中国华电集团有限公司
CHINA HUADIAN CORPORATION LTD.
中国华电科工集团有限公司
CHINA HUADIAN ENGINEERING CO., LTD.

巴厘通用能源公司
PT GENERAL ENERGY BALI

巴厘通用能源公司
PT.GENERAL ENERGY BALI

巴厘通用能源公司电气试验（升压站 150kV 侧金属氧化物避雷器带电测试，启备变预防性试验、仪表校验）技术规范书

Electrical tests (Live-line testing of 150kV side metal oxide surge arresters at the substation, preventive testing of standby transformers, and instrument calibration) of PT.GENERAL ENERGY BALI

批准(APPROVE)：

审核(VERIFY)　：

编制（Prepared by）：

2026 年 07 月 15 日

巴厘通用能源公司电气试验（升压站 150kV 侧金属氧化物避雷器带电测试，启备变预防性试验、仪表校验）技术规范书

Electrical tests (Live-line testing of 150kV side metal oxide surge arresters at the substation, preventive testing of standby transformers, and instrument calibration)of PT.GENERAL ENERGY BALI

1. 总则 General Requirements

1.1 适用范围 Scope of application

本技术规范书适用于巴厘通用能源公司电气试验（升压站 150kV 侧金属氧化物避雷器带电测试，启备变预防性试验、仪表校验）外委项目，明确承包方在技术、质量、安全、环保、进度、责任及义务等方面的要求，以确保项目高质量完成。

This technical specification applies to the outsourced electrical testing (Live-line testing of 150kV side metal oxide surge arresters at the substation, preventive testing of standby transformers, and instrument calibration) project of Bali General Energy Company. It clarifies the requirements of the contractor in terms of technology, quality, safety, environmental protection, schedule, responsibilities and obligations to ensure the high-quality completion of the project.

编制依据 Preparation basis

1.2.1 相关法律法规

Relevant laws and regulations

《中华人民共和国招标投标法》

Tendering and Bidding Law of the People's Republic of China

1.2.2 相关行业标准

Related industry standards

《电力设备预防性试验规程》《电流表、电压表、功率表及电阻表检定规程》

Preventive Testing Procedures for Power Equipment，Verification Procedures for Ammeters, Voltmeters, Wattmeters and Resistance Meters.

1.2.3 企业标准及管理要求

Enterprise management requirements

电气专业《设备检修规程》相关内容

Relevant content of the "Equipment Maintenance Procedures" for each specialty

1.2.4 设计文件、设备技术资料

Design documents, equipment information

《厂家资料》

Manufacturer Information

1.3 技术规范的解释权 Right of interpretation

本技术规范书由巴厘通用能源公司生产技术部编制并解释，未尽事宜由双方协商确定。

This technical specification is prepared and interpreted by the Production Technology Department of Bali General Energy Company. Any matters not covered shall be determined by negotiation between the two parties.

2. 工作范围 Working scope

2.1 项目概述 Project Overview

2.1.1 项目名称

Project Name

电气试验（升压站 150kV 侧金属氧化物避雷器带电测试，启备变预防性试验、仪表校验）。

Electrical testing (live-line testing of 150kV side metal oxide surge arresters in the substation, preventive testing of standby transformers, and instrument calibration).

2.1.2 项目地点

Project Location

巴厘通用能源公司（印度尼西亚巴厘岛）

Bali General Energy Company (Bali, Indonesia)

2.1.3 项目背景及目的

Project Background and Purpose

印尼巴厘岛一期 3×142MW 燃煤电厂启备变由江苏上能新特变压器有限公司生产，型号为 SFZ10-55000/220，三相双线圈铜绕组无励磁调压油浸式变压器，冷却方式为自然油循环风冷（ONAF），额定频率 50HZ，额定容量：37MVA（绕组温升 65K 时），额定电压高压侧 160±2×2.5％kV 低压侧 6kV，联接组标号 YNyn0yn0+d，端子连接方式：高压侧：架空线；低压侧：离相封闭母线。启备变自 2015 年投产以来，未做过预防性试验，为防止出现变压器事故，计划停设备进行预防性试验。

150kV 出线一至出线四，每条线路有 A、B、C 三相金属氧化物避雷器，未做带电测试。依据《防止电力生产事故的二十五项重点要求》定期对金属氧化物避雷器开展带电测试工作）。

电气仪表按照要求已超期未试验。

The standby transformer for the first phase of the 3×142MW coal-fired power plant in Bali, Indonesia, was manufactured by Jiangsu Shangneng Xinte Transformer Co., Ltd. The model is SFZ10-55000/220, a three-phase, double-coil, copper-winding, non-excitation, voltage-regulating oil-immersed transformer with natural oil circulation air cooling (ONAF). It has a rated frequency of 50Hz, a rated capacity of 37MVA (at a winding temperature rise of 65K), and rated voltages of 1602×2.5%kV on the high-voltage side and 6kV on the low-voltage side. The connection group designation is YNyn0yn0+d, and the terminal connection method is: high-voltage side: overhead line; low-voltage side: isolated phase busbar. Since its commissioning in 2015, the standby transformer has not undergone preventative testing. To prevent transformer accidents, a planned shutdown for preventative testing is scheduled.

The 150kV outgoing lines one through four each have three-phase metal oxide surge arresters (A, B, and C), but no live-line testing has been performed. In accordance with the "Twenty-Five Key Requirements for Preventing Power Production Accidents", live-line testing of metal oxide surge arresters shall be carried out regularly.
The electrical instruments have not been tested as required and the testing period has expired.

2.1.4 工程范围

Project scope

启备变1台预防性试验，150kV线路12个金属氧化物避雷器带电测试。三台机组电气仪表包括：#1机-#3机各18个发变组变送器。

One standby transformer was tested for preventative purposes, and 12 metal oxide surge arresters on the 150kV line were tested under energized conditions. The electrical instrumentation for the three generating units included 18 transmitters for each of units #1 to #3.

2.2 外委工作内容 Outsourcing work content

现场施工、试验、验收及培训

On-site construction, testing, acceptance and training

2.2.1 启备变预防性试验

Preventive testing of standby transformer

绕组直流电阻；
绕组连同套管的绝缘电阻、吸收比或极化指数；
绕组连同套管的介质损耗因数及电容量；
铁心及夹件绝缘电阻；
短路阻抗；
频率响应测试；
测温装置校验及其二次回路试验；
气体继电器校验（仅功能模拟测试）及其二次回路试验；
压力释放器校验（仅功能模拟测试）及其二次回路试验；

油压速动继电器（仅功能模拟测试及其二次回路试验）；
油浸式电流互感器（高压侧套管）电容型套管末屏对地绝缘电阻。
Winding DC resistance;
Insulation resistance, absorption ratio, or polarization index of windings (including bushings);
Dielectric loss factor and capacitance of windings (including bushings);
Insulation resistance of the core and clamping structure;
Short-circuit impedance;
Frequency response test;
Calibration of temperature monitoring devices and testing of their secondary circuits;
Calibration of gas relays (functional simulation test only) and testing of their secondary circuits;
Calibration of pressure relief devices (functional simulation test only) and testing of their secondary circuits;
Rapid oil-pressure relay (functional simulation test and secondary circuit test only);
Insulation resistance to ground of the capacitive bushing test tap (on the high-voltage side bushing) for oil-immersed current transformers.

2.2.2 150kV 金属氧化物避雷器带电测试

150kV Metal Oxide Surge Arrester Live-Line Testing

全电流与阻性电流测量：通过专用测试仪获取运行电压下的全电流、阻性电流基波分量，判断避雷器阀片是否受潮、老化。

谐波分量分析：测量泄漏电流的 3 次、5 次、7 次谐波分量，排除电网电压谐波对测试结果的干扰，识别是否存在劣化隐患。

三相不平衡系数比对：对比同线路上三相避雷器的电流参数，判断是否存在特性异常的相别。

有功功率/容性电流测量：计算避雷器运行中的有功损耗，辅助判断内部发热和绝缘劣化程度。

Total Current and Resistive Current Measurement: A dedicated testing instrument is used to acquire the fundamental components of the total current and resistive current under operating voltage to determine if the surge arrester varistors are damp or aged.

Harmonic Component Analysis:The 3rd, 5th, and 7th harmonic components of the leakage current are measured to eliminate interference from grid voltage harmonics and identify potential deterioration risks.

Three-Phase Unbalance Coefficient Comparison: The current parameters of three-phase surge arresters on the same line are compared to determine if any phases exhibit abnormal characteristics.

Active Power/Capacitive Current Measurement: The active power loss during surge arrester operation is calculated to aid in assessing internal heating and insulation degradation.

2.2.3 仪表校验
Instrument calibration

#1 机-#3 机各 18 个，共 54 个发变组变送器校验，根据变送器功能包括电压、电流、频率、功率因数等。

There are 18 transmitters each for units #1 to #3, totaling 54 transmitters for generator-transformer group calibration. The transmitters are calibrated based on their functions, including voltage, current, frequency, and power factor.

2.3 修复工作需要的甲方、乙方人员配合及工期

甲方委派一名中方人员全程跟踪监护，办理工作票；乙方委派至少 2 名试验人员，其中 1 人为中方人员或可翻译中文方便交流试验方案及安全措施。启备变及避雷器试验日期在签订合同后 40 天内，乙方根据甲方要求到厂试验，启备变试验工期控制在 8 小时内，避雷器试验无特殊时间要求；仪表校验需要在 2026 年 12 月、及 2027 年第一季度甲方停机检修时分三次进行；甲方需提前 10 天告知乙方试验时间方便乙方运输试验仪器及行程安排。试验所需的仪器及工器具、耗材、劳保用品、往返交通由乙方负责，甲方为乙方免费提供试验期间厂区住宿、中方餐厅伙食。

Party A shall designate a Chinese staff member to oversee the entire process and handle work permits; Party B shall designate at least two testing personnel, one of whom must be a Chinese national or capable of translating Chinese to facilitate communication regarding testing protocols and safety measures. Testing for the start-up/standby transformer and lightning arresters is to be conducted at the site within 40 days of contract signing, in accordance with Party A's requirements; the duration for the transformer test shall not exceed 8 hours, while there are no specific time constraints for the lightning arrester test. Instrument calibration must be carried out in three stages: in December 2026 and during Party A's scheduled maintenance shutdowns in the first quarter of 2027. Party A shall notify Party B of the testing schedule 10 days in advance to allow for the transport of testing equipment and travel arrangements. Party B is responsible for providing all necessary testing instruments, tools, consumables, and personal protective equipment (PPE), as well as arranging round-trip transportation; Party A shall provide on-site accommodation and meals at the Chinese staff canteen for Party B's personnel during the testing period at no cost.

3. 技术要求 Technical requirements

3.1 主要技术指标 Main technical indicators

3.1.1 主要技术参数要求
Technical parameter requirements

试验数据根据《电力设备预防性试验规程》《电流表、电压表、功率表及电阻表检定规程》标准进行分析，出具试验报告。

The test data are analyzed according to the standards of "Preventive Test Procedures for Power Equipment" and "Verification Procedures for Ammeters, Voltmeters, Power Meters and Resistance Meters", and a test report is issued.

3.2 质量要求 Quality requirements

3.2.1 质量验收标准及方法
Quality acceptance standards and methods

按相关国家、行业标准验收。

Acceptance shall be conducted in accordance with relevant national and industry standards.

3.2.3 质保期限及售后服务
Warranty period and after-sales service

检修完成投入运行后一年内，无因施工质量引起的故障。

Within one year of the completion of the overhaul and commissioning, there were no malfunctions caused by construction quality.

3.3 试验要求 Test requirements

3.3.1 试验技术要求
Test technical requirements

通用要求：试验需符合现行电力行业标准，环境温湿度满足绝缘试验基本条件，仪器经校准合格，数据可追溯存档。

避雷器试验：运行电压下的电流、谐波、三相平衡度等参数，判断受潮劣化趋势。

变压器试验：绕组电阻、绝缘特性、介损等核心指标，与出厂数据比较是否存在故障隐患，绕组、铁心、二次回路无异常缺陷。

油浸式电流互感器试验：性能满足基本运行要求，无内部隐患。

General Requirements: Testing must comply with current electric power industry standards; ambient temperature and humidity must meet the basic conditions for insulation testing; instruments must be successfully calibrated; and data must be traceable and archived.
Lightning Arrester Testing: Parameters such as operating current, harmonics, and three-phase balance are measured to assess trends regarding moisture ingress and degradation.
Transformer Testing: Core indicators—including winding resistance, insulation characteristics, and dielectric loss—are compared against factory data to identify potential faults; checks ensure there are no abnormal defects in the windings, core, or secondary circuits.
Oil-Immersed Current Transformer Testing: Performance must meet basic operational requirements, with no internal hidden defects.

3.3.2 试验设备和仪器的管理

Management of equipment and materials during construction

试验前核验：核查所有进场仪器的检定/校准证书，确认在有效期内。

现场开展仪器外观、通电功能预试，排除故障隐患。

核对仪器量程、精度与本次试验项目的匹配度。

试验中管控：严格按仪器操作规范接线、设置参数，严禁超量程使用。

安排专人监护试验仪器运行状态，避免过载、误操作。

试验后闭环：及时关闭仪器电源、拆除接线，清洁后妥善收纳。

导出本次试验原始数据，确认仪器无损坏、无遗留缺陷。

登记本次试验仪器使用记录，与试验报告同步归档。

Pre-test Verification: Verify the validity of all inspection/calibration certificates for incoming instruments.
Conduct on-site pre-tests of instrument appearance and power-on functionality to eliminate potential faults.
Check the compatibility of instrument range and accuracy with the test requirements.
During Test Control: Strictly adhere to instrument operating procedures for wiring and parameter settings; exceeding the range is strictly prohibited.
Assign dedicated personnel to monitor the instrument's operation to prevent overload and misoperation.
Post-Test Closed-Loop: Promptly shut down instrument power, disconnect wiring, clean, and properly store.
Export the original test data to confirm the instrument is undamaged and free of defects.
Register the instrument usage record for this test and archive it concurrently with the test report.

3.4 验收 acceptance

3.4.1 合格标准

Qualification Standard

所有试验项目无遗漏，各项试验均符合 DL/T 596-2021 规程要求。

试验过程合规，仪器在检定有效期内，现场安全措施落实到位，试验环境满足规范要求。

试验中发现的隐患记录在报告中。

All tests were conducted without omission, and all test met the requirements of DL/T 596-2021.
The testing process was compliant, the instruments were within their calibration validity period, on-site safety measures were implemented effectively, and the testing environment met the specifications.
Any potential hazards discovered during the tests were recorded in the report.

3.4.2 试验报告要求

Test report requirements

报告需完整覆盖本次所有试验项目，附带对应试验仪器的有效校准证书佐证材料。

清晰标注每一项试验的实测数据、标准限值，给出明确的合格性判定结论，数据可追溯。

报告需加盖试验单位资质章，附带试验人员、审核人员签字，出具正式的合规纸质/电子版本。

试验合格的设备，要在合适的位置张贴规范的合格证。

The report must comprehensively cover all test items and include valid calibration certificates for the corresponding testing instruments.
The measured data and standard limits for each test must be clearly indicated, along with a clear conclusion on whether the test is qualified, and the data must be traceable.
The report must bear the official seal of the testing unit, be signed by the testing personnel and the reviewer, and be issued in a formal, compliant paper/electronic version.
Equipment that has passed testing must have a standard compliance label affixed in an appropriate location.

4. 进度要求 Progress requirements

4.1 总工期要求

Total construction period requirements

根据合同签订日期及甲方通知完成工作。

Complete the work according to the contract signing date and the client's notification.

4.2 各阶段时间节点

Time nodes of each stage

无要求

No requirements

5. 安全及环保要求 HSE requirements

5.1 安全管理 Safety Management

5.1.1 施工安全管理要求

Construction safety management requirements

5.1.1.1 所有参加试验工作的人员，在施工过程中，做好防护工作，佩戴合格的劳保用品。

All personnel participating in the testing work shall take protective measures and wear qualified personal protective equipment during the construction process.

5.1.1.2 所有参加试验工作的人员，必须严格遵守电力安全工作规程、电站检修安全管理规定等有关安全生产工作制度。

All personnel participating in the test must strictly abide by the relevant safety production work systems, such as the power safety work regulations and the power plant maintenance safety management regulations.

5.1.1.3 工作期间认真执行“两票三制”，按有关规程、制度的规定正确填写工作票，及时办理。工作票终结后，要认真填写检修交代，做到清楚明了。

During the work period, the "two-ticket, three-system" requirement must be strictly implemented. Work permits must be filled out correctly and processed promptly according to relevant regulations and systems. After the work permit is completed, a maintenance handover report must be filled out clearly and concisely.

5.1.1.4 施工单位都应高度重视工作安全，并注意协调配合，试验单位应指定现场专职安全员，严把安全关，并要有明确的试验组织机构和各自的责任，有明确的分工。

Construction units should attach great importance to work safety and pay attention to coordination and cooperation. Testing units should designate a full-time on-site safety officer to strictly control safety and have a clear testing organization and responsibilities with a clear division of labor.

5.1.1.5 防高空坠落措施：高空作业应系好安全带，防止高空坠落；穿防滑鞋，带工具袋。

Fall prevention measures: When working at heights, safety belts must be worn to prevent falls; non-slip shoes must be worn, and tool bags must be carried.

5.1.1.6 正确操作试验仪器，采取防护措施，防止人身触电，确保现场的设备不发生设备损坏。

Operate the testing instruments correctly, take protective measures to prevent electric shock, and ensure that the equipment on site is not damaged.

5.1.1.7 施工现场配备干粉灭火器。

Dry powder fire extinguishers should be available on the construction site.

5.1.1.8 至少应两人进行，一人监护，一人操作，在停电设备上工作，为了防止误合刀闸，刀闸拉开后应加以绝缘罩，并悬挂“禁止合闸，有人工作”的标示牌。安装临时电源线应有专人负责，并指定人员禁止乱动乱拉临时线路。不可用湿手触摸开关和其他用电设备；禁止将电线裸露插入插座中或裸露钩挂在电源开关上。

At least two people should be involved, one supervising and one operating. When working on de-energized equipment, to prevent accidental closure of disconnect switches, insulated covers should be placed after the switches are opened, and a "Do Not Close, People Working" sign should be displayed. The installation of temporary

power lines should be the responsibility of designated personnel, and designated personnel should be prohibited from tampering with or extending temporary wiring. Do not touch switches or other electrical equipment with wet hands; do not insert exposed wires into sockets or hang exposed hooks on power switches.

5.1.2 试验人员资质及企业要求

Test personnel qualifications and company requirements

试验员须具备相关专业岗位资格证书。 特种作业人员（如电工、焊工）须持有应急管理部门颁发的操作证，并通过年审。企业资质、施工总承包三级资质要求：企业要有二级或以上资质，可承接 330 千伏及以下电压等级电力设施的试验活动。

Test workers must possess relevant professional qualification certificates. Special operation personnel (such as electricians and welders) must hold operation certificates issued by the emergency management department and pass the annual review. Enterprise qualifications and general contracting level three qualification requirements: The enterprise must have a level two or above qualification and be able to undertake testing activities for power facilities with voltage levels of 330 kV and below.

5.1.3 防范措施及应急预案

Preventive measures and emergency plans

施工前必须编制三措两案，并审批通过。

Three measures and two plans must be prepared and approved before construction.

5.2 环保要求 Environmental requirements

5.2.1 施工现场环保管理措施

Environmental protection management measures at construction sites

废旧物料需当天清理，禁止随意丢弃。

5.2.2 废弃物处理规定

Waste disposal requirements

设置分类回收设施，有环境污染风险的垃圾工作完成后交由甲方统一委托有资质单位回收。

Set up classified recycling facilities, and hand over waste that poses a risk of environmental pollution to qualified units for recycling after the work is completed.

6 违约责任 Liability for breach of contract

6.1 甲方或乙方违反合同规定造成对方损失的应承担违约责任。

Party A or Party B shall bear the liability for breach of contract if it violates the contract and causes losses to the other party.

6.2 因乙方责任造成甲方损失的，由乙方继续完善检修工作，并按损失的大小减收检修费。乙方承担的所有赔偿金额累积不超过本合同金额的 3%。

If Party B causes losses to Party A due to Party B's responsibility, Party B shall continue to improve technical supervision work and reduce supervision fees according to the size of the losses. The total amount of compensation borne by Party B shall not exceed 3% of the amount of this contract.

6.2.1 由于乙方出具的技术措施、试验数据、技术报告等技术性材料不正确，给甲方造成损失时。每次考核金额为 400 美元，累计扣罚金额不大于甲方应付款费用的 3%。

When Party B suffers losses due to incorrect technical materials such as technical measures, test data, technical reports, etc., the amount of each assessment is US$400, and the cumulative penalty amount shall not exceed 3% of the payable fees of Party A.

6.2.2 由于乙方的工作延误、疏忽或者错误等原因，不能按照合同要求完成有关工作，给甲方工作造成较大影响时，每项/次按 400 美元考核，累计扣罚金额不大于甲方应付款费用的 1%。

If Party B is unable to complete the relevant work as required by the contract due to delays, negligence or errors in its work, which has a significant impact on Party A's work, a penalty of USD 400 will be imposed for each item/time, and the cumulative penalty amount shall not exceed 1% of Party A's payable expenses.

6.2.3 在合同履行期间，由于甲方原因，甲方要求终止或解除合同，甲方应根据乙方已进行的实际工作量，向乙方支付已完成工作的相应费用并赔偿乙方由此引起的直接损失。

During the performance of the contract, if Party A requests to terminate or cancel the contract due to Party A's reasons, Party A shall pay Party B the corresponding expenses for the completed work and compensate Party B for the direct losses caused thereby based on the actual workload performed by Party B.

6.3 争议解决 Dispute Resolution

6.3.1 争议解决方式及管辖归属

Dispute resolution and jurisdiction

6.3.1.1 双方因合同发生争议，由双方当事人协商解决，协商不成的，提交至中国国际经济贸易仲裁委员会仲裁解决。

Any dispute between the two parties arising from the contract shall be resolved through negotiation. If no agreement is reached through negotiation, the dispute shall be submitted to the China International Economic and Trade Arbitration Commission for arbitration.

6.3.1.2 如有争议，以英文合同及协议版本为准。

In case of any dispute, the English version of the contract and agreement shall prevail.

7. 其他要求 Other requirements

7.1 文件提交要求

Document submission requirements

无

no

7.2 其他附加条款

Other additional terms

无

no

附录 Appendix（如需要 If necessary）：

无

no