感器的定位式（IP 摄像机）。本规范的目的是规定用于从电厂的各个操作区域收集视频信息的 CCTV 系统的功能和设计要求。承包商应负责确保在行业领先的前 3 家制造商的工厂/现场进行的选择、设计、工程、制造、测试以及系统的安装和调试满足要求。

All the cables, cable trays, power racks, erection hardware's etc. are also included in Contractor's scope.
所有电缆、电缆桥架、电源机架、安装硬件等都包括在承包商的范围内。

The scope shall also include successful demonstration of performance testing specified herein, completing in all respects with cables, cable trays, junction boxes, earth wire and accessories like standard brackets, nut-bolts, glands, lugs, conduit sleeves, etc. as required, to complete the proper for completeness of the system shall be furnished by the Contractor within the quoted price, whether these are specifically mentioned herein or not.
范围还应包括成功证明本文件规定的性能试验，为实现系统的完整性而在各个方面需要的电缆、电缆桥架、接线盒、接地线以及标准支架、螺母螺栓、密封套、接线片、导管套筒等附件应由承包商在报价中提供，无论它们是否在本文件中特别提及。

All major equipment such as cameras, video switcher/control system, keyboards, receiver drivers, video amplifiers, network video recorder, archiving system etc. should be of the same make.
所有主要设备，例如：摄像机、视频切换器/控制系统、键盘、接收器驱动器、视频放大器、网络录像机、存档系统等应为同一品牌。

Necessary surge protection device (SPD) shall be provided for the cameras and CCTV to provide high levels of lightning & surge protection while maintaining high quality video signals.
应为摄像机和 CCTV 提供必要的电涌保护器 (SPD)，以提供高水平的雷电和浪涌保护，同时保持高质量的视频信号。

The system and all the equipment shall conform to the latest edition of national standards as applicable.
系统和所有设备应符合适用的最新版国家标准。

8.10 Codes and Standards
规范和标准

All works, equipment, materials and systems shall be designed, manufactured, and/or constructed in accordance with the latest issue of the local codes and standards.
所有工作、设备、材料和系统应根据当地规范和标准的最新版本进行设计、制造和/或施工。

9 TEST REQUIREMENTS AND ACCEPTANCE CRITERIA
试验要求和验收标准

9.1 General
概述

This chapter specifies the minimum technical requirements for testing of materials, parts, equipment and workmanship of the plant during assembly, erection and upon completion to demonstrate compliance with the specification, codes and standards and to ensure overall availability and reliability of plant operation and performance. All test shall, as a minimum, comply to the below listed items, comply with the electrical authority's requirements as stated in Section 4.1 and furthermore ensures to be in correspondence with latest industry standards.
本章规定了在装配、安装和完工时测试材料、零件、设备和工艺的最低技术要求，以证明符合规格、规范和标准并确保电厂运行和性能的总体可用性和可靠性。所有试验应至少遵循下列项目，符合章节 4.1 所述的电力管理局要求，此外还确保符合最新的行业标准。

All works supplied under this document shall be adequately inspected and tested through visual, material, non-destructive, and functional and performance inspection, tests during manufacture, after delivery on site, during erection and after erection completion on site. The Owner reserves the right to witness the main equipment manufacturing tests and the Contractor shall facilitate and coordinate the same. The Contractor shall prove through the issuing of test records and reports, that all material and equipment complies with the requirements of the specification and is in accordance with the applicable codes and standards and has successfully passed all inspections and tests. To ensure a proper operation of the PV power plant, all necessary tests shall be performed on the PV modules, inverters, cables and additional equipment such as electrical systems, PCMS equipment, etc.
根据本文件提供的所有产品应在制造过程中、现场交货后、安装期间和现场安装完成后通过目视、材料、无损、功能和性能检查和试验进行充分检验和测试。业主保留见证主要设备制造试验的权利，承包商应进行促进和协调。承包商应通过发布试验记录和报告证明所有材料和设备符合本规范的要求，符合适用的规范和标准，并成功通过所有检验和试验。为了确保光伏电站正常运行，应对光伏组件、逆变器、电缆以及电气系统、PCMS 设备等其他设备进行所有必要的试验。

Precondition for starting the tests on completion of the PV power plant are the availability of complete design documentation including as built drawings, string measurement protocols, availability of plant operation and maintenance manuals and a fully operating

monitoring system including on site meteorological measurement station. All measurements and testing results shall be presented within the individual commissioning reports including details of the tests and shall at least include the list of the measurement equipment, responsible engineers and timestamps.
在光伏电站竣工后开始试验的前提条件是包括竣工图在内的全部设计文档、组串组测量协议、电厂运行和维护手册以及包括现场气象测量站在内的全面运行监测系统可用。所有测量和试验结果应在单独的调试报告中提供，包括试验细节，并至少包括测量设备、负责的工程师和时间戳列表。

9.1.1 Codes and Standards
规范和标准

Where no specific code or standard is mentioned in the specification, the various components of the PV power plant shall be tested in accordance with the relevant international or/and national standards. IEC standards are compulsory for the DC electrical equipment. Tests shall also be carried out in accordance with the Electrical Authority's Interconnection Code and with the manufacturer's standard codes of practice and recommendations shall be approved by the Owner/Owner's Engineer.
本规范没有提及具体的规范或标准时，应根据相关的国际或/和国家标准对光伏电站的各个组件进行测试。IEC 标准是电气设备的强制性标准。还应根据电力管理局的互连规范进行试验，制造商的标准操作规程和建议应由业主/业主工程师批准。

9.1.2 Work Progress Inspection (Process-Report)
工作进度检查（过程报告）

- Project administration
  项目管理
- Project planning and control
  项目规划和控制
- Project design, drawing list updated
  项目设计、图纸清单更新
- Detailed progress schedule
  详细的进度时间表
- Construction/erection, commissioning, site staff record, site delivery report
  施工/安装、调试、现场工作人员记录、现场交付报告
- Areas of concern, delays or otherwise and measures to be taken to overcome the delays/obstacles
  值得关注的方面、延误或其他问题，以及为克服延误/障碍而采取的措施
- Internal quality inspection reports of materials delivered by the suppliers for all main components
  供应商为所有主要部件提供的材料的内部质量检验报告

- Invoicing schedule 更新的发票清单

- Colour photographs showing the progress of Works and completion of each structure of major feature if permitted by building owner..在业主许可下，显示工作进度和主要功能的每个结构完成情况的彩色照片。

- The project progress report shall report about the activities for the previous reporting period, shall document sufficiently the status of the project at the end of each reporting period and give an outlook for the following three (3) reporting periods . Any critical events or milestone shall be reported about. Photographs shall also be used to document the progress on site.
  项目进度报告应报告上报告周期的活动，在每个报告周期结束时全面记录项目状态，并对未来三 (3) 个报告周期进行展望。应报告所有重大事件或里程碑。照片也应用于记录现场的进度。

- The updated detailed progress schedule reduced to A3 or A4 size shall be part of the project progress report.
  更新的详细进度时间表缩小为 A3 或 A4 尺寸，应作为项目进度报告的一部分。

9.1.3 Test Equipment
试验设备

All equipment for tests shall be supplied by the Contractor (except for IV test and Thermography test which relevant equipment will be provided by the Owner) and shall be retained by him upon the satisfactory conclusion of all such tests at site unless otherwise specified in this document. All costs associated with the supply, calibration and installation of the instrumentation devices for testing of the plant shall be included in the contract price. All test instruments shall be supplied with up-to-date calibration certificates issued by an accredited independent testing laboratory.
除非本文件另行规定（IV 测试和热成像测试的设备由发包方提供），所有用于试验的设备应由承包商提供，在现场成功完成所有试验后由其保存。与用于电厂测试的仪表设备的供货、校准和安装相关的所有费用均应包括在合同价格中。所有试验仪器应随附公认的独立检测实验室颁发的最新校准证书。

9.2 Rejection due to Test Results
由于试验结果而被拒收

If any item and / or component fail to comply with the requirements under this document, the Owner reserves the right to reject the item, or defective component. The corrective action shall be performed by the Contractor as instructed by the Owner/Owner's Engineer and the Contractor shall submit request for further inspection and/or test. In the event of a defect on any item, the item shall be replaced by the Contractor at his own expense. No extension of time or extra costs shall be considered as a result of repeated tests or material/equipment rejection.
如果任何物品和/或组件不符合本文件的要求，发包人有权利拒收物品或有缺陷的组件。承包商应按照发包人/发包人工程师的指示执行纠正措施，并应提交进一步检验和/或试验的

申请。如果任何物品存在缺陷，则承包商应自费更换该物品。不得由于反复试验或材料/设备拒收而考虑延长时间或增加费用。

9.3 Formal Requirement for Inspection and Testing
检验和试验的正式要求

9.3.1 Inspection and Testing Program
检验和试验方案

批注 [S16]: No Tests?

The Contractor shall issue a quality assurance program, indicating the kind and extent of all inspections and tests to be carried out on plant components subject to be approved by the Owner/Owner's Engineer. The quality assurance program shall be based on the tests and inspections specified in the various parts of the specification. An Inspection and Test Plan (ITP) shall be prepared by the Contractor or its representatives and shall be agreed by the Owner/Owner's Engineer. The ITP shall contain test procedures and schedule of the inspection required ensuring that dispatched materials meet the specification requirements.
承包商应出具一份质量保证方案，说明对业主/业主工程师批准的电厂部件进行的所有检验和试验的种类和程度。质量保证方案应以本规范的各部分规定的试验和检验为基础。检验和试验计划 (ITP)应由承包商或其代表编制，并由业主/业主工程师确认。ITP 应详细说明为确保发货的材料符合规范要求所需的检验的程序和时间表。

9.3.2 Test Procedures
试验程序

The development and implementation of test procedures for the construction, inspection, commissioning, start-up and performance testing of the PV power plant shall be the responsibility of the Contractor and shall be performed in accordance with the plant description, design conditions and technical data. The inspections, tests, commissioning, start-up and performance procedures and method statements shall be agreed by the Supervisor company and/or Owner/Owner's Engineer. All tests except where third-party involvement is required, shall be performed by the Contractor or his authorized representative and guided by the Supervisor company and/or Owner/Owner's Engineer , and all test participent need to place signature in the test report to prove the validity.

If the Supervision Company and/or Owner/Owner's Engineer give up the obligation on-site guidance, all test reports which are done by Contractor or its representatives should be treated as valid.
光伏电站的施工、检验、调试、启动和性能试验的试验程序应由承包商负责编制和实施，并应根据电厂描述、设计条件和技术数据执行。检验、试验、调试、启动的方法说明应由监理单位 和/或 业主/业主工程师批准。除需要第三方参与的试验外，所有试验应由承包商或其授权的代表执行，并由业主/业主工程师或监理公司指导，所有参与实验的相关方均应在实验报告上签字以证明其有效性。
如果业主/业主工程师或监理公司放弃现场指导的义务，所有由承包商或其代表所完成的实验报告均应视为有效。

The overall testing program for the PV power plant shall consist but is not limited to the following:
光伏电站的总体试验方案应包括但不限于以下内容：

- Inspection, testing, start-up, operating tests of the electrical systems and sub-systems.
  电气系统和子系统的检验、测试、启动、运行试验。
- Inspection, testing, start-up and operation testing of the PV power plant, related equipment and systems.
  光伏电站、相关设备和系统的检验、测试、启动和运行试验。
- Inspection, testing, start-up and operating tests of plant auxiliary equipment such as Plant Control and Monitoring System (PCMS), security system, Energy Meters, etc.
  电厂控制和监测系统 (PCMS)、安全系统、电能表等电厂辅助设备的检验、测试、启动和运行试验。
- Performance ratio tests.
  性能比试验。

All testing activities for the electrical facilities of the PV power plant shall be implemented and coordinated with the testing and commissioning of the installed equipment and components. The Contractor shall submit a description of all relevant test procedures in written form. The description shall be submitted to the Supervision Company and/or Owner and shall include but not limited to:
应对光伏电站的电气设施进行所有试验活动，并与安装的设备和部件的试验和调试进行协调。承包商应以书面形式提交所有相关试验程序的说明。该说明应提交给业主或监理公司，包括但不限于：

- Test programs and schedules
  试验程序和时间表
- Test standards
  试验标准
- Type of inspection and tests
  检验和试验类型
- Check lists
  检查清单
- Description of instrumentation to be used during testing
  进行测试期间所用仪器的说明
- List of the tests which shall be witnessed by third parties
  应由第三方见证的试验清单

- Quality control procedures
  质量控制程序

- Forms of test records and reports
  试验记录和报告的形式

Formulas, correction factors and methods used for adjustment to reference site conditions, which it shall be approved by the Supervision Company and/or Owner/Owner's Engineer.
调整参考现场条件所用的公式、修正系数和方法，其应由业主/业主工程师或监理公司批准。

9.3.3 Construction Progress Inspections and Certifications
施工进度检查和认证

The Owner and/or its authorized representatives are irrevocably entitled to inspect any equipment upon arrival at site, under erection or commissioning at site at any time without prior announcement to inspect the works performed in connection with this project and to monitor the progress of work, scrutinize related documents and to take photos as may be deemed adequate to the judgement of the said persons to document the actual status of work.
业主和/或其授权代表有权在未事先通知的情况下在设备到达现场时、现场安装或调试过程中随时检查设备，以检查与本项目有关的工作，监视工作进度，仔细检查相关文件，并拍摄被认为足量的照片以判断所述人员是否记录了实际工作状态。

All tests shall be accompanied by the test records signed by all parties. In case of tests involving also activity of other contractors all remarks and comments shall be placed in the test record signed by all participants. Erection and construction checks/tests shall be announced and carried out after completion of the electromechanical installation works.
所有试验应随附各方签字的试验记录。如果试验涉及其他承包商的活动，则应在所有参与方签字的试验记录中添加所有备注和评论。在完成机电安装工作后，应宣布并执行安装和施工检查/试验。

A punch list will be generated during random progress visits by the Supervision Company and/or Owner/Owner's Engineer. Prior to each official site inspection witness by the Owner this punch list will be submitted along with Request for Inspection (RFI) to the Contractor. Such punch list will include a brief description of identified deficiencies, the corrective work to be performed and items classification in three (3) categories:
业主/业主或监理公司工程师在随机进度访问期间将生成剩余工作清单。业主每次进行正式现场检查见证前会将该剩余工作清单与检验申请表 (RFI)一起提交给承包商。此类剩余工作清单包括所发现缺陷的简要描述、要进行的纠正工作和三 (3) 个类别的分类：

Category **A** major default shall be fixed with undue delay and before acceptance and transfer of risk.
A 类重大违约行为应在验收和风险转移前立即修复。

Category **B** minor defects but negative impact on yield production and therefore shall be fixed before acceptance and transfer of risk.
B 类轻微缺陷对产量有负面影响，因此，应在验收和风险转移前进行修复。

Category **C** minor defects without negative impact on the yield production within 1 months after acceptance test and before Taking Over.
C 类轻微缺陷在验收试验后和移交前的 1 个月内对产量没有负面影响。

When a system or part of a system is completely erected, the Contractor shall notify in writing to the Owner that an inspection should take place to determine that the concerned system is installed according to the specifications and according to the approved drawings. Such notice shall be in writing and shall be deemed to be a request by the Contractor for the Owner to issue a Completion Certificate.
当系统或系统的一部分完全安装时，承包商应书面通知业主进行检验，以确定相关系统根据规范和批准的图纸进行安装。此类通知应为书面形式，并应视为承包商请求业主颁发竣工证明书。

9.4 Commissioning
调试

The issuance of the Completion Certificate is a prerequisite for commencement of commissioning works. The Contractor shall be responsible for the safe and efficient setting to work on the entire PV power plant and equipment. The methods adopted on site shall be in accordance with all applicable safety and permit regulations. The Contractor shall submit, a comprehensive commissioning manual detailing the approach for individual system/subsystem commissioning, all preparations for the start-up of the entire PV power plant and execution of reliability and performance tests for the Owner/Owner's Engineer approval. The condition for allowing any system or equipment to be operated requires the successful tests on completion, documented by a duly completed and countersigned erection checklist.
颁发完工证明书是启动调试工程的先决条件。承包商应负责确保整个光伏电站与设备安全有效投入运行。现场采用的方法应符合所有适用的安全和许可规定。承包商应提交全面的调试手册，以供业主/业主工程师批准，该手册详述了各个系统/子系统的调试方法、启用整个光伏电站的所有准备工作以及可靠性和性能测试的执行过程。任何系统或设备的运行许可条件是需要成功完成完工测试，并填妥相关文件，最后在安装清单上签字。

The Contractor shall ensure to fulfill the electrical authority's requirements as stated in Section 4.1 and submit the commissioning reports.
承包商需确保调试工程应符合第 4.1 节中所述的电力局要求并提交调试记录和报告。

The Contractor shall ensure the commissioning completion by performing a joint walk down together with the Owner, Owner's Engineer, representatives of the network operator, if required, to generate a punch list report on a system, listing and identifying the outstanding items and/or corrective works to be performed as well as their priorities.
承包商应确保与业主、业主工程师、网络运营商代表一起按顺序完成调试（若有需要），并在系统上生成一份问题清单报告，列出和确定未清项目和/或纠正须执行的工作以及其优先顺序。

All test equipment, tools, materials, consumables, labour and spare parts required during commissioning shall be provided by the Contractor.
承包商应提供调试期间所需的所有测试设备、工具、材料、耗材、劳动力和备件。

9.4.1 Staffing
人事

During commissioning, the Contractor shall make available the responsible to supervise and manage their staff. The Contractor shall provide a team of suitably qualified and experienced technicians to pre-commission and commission the overall plant. The Contractor shall ensure at all times that his staff and any sub-contractor or seconded staff shall observe all prescribed safety rules and regulations.
在调试期间，承包商应负责监督和管理员工。承包商应提供具有适当资格和经验的技术人员团队，以便对整个机组进行预调试和调试。承包商应确保其工作人员和任何分包商或借调人员始终遵守所有规定的安全规则和条例。

9.4.2 Commissioning Tests
调试测试

The Contractor shall perform the tests after approved by local electrical authority. The Contractor shall provide all the personnel, test facilities, equipment and tools to assist with the Commissioning works. The testing will prove that the PV power plant (mechanically and electrically) and the PCMS meet all the specified requirements and be well functional. The plant performance test shall be commenced upon the commissioning works have been successfully completed.
承包商应在电力局批准的后进行测试。承包商应提供所有的人员、测试设备、装置和工具来协助调试工作。该测试可证明光伏电站（机械和电气）和 PCMS 符合所有的指定要求，并且运行状态良好。电站性能测试应在调试工作顺利完成后开始。

9.4.3 String Commissioning
组列调试

String commissioning involves visual inspections as well as tests and measurements to verify the safe and proper operation of the system according to the contract. The verification shall be carried out in according to the GB 20513.
组列调试应根据合同约定，其中包括视觉检查以及相关测试和测量，旨在验证该系统的安全性以及是否运行正常。应按照 GB 20513 进行该验证。

The Contractor can carry out the test after the inspection has been completed.
完成检查后，承包商可以执行该测试。

The Test shall be conducted with the appropriate apparatus provided by the owner and in accordance to the proper procedure according to the EPC Contract.
应使用由业主提供的适当的仪器并按照 EPC 合同约定的程序进行该测试。

9.4.4 Thermography Test
热成像测试

Thermography Test for Solar PV Modules
太阳能光伏模块的热成像测试

批注 [S17]: We would like to do this test during the first two years of operation to make sure that there are no warranty claims for the modules.

The Infrared Thermography test shall be performed 3 months prior to the end of the defeat liability period according to the contract to identify unusual temperature differences during operation of the solar modules to diagnose thermal and electrical failures in PV modules, such as identify defective cells, bypass diodes, solder contacts, etc. Abnormalities shall be evaluated with the Owner/Owner´s Engineer and fixed in accordance to the recommendations of the Owner/Owner´s Engineer
红外热成像测试应在缺陷责任期结束前 3 个月按合同执行并应能够识别太阳能模块运行期间的异常温度差异，从而诊断光伏模块中的热故障和电气故障，例如识别已故障的电池、旁路二极管、焊接触点等。对于整个装置，最小测量样本百分比为 5%。异常应由业主/业主工程师进行评估，并按照业主/业主工程师的建议采取措施。

Thermography Test for BOS Components
BOS 组件的热成像测试

BOS components, including Combiner Box, Inverter, AC Switch Cabinet Cables and Cable Connectors shall be detailed checked with devices provided by the Owner according to the Contract. Abnormalities shall be evaluated with the Owner/Owner´s Engineer and fixed in accordance to the recommendations of the Owner/Owner´s Engineer.
BOS 组件（其中包括汇流箱、逆变器、交流开关柜电缆和电缆连接器）应以业主提供的设备按照合同进行详细检查。异常应由业主/业主工程师进行评估，并按照业主/业主工程师的建议采取措施。

9.5 Plant Performance and Guarantee Requirements
设备性能和保证要求

9.5.1 Input Data for Performance Ratio Simulation
用于能效比模拟的输入数据

The Contractor shall provide an Energy Yield Assessment using the meteorological data provided in APPENDIX 3. The Contractor shall provide an Energy Yield Assessment report with justification for the input parameters and loss parameters used to calculate the yield and performance of the PV system. The Contractor shall provide and include Appendix 3 the PV power plant simulation report using bankable high quality software e.g. PVSyst.
承包商应使用附录 3 中提供的气象数据进行能源产出评估。承包商应提供一份能源产出评估报告，并说明用于计算光伏系统产量和性能的输入参数和损失参数的合理性。承包商应使用银行认可的高质量软件（如 PVSyst），从而制定光伏电站模拟报告，并包含附录 3 中。

9.5.2 General
概述

The Contractor shall guarantee the solar PV power plant to meet the conditions of performance, availability and utilisation in the Owner's Requirement as a minimum requirement.
承包商应保证光伏电站符合业主的最低要求，即性能条件、可用性和利用率。

After the reliability test run, the PR tests shall commence and the guarantee figures according to the Contract specifications shall be demonstrated and complied with. The PR test shall be done for a period of 7 (seven) consecutive days and the power plant shall demonstrate to achieve the guaranteed PR value in year 1 (corresponding to the month of testing). The PR shall be calculated as stipulated in this section. If the guaranteed figures cannot be met, corrective actions shall be undertaken to reach the required Performance Ratio, additionally Liquidated Damages for the Initial Performance Ratio Guarantee as defined shall be paid to the Owner.
在执行可靠性测试之后，应开始能效比测试，并且按照本合同规范证明和遵守保证数值。能效比测试应持续进行 7（七）天，并且该发电站应在第 1 年（对应于测试月份）证明其已达到保证的能效比值。应按本节规定计算能效比。如果无法满足保证数值，则应采取纠正措施，使其达到要求的能效比，此外，还应按要求向业主支付初始能效比保证违约金。

If during the measurement an external power outage happens, those days of the power outage shall be excluded and the duration of the PR Test shall be extended to reach the minimum period of 7 days of measurement.
如果在测量过程中发生外部停电事故，则不应计入停电天数，并且能效比测试的持续时间应达到至少 7 天（最短测量期限）。

It shall be noted that the PR varies with changes in meteorological conditions and thus changes throughout the year. A temperature correction factor is therefore taken into account to achieve a more accurate assessment of the PR between simulated and measured during commissioning.
应当指出的是，能效比会随着气象条件的变化而变化，因此，该值全年均会发生变化。因此，应考虑到温度校正因子，以便在调试期间对能效比模拟值和测量值进行更为精确的评估。

The PR (Performance Ratio) will be calculated according to the following formula:
按照以下公式计算 PR（能效比）：

$$PR = \frac{\sum_j E_{Produced\ System\ Energy,j}}{\sum_j GTI_j * A_{Total\ Module\ Area} * \eta_{STC\ Module} * \alpha_{Temp\ Correction}}$$

Corresponding units:
相应单位：

Symbol 符号	Unit 单位	Description 说明
E *Produced system energy*	[kWh]	Produced system energy will be measured during the test period of 10 consecutive days. The relevant meter where produced

E *已产生的系统能量*		energy will be measured shall be the one where remuneration for electricity production will be granted. 已产生的系统能量将在连续 10 天的测试期间进行测量。用于测量已产生能量的相关计量表应是唯一的，并且应该是所生产电力的计量单位。
GTI	[kWh/m ^{2}]	Measured insolation on a tilted in-plane Secondary Standard (ISO-9060) Pyranometer. 测量倾斜式平面内二次标准（ISO-9060）日射强度计上的日照。
A*Total Module Area* A *总模块面积*	[m ^{2}]	Total module area 总模块面积
η*STC Module* η*STC 模块*	[%]	Efficiency according to PV module datasheet 根据光伏模块数据表的效能
α*Temp correction* α *温度校正*	Factor 因子	Temperature correction factor 温度校正因子
j	[min] [分钟]	interval of measurements = 15min 测量间隔 = 15 分钟

The following formula shall apply for the temperature correction factor:
温度校正因子应适用于下列公式：

$$\alpha_{Temp\ Correction} = (1 + (T_{Module\ Average\ measured} - T_{Module\ Average\ Simulation}) * K_{MPP_{STC}})$$

Corresponding units:
相应单位：

Symbol 符号	Unit 单位	Description 说明
$T_{Module\ Average\ measured}$	[°C]	The average module temperature over the test period 测试期间的平均模块温度
$T_{Module\ Average\ Simulation}$	[°C]	The average module temperature is to be taken from a simulation software (e.g. PVSyst). 通过仿真软件（如 PVSyst）获得平均模块温度。
$K_{MPP_{STC}}$	[%/°C]	Temperature coefficient of the PV module at MPP $_{STC}$ according to PV module datasheet 根据光伏模块数据表，光伏模块相对于 MPP STC 的温度系数

It shall be noted that not the yearly average PR, but the PR value as simulated of the respective testing month shall be met.
需要注意的是，该值不是年均能效比，而应符合相应测试月份的能效比模拟值。

9.5.3 Plant Performance Test Criteria 电站性能测试标准

Requirements before the Test
测试前的要求

Before the test can commence, the following need to be completed:
在测试开始之前，需要完成以下工作：

1. Install and calibrate all primary measurement instruments.
   安装和校准所有主要测量仪器。
2. A test procedure shall be issued by the Contractor and agreed to by all parties prior to the test.
   该测试程序应由承包商发布，并在测试前经各方同意。

Minimum Irradiance Criteria
最低辐射度标准

The duration of the plant acceptance test period is 7 days with the following minimum irradiance criteria:
电站验收测试期限为 7 天，最低辐照标准如下：

1. At least seven (7) days must have an irradiance measured in the plane of the array that is greater than 600 W/m² for three continuous hours, and the daily total irradiance must exceed 3,000 Wh/m² /day.
   在至少七（7）天内，必须连续三个小时对阵列平面进行超过 600 W/m²的辐射，并进行测量，每天的总辐射度必须超过 3,000 Wh/m²/天。
2. If there are not seven (7) days that meet these minimum irradiance criteria, the test period may be extended until seven (7) sufficient days have been recorded. There will not be any liquidated damages triggered as a result of this weather-related test delay.
   如果满足这些最低辐照度标准的天数少于七（7）天，则可能会延长测试期，直至记录天数达到七（7）天。如果该测试由于天气而发生延迟，则不会产生任何违约金。
3. For the test period, any recorded values when GTI is below 50 W/m² shall not be considered as usable input for the calculation of the Performance Ratio Evaluation.
   在测试期间，当 GTI 低于 50 W/m2 时，则任何记录值均不应视为是用于计算能效比评估的可用输入值。

9.5.4 Plant Performance during Defect Liability Period
缺陷责任期内的设备性能

At the end of each year of operation starting from Final Acceptance of the PV power plant, plant performance test may be performed at the end of the 1st, 2nd and 3rd year of operation of the PV power plant, the PR of the PV power plant will be verified based on

the annual average PR of the PV power plant.
从光伏电站最终验收至每年运行结束，可在光伏电站运行的第一年、第二年和第三年末进行电站性能测试，并且应根据光伏电站的年平均能效比验证光伏发电站的能效比。

The PR calculation during the Defect Liability Period is exclusive of external events that cannot be accounted for or controlled by the Contractor. The PR (Performance Ratio) during the DLP will be calculated according to the following formula:
在缺陷责任期内的能效比计算不包括承包商无法解释或无法控制的外部事件。应根据以下公式计算缺陷责任期内的 PR（能效比）：

$$PR_i = \frac{E_{Produced\ System\ Energy,i}}{(GTI_{Year} - GTI_{Down\ Time\ External}) * A_{Total\ Module\ Area} * \eta_{STC\ Module} * \alpha_{Temp\ Correction}}$$

Corresponding units:
相应单位：

Symbol 符号	Unit 单位	Description 说明
E *Produced system energy* E *产生的系统能量*	[kWh]	Total produced system energy during the year of measurement. The relevant meter where produced energy will be measured shall be the one where remuneration for electricity production will be granted. 在测量年度内产生的系统总能量。用于测量已产生能量的相关计量表应是唯一的，并且应该是所生产电力的计量单位。
GTI Year GTI 年	[kWh/m ^{2}]	Yearly sum of measured insolation on a tilted in-plane Secondary Standard (ISO-9060) Pyranometer. 根据倾斜式平面内二次标准（ISO-9060）日射强度计测得的年度日射量总和。
GTI Down Time External GTI 停机时间（外部因素）	[kWh/m ^{2}]	Yearly sum of measured insolation on a tilted in-plane Secondary Standard (ISO-9060) Pyranometer during system down time due to external events 在由于外部事件导致的系统停机时间内，根据倾斜式平面内二次标准（ISO-9060）日照强度计测得的年度日射量总和
A *Total Module Area* A *总模块面积*	[m ^{2}]	Total module area 总模块面积
η *STC Module* η*STC 模块*	[%]	Efficiency according to PV module datasheet 根据光伏模块数据表的效能
α *Temp correction* α *温度校正*	Factor 因子	Temperature correction factor 温度校正因子
i	[Year]	Year (1 st, 2 nd or 3 rd)

	[年]	年份（第 1 年，第 2 年或第 3 年）

9.5.5 Guaranteed Performance Ratio
保证的效能比

The plant shall have an installed capacity as agreed in the EPC Contract under Standard Test Conditions (STC) according to the nominal power of the modules. The actual Performance Ratio (PR) shall reflect the requested output power requirement and be higher or equal the Contractual PR. The Contractor shall provide the guaranteed values of its designed PV power plant prior to contract. The table shall be provided for 2 years as a guaranteed value for the performance during the Defect Liability Period (DLP), the annual module degradation shall be taken into account.
根据模块的标称功率，发电站应有标准试验条件（STC）下的 EPC 合同中规定的装机容量。实际能效比（PR）应反映要求的输出功率要求，并高于或等于合同上的能效比。承包商应在合同签署前提供其设计的光伏电站的保证值。应连续 2 年提供缺陷责任期（DLP）内的效能保证表，同时应考虑年度模块性能退化。

批注 [S18]: 3 years is our requirement and shall not be changed. If agreed otherwise in EPC contract its Ok but in RFP should be three years.

The Contractor shall comply and demonstrate the plant performance namely:
承包商应遵守和证明发电站效能，即：

Should the Contractor not be able to demonstrate the plant performance to meet the initial PR Guaranteed Values, the Contractor will pay to the Owner liquidated damages as defined by the EPC contract.
如果承包商无法证明发电站效能符合初始能效比保证值，则其将按照合同约定向业主支付违约金。

The Owner retains the right to terminate the project agreement(s) should the Performance Ratio fail to reach 72% within 1 years from the first scheduled initial performance test as defined by Right to Terminate Due to Inferior Performance.
根据由次等效能所引起终止权的定义，如果能效比自首次计划的初始效能试验起一年内未达到 72%，则业主保留终止项目协议的权利。

9.5.6 Final Acceptance
最终验收

After the successful execution of the performance tests and hand over of all documentation as a minimum set out in Section 10 final inspection shall be arranged between the Contractor and the Owner/Owner's Requiremen. Moreover all listed deficiencies recorded in punch lists shall be compelled and defects are removed.
作为第 10 节的最低限度规定，在成功执行效能试验和移交所有文件后，应在承包商和业主/业主之间安排最终检查。此外，所有列出并记录在问题清单中的缺陷将强制删除。

If remaining deficiencies could be identified, a definite completion date (within 2 months after found the remaining deficiencies) shall be given by the Contractor for each single item recorded in the punch list. If the PV power plant past all tests, all deficiencies are resolved and the final documentation is available. The Owner shall issue the Certificate of Final Acceptance, as defined, of the PV power Plant.

如果可以确定剩余缺陷，则承包商应为记录在问题清单上的每一个项目确定缺陷解决日期（发现剩余缺陷后的 2 个月内）。如果光伏电站通过所有试验、所有缺陷已解决且已编制出最终文件，则根据定义，业主应颁发光伏电站的最终验收证书。

10 PROJECT HANDOVER AND DOCUMENTATION
项目移交和文件

The Contractor shall submit the Final Documentation to the Owner sixty (60) days after Provisional Acceptance. Provisional Acceptance can be awarded when commissioning has been completed, all plant facilities has been safely operating and all documents and information regarding to the plant facilities and operation and maintenance such operation and maintenance manuals have been supplied to the Owner. The contents and format of the Final Documentation to be agreed by Owner before submission. The Final Documentation shall include as a minimum the documents listed below.
承包商应在临时验收后六十（60）天内向业主提交最终文件。在完成调试、已安全运行所有发电站设施、所有与发电站设施、运行和维护有关的文件和信息以及这些运行和维护的手册已经提供给业主后，业主可以授予承包商临时验收。最终文件的内容和格式在提交之前要得到业主的同意。最终文件应至少包括下列文件。

10.1 Equipment Documentation
设备文件

Equipment Dossiers (e.g. specifications, reports, calculations, datasheet, performance and test data, material certificate, operation and maintenance manual, drawings etc) Quality Assurance (QA) and Quality Control (QC) Dossiers.
设备档案（如规范、报告、计算、数据表、效能和试验数据、材料证书、运行和维护手册、图纸等）、质量保证（QA）和质量控制（QC）档案。

The equipment dossiers shall cover as a minimum the listed equipment:
设备档案应至少包括列出的设备：

- PV modules
  光伏模块
- Mounting structures
  安装结构
- String inverters
  串式逆变器
- DC and AC cables
  直流和交流电缆
- Ground cables
  接地电缆
- Other supplied equipment
  其他提供的设备

10.2 Testing, Pre-commissioning & Commissioning Documentation
试验、预调试和调试文件

The Contractor shall submit, at a minimum, the following documentation:
承包商应至少提交以下文件：

- Engineering Designs
  工程设计
- Manufacturer Technical Data
  制造商技术数据
- As-Built Drawings (*dwg, *.pdf)
  完工图纸（*dwg,*.pdf）
- Safety Instructions
  安全守则
- Close Out Report
  完工报告
- Construction Record
  施工记录
- Regulatory Approval Records
  监管批准记录
- Minutes of Meeting
  会议纪要
- Project Correspondence
  项目通信
- Accident / Incident Report
  事故/事件报告
- All documentation and data in EDMS
  EDMS 中的所有文件和数据

The Contractor shall provide the Final Documentation in two (2) hardcopies, one for the owner and one for the O&M operator, binded with hard cover and one (1) set of soft copies (.pdf). All as-built drawings must be provided in the latest AutoCAD (.dwg) format with two (2) sets of blue print and one (1) set transparent print in A1 and A3 format.
承包商应提供两（2）份用硬封面包扎的最终文件硬拷贝（一份交发包人，一份交运维人员）和一套软拷贝（.pdf）。所有完工图纸必须以最新的 AutoCAD（.dwg）格式提供，其中包含两套（2）蓝图和一套（A1）和 A1（A3）格式的底图。

10.3 Provisional Acceptance and Close Out Report
初步验收和完工报告

The Close Out report shall contain the following as a minimum and must be submitted prior to applying for Provisional Acceptance:
完工报告应至少包含以下内容，且必须在申请初步验收之前提交：

- Commissioning Report approved by Owner
  业主批准的调试报告
- Permit & Licenses Status Report
  许可证和执照状态报告
- Electrical Authority's Regulation Compliance Report
  电力局的法令遵循报告
- First Synchronization Status
  第一个同步状态
- First draft of as-built drawings
  完工图纸的初稿
- Punch list signed by Owner
  业主签署的问题清单
- List of remaining works signed by owner
  业主签署的余下工作清单
- Compilation of all work inspection reports
  所有工作检查报告的汇集
- All PV and equipment testing reports
  所有光伏设备试验报告

10.4 Training Program
培训计划

The Contractor shall propose and submit a Training Program to the Owner and O&M operator.
承包商应向业主和运维单位提出并提交培训计划。

The Training Program shall consist of but not limited to:
培训计划应包括但不限于：

- The Training program and methodology
  培训计划和方法
- Training schedule,
  培训计划

- Training contents,
  培训内容
- All relevant documentation including FACILITY Plant manufacturers' references, etc.
  所有相关文件，包括设施发电站厂商参考资料等。

The Training Program shall cover Commissioning including shutdown, emergency, handling upsets and normal operations and maintenance. The Contractor shall submit the Training Program at least one (1) month before the end of Defect Liability Period, which is at least two (2) years after Final Performance Acceptance Test. It shall consist but not limited to training manual, training methodology and syllabus and assessment program.
培训计划应涵盖包括关机、紧急情况、处理异常和正常运行和维护在内的调试。承包商应至少在最终性能验收后两（2）年的缺陷责任期结束前一（1）个月提交培训计划。该计划应包括但不限于培训手册、培训方法和教学大纲和评估程序。

The Contractor shall conduct the assessment soon after completion of each training module. The assessment shall at least consist of on-field tests with the trainees' implementation and the trainers' supervision. The Contractor shall train O&M Contractor (in case other Contractors are awarded for operation and maintenance of the plant) to be able to monitor and maintain the facilities.
承包商应在每个培训模块完成后尽快进行评估。评估应至少包括在培训导师监督下由学员执行的现场试验。承包商应对运维承包商进行培训（如果授予其他承包商来负责工程的运维服务），以便监测和维护设施。

批注 [S19]: Don't understand why you are taking this out here?

批注 [S20]: This needs to stay in and further defined in EPC contract.

11 APPENDICES
附录

APPENDIX 1: Head of Terms (Not used)
附录 1：条款要点(不适用)

APPENDIX 2: License List
附录 2：许可证列表

- Business License 营业执照
- Construction Qualification Certificate 建筑业企业资质证书

APPENDIX 3: Meteorological Data
附录 3：气象数据

- PVsyst simulation report

  PVSyst 光伏电站模拟报告

APPENDIX 4: Regulatory Guidelines
附录 4：管理指南

- GB/T 50796-2012 Code for acceptance of photovoltaic power project

  GB/T 50796-2012 光伏发电工程验收规范

- GB50794-2012 Code for construction of PV power station

  GB50794-2012 光伏发电站施工规范

APPENDIX 5: Grid Interconnection Code (Not used)
附录 5：电网互联代码(不适用)

APPENDIX 6: EHS Regulation
附录 6：EHS 规范

- Principles of Environmental Protection, Health Management and Safety (EHS Principles) – Siemens Circular No. 171, Version 2.2

APPENDIX 7: Conceptual Design
附录 7：概念设计

- PV layout drawings and construction design

  光伏组件分布平面图和施工设备大样图

- 25 years electricity generation forecast

  25 年发电量预测

APPENDIX 8: Project Parameters

APPENDIX 8.1: General

The Project is located at location with the coordinates (WGS84) as below,
项目位于以下地点，

- 30°48'46.62"N, 121°20'51.88"E (Shanghai)
  30°48'46.62"N, 121°20'51.88"E (上海)

and the total roof top area is 15,000sqm.
屋顶总面积为 15,000 平方米。

The installed solar PV power plant shall have a maximum capacity of 0.915MW_{DC} (under Standard Testing Conditions - STC). Further design criteria and technical specification will be described in detail in subsequent chapters.
安装的太阳能光伏电站应具有最大为 0.915MW_{DC} 的装机容量（在标准测试条件下 - STC）。。下文将详述进一步的设计标准和技术规格。

APPENDIX 8.2: PV Power Plant Overview
光伏电站概述

The following particular requirements shall be taken into consideration.
工程应考虑以下特殊要求。

Table 4: PV Power Plant Overview
表 4：光伏电站概述

CRITERIA 标准	REQUIREMENTS 要求
Module technology 组件技术	☐ Poly-Crystalline 多晶 ☒ Mono-Crystalline 单晶 ☐ Thin Film 薄膜 ☐ Double Glass (Glass Backsheet) 双层玻璃（玻璃底片）
Maximum Installed DC Capacity (STC) 最大直流装机容量（标准测试条件）	915KW
Minimum Installed DC Capacity (STC) 最小直流装机容量（标准测试条件）	915KW
Min. module efficiency (STC)	18.68%

CRITERIA 标准	REQUIREMENTS 要求
最小组件效率（标准测试条件）	
Module PID resistance 组件电势诱导衰减电阻	<5% 小于 5%
Degradation of the modules shall insure 组件衰减应确保	2.5% for 1st year, 0.7% for the other years till 25th year 第 1 年 2.5%，其后第 2 年到第 25 年，每年最大衰减值 0.7%
Inverter technology 逆变器技术	☒ String Inverter 组串型逆变器 ☐ Central Inverter 集中式逆变器
DC combiner box 直流汇流箱	☐ YES ☒ NO ☐是☒否
Mounting structure 安装结构	Light steel rooftop, concrete rooftop 彩钢瓦屋顶，混凝土屋顶
DC/AC Ratio 直流/交流比率	＞98%
Connection Voltage 连网电压	10kV
Operation and Maintenance (O&M) 运行与维护（O＆M）	
- O&M Manual 运维手册	☒ YES ☐ NO ☒是☐否
- Procedures 流程	☒ YES ☐ NO ☒是☐否
- Training (on–site) 培训（现场）	☒ YES ☐ NO☒是☐否
Cable losses 电缆损耗	<3% 小于 3%
Environmental Conditions 环境条件	temperature between -10.1℃ to 39.9℃, annual precipitation 1,173.4mm. 上海属亚热带季风性气候，平均气温 17.6℃，降水量 1173.4 毫米。极端最低气温-10.1℃，极端最高气温 39.9℃。
Lifetime of the Plant 电站生命周期	25 Years 25 年

CRITERIA 标准	REQUIREMENTS 要求
General Design 总体设计	O&M walk way, cleaning pipe system 格栅通道、清洗水管
Monitoring System 监控/监控系统	Data collection, storage, transmition. CCTV 数据采集、存储、发送，视频监控
Security 安全性	Safe line and safe pole 生命线，立柱
Quality 质量	INSERT QUALITY 插入质量

APPENDIX 8.3: Site Location Information
现场位置信息

The information provided in this sub-chapter is based on the Owner's investigation results. If further detailed investigations or studies are necessary, those shall be performed by the Contractor.
本节信息基于发包人提供的勘测结果。如需进一步的详细勘测或研究，应由承包人负责进行。

The description of the PV power plant location provided below considers the following items:
下文给出的光伏电站位置描述充分考虑了以下因素：

- Coordinates of the proposed site
  拟建现场坐标
- Site Conditions
  现场条件
- Weather Data
  天气数据
- Grid Connection
  连接电网
- Other important environmental conditions
  其它重要的环境条件

Note: The provided information in this sub-chapter does not relieve the Contractor from his contractual obligations and responsibility of evaluating the present site conditions.
注：本节信息并不免除承包人在评估现场条件方面的合同义务和责任。

APPENDIX 8.4: Site Location
现场位置

The following table shows the geographic coordinates of the site : (**Reference to page 17**)
下表给出了项目现场的地理坐标：（参考第 17 页）

Table 5: Site coordinates
表 5：现场坐标

SITE CORNERS 现场四角	LATITUDE 纬度	LONGITUDE 经度
1	30.817095°	121.339752°
2	30.816117°	121.339958°
3	30.816539°	121.342504°
4	30.817575°	121.342269°

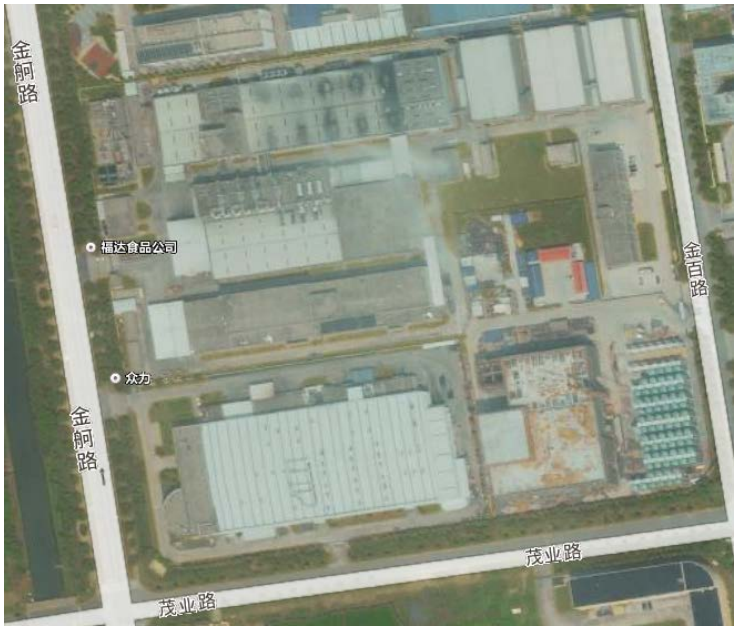

Figure 1: Site Location in Shanghai Heinz
图 1：上海项目地点中的现场位置

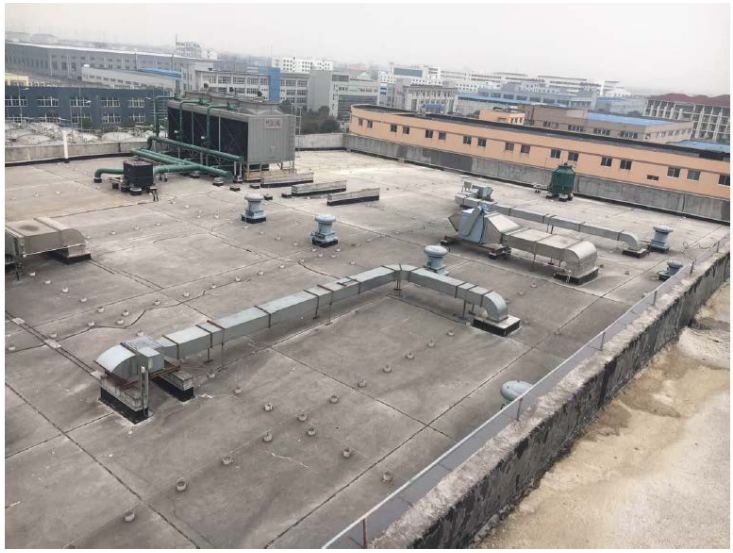

Figure 2: Site Geometry
图 2：现场情况

APPENDIX 8.5: Site Conditions
现场条件

The project site with a total area of approx. 15,000 sqm.
项目占地总面积约为 15,000 平方米。

A topographical survey in a resolution of 437 x 333 is available for the whole site..
我们提供了整个施工现场的地形勘察图片，解析度为 437 x 333。

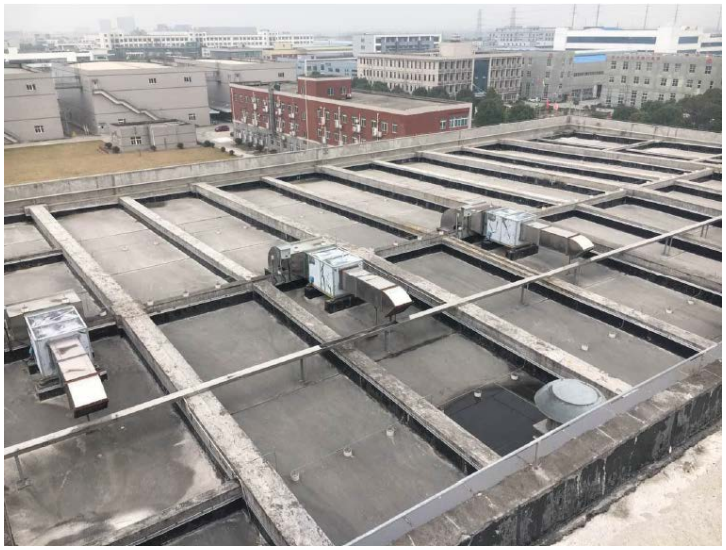

Figure 3: Site survey photo
图 3：现场勘测照片

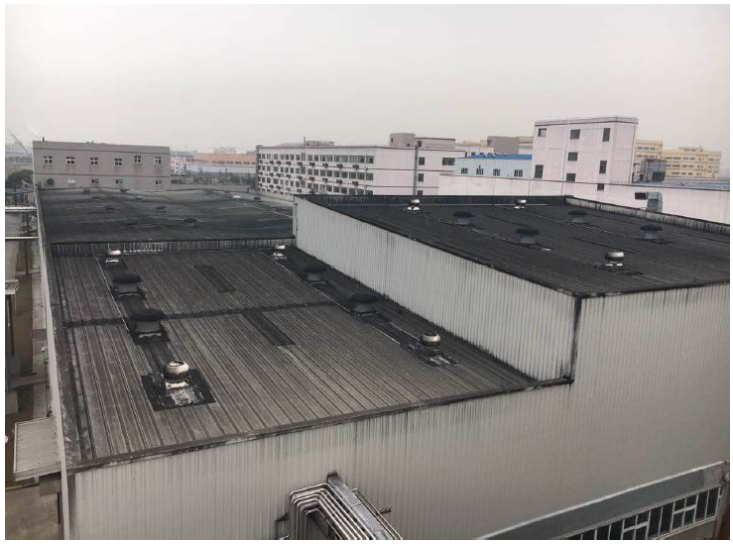

Figure 4: Site survey photo
图 4：现场勘测照片

APPENDIX 8.6: Weather and Climate Data
天气和气候资料

Following data sets are provided:
文件提供了以下数据集：

- Global Horizontal Irradiation (GHI)
  全球水平辐照量（GHI）
- Diffuse irradiation
  漫射辐照量
- Ambient temperature
  环境温度
- Wind speed at 10 m above ground
  地面 10 米高处的风速

The table below presents the average GHI and temperature which shall be used for all yield calculation related to the plant design of this project. The complete data set can be found in **Meteonorm 6.1**. The Contactor shall not modify the data.
下表列出了与工程电站设计相关的发电量计算书所使用的平均 GHI 和温度。完整数据集可查阅 Meteonorm 6.1。承包人不得修改数据。

Table 6: Monthly average GHI and ambient temperature at the site
表 6：现场月平均 GHI 和环境温度

MONTH 月份	GLOBAL HORIZONTAL IRRADIATION [KWH/M²] 全球水平辐照量	AMBIENT TEMPERATURE [°C] 环境温度
January 一月	69.7	3.8
February 二月	73.3	6
March 三月	96.9	10.4
April 四月	115.5	16.5
May 五月	135.5	21.5
June 六月	125.2	25.3
July 七月	158.4	28.9
August 八月	152.3	28.3
September 九月	111	24.5

MONTH 月份	GLOBAL HORIZONTAL IRRADIATION [KWH/M²] 全球水平辐照量	AMBIENT TEMPERATURE [°C] 环境温度
October 十月	99.5	19
November 十一月	77.4	13.2
December 十二月	70.5	6.5
Year 年份	1,285.1	17

As additional design criterion a minimal temperature of -10.1°C and a maximum temperature of 39.9°C shall be considered. All plant components shall perform under the described conditions. The following table shows the design climate conditions.
作为附加设计标准，现场最低环境温度不得低于-10.1°°C，最高温度不得高于 39.9°C。所有设备部件应在所述条件下运行。下表为设计气候条件。

Table 7: Design Climate Conditions
表 7：设计气候条件

CONDITION 条件	UNIT 单位	VALUE 数值
Min. Temperature 最低温度	°C	-10.1℃
Max. Temperature 最高温度	°C	39.9℃
Wind Speeds 风速	m/s	2.7
Rainfall 降雨量	mm/a	1,159.2
Seismic Zone 地震带	Zone 区域	PGA = 0.1 m/s2, PGA = peak ground acceleration PGA = 0.1 m/s2，PGA =峰值地面加速度
Climate Type 气候类型	-	Subtropical Monsoon Climate 亚热带季风性气候

APPENDIX 8.7: Point of Connection
连接点

The point of the connection shall be the 10kV distribution system operated by Heinz Shanghai and inside the factory. The grid frequency is 50 Hz.
连接点应为（福达上海食品有限公司）工厂内运行的（10kV）配电系统，电网频率是（50 Hz）。

APPENDIX 9: Minimum Technical Requirements
最低技术要求

The minimum technical requirements for the equipment and installation are defined in this section. Where the Owner has selected to choose one (1) or more items for the equipment's requirements, the Bidder is free to propose to the Owner the most economical and optimal technical solution.
本节定义了设备及安装应达到的最低技术要求。发包人为设备要求选择超过一（1）件设备的，投标人可根据自己的看法向发包人提出最经济、最优化的技术方案。

APPENDIX 9.1: System Requirements
系统要求

The specific system requirements are listed in the table below.

CLAUSE 项目	CRITERIA 标准	REQUIREMENTS 要求
1.82	Electrical Authority 电气管理局	☒ JinShan Electricity Authority ☐ Other ☒ 金山市电力局 ☐ 其它
1.83	DC Voltage 直流电压	☒ 1,000 V ☐ 1,500 V
1.84	Low Voltage 低压	☐ Please Mention ☐ 请具体指出
1.85	Medium Voltage 中压	☒ 10kV ☒ 10kV
1.86	Grid Voltage 电网电压	☒ 10kV ☒ 10kV

APPENDIX 9.2: Electrical Equipment

APPENDIX 9.2.1: LV Switchgear
低压开关柜

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.87	Required 要求	☒ Yes ☐ No ☒ 是☐ 否
1.88	Rated Voltage 额定电压	☐ 10kV ☐ 10kV
1.89	Nominal Voltage 标称电压	☐ 10kV☐ 10kV
1.90	Basic Insulation Level	Please Mention

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
	基本绝缘标准	请具体指出
1.91	One minute power frequency withstand voltage 一分钟工频耐压	>42kV 不低于 42kV
1.92	Rated Current (busbars / incoming / outgoing) 额定电流（母线/输入/输出）	Defined by Bidder 由投标人定义
1.93	Rated short time withstand current 额定短时耐受电流	Defined by Bidder 由投标人定义
1.94	Rated duration of short circuit 额定短路持续时间	3 seconds 3 秒
1.95	Rated peak withstand current 额定峰值耐受电流	Defined by Bidder 由投标人定义
1.96	Min. temp. operating range 最低工作温度范围	-5°C to +55°C -5°C 至 +55°C
1.97	IP Class 防护等级	☐IP41 ☐IP54 ☒ IP65
1.98	Min. product warranty 最短产品质量保修期	5 years 5 年

APPENDIX 9.2.2: Medium Voltage Switchgear (not used)
中压开关设备 (不适用)

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.99	Required 要求	☐ Yes ☐ No ☐ 是☐ 否
1.100	Rated Voltage 额定电压	☐ Please Mention ☐ 请具体指出
1.101	Nominal Voltage 标称电压	☐ Please Mention ☐ 请具体指出
1.102	Basic Insulation Level 基本绝缘标准	Please Mention 请具体指出
1.103	One minute power frequency withstand voltage 一分钟工频耐压	Please Mention 请具体指出

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.104	Rated Current (busbars / incoming / outgoing) 额定电流（母线/输入/输出）	Defined by Bidder 由投标人定义
1.105	Rated short time withstand current 额定短时耐受电流	Defined by Bidder 由投标人定义
1.106	Rated duration of short circuit 额定短路持续时间	3 seconds 3 秒
1.107	Rated peak withstand current 额定峰值耐受电流	Defined by Bidder 由投标人定义
1.108	Min. temp. operating range 最低工作温度范围	-5°C to +55°C -5°C 至 +55°C
1.109	IP Class 防护等级	☐IP41 ☐IP54 ☐IP65
1.110	Min. product warranty 最短产品质量保修期	5 years 5 年

APPENDIX 9.2.3: Step up Transformer
升压变压器

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.111	Required 要求	☒ Yes ☐ No ☒ 是☐ 否
1.112	Primary Voltage 初级电压	☐ 0.48KV ☐ 0.48KV
1.113	Secondary Voltage 次级电压	According to primary of Dirtribution Transformer 0.48KV/10K 根据配电变压器初级电压决定 0.48KV/10K
1.114	Rated power 额定功率	Defined by Bidder 由投标人定义
1.115	Number of windings 绕组数	Please Mention 请具体指出
1.116	Vector Group 矢量组	As per **Electrical Authority's** requirements 根据**电力管理局**要求
1.117	Type of cooling 冷却类型	Please Mention 请具体指出

ITEM 项目	CRITERIA 标准	REQUIREMENTS 要求
1.118	Impedance voltage 阻抗电压	According to IEC 60076 遵照 IEC 60076
1.119	IP Class 防护等级	IP 54
1.120	Min. product warranty 最短产品质量保修期	5 years 5 年