

SECTION 261300 -- MEDIUM-VOLTAGE SWITCHGEARS (13.8KV)

PART 1 - GENERAL

1.1 SUMMARY

A. General

1. Read this Section in conjunction with other related Sections, Division 01 General, the Design Drawings and the Contract Conditions.

B. Engineer's Design Work

1. Refer to the Contractor's Responsibilities in Division 01 General, Section 011000 Summary for specific requirements.
2. Supply, deliver, install and warrant the work in strict compliance with the materials and workmanship requirements of the Specification.
3. Where required to prepare Shop Drawings, these shall be limited to final detailing of components, systems indicated on the Design Drawings, necessary to demonstrate their safe installation.
4. Where products are offered by the Contractor for acceptance by the Engineer, provide full supporting documentation in respect of the complete system or installation.

C. Included Systems/ Products

1. Medium Voltage Switchgear.

1.2 SUBMITTALS

A. General

1. Comply with the requirements of Division 01 General, Section 013300 Submittal Procedures and submit the following.

B. Post Contract Submittals

1. Shop Drawings.
 - a The Contractor shall furnish the following drawings and documents along this submittal for approval:
 - 1) Dimensioned drawing showing outline of the switchgears arrangement and position of important external features. These drawings shall show masses, crane lift necessary for untanking and size of lifting lugs or eyes.
 - 2) Single line diagram showing all auxiliary devices.
 - 3) Original catalogues for various proposed components.
 - 4) Drawings of nameplate and all termination arrangements.
 - 5) Drawing giving typical mechanical and electrical details of the voltage control apparatus.
 - 6) Details of cable terminations and fittings.
 - 7) Foundation plan, including foundation loading.
 - 8) Schematic and connection diagrams covering all equipment pertaining to the switchgear.
 - 9) Controls details and diagrams for the automatic switching of circuit protection

中华人民共和国一级注册建筑师
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)
资质证书号: A131002923
有效期至: 2025年03月16日



- devices.
- 10) Type and special test certificates as applicable.
 - 11) Approved test certificate / test report.
 - 12) Schedule of Accessories and Fittings.
 - 13) Technical Manual giving installation, operation and maintenance instructions.
 - 14) Schedule of recommended spare parts.
 - 15) Automatic switching of devices.
2. Calculations: Forward the following calculations and data.
- 1) Calculations and charts proving that discrimination in the breaker characteristics are achieved with upstream circuit protective devices and downstream circuit protective devices. The protection device to be coordinated with upstream switchgear.
 - 2) Detailed short circuit level calculation to select the short circuit rating of the various switchgears. The protection device to be coordinated with upstream switchgear.
 - 3) Bus bar sizing calculation for each switchgear. Busbar size and temperature rise shall be same as per Type Test.
 - 4) Calculation for temperature rise inside switchgears.
 - 5) Load analysis report for each substation and logic design for monitoring and control through Program Logic Control/ BMS or SCADA.
 - 1) Tenderers shall make adequate provision for configuration of the SCADA system, and shall allow for a fully integrated substation protection and control solution utilising the IEC 61850 network-based protocol within the substation where both Protection peer-to-peer and local automation is required, which is interfaced directly to the SCADA Master Station over a dual (redundant) communication system, using IEC60870-5-101 and IEC60870-5-104 protocols.
 - 2) The operation and integration between the substation's secondary plant and the SCADA Master Station system shall be facilitated by means of a Gateway that shall be capable of supervising a limited number of traditional hard-wired functions, for the purpose of monitoring and controlling nonIEC61850 compliant devices such as transformer gas monitoring, fire detection, Load Management / Ripple control, optical fibre, battery charging and AC changeover systems.
 - 6) Incoming and outgoing circuit breaker, close, open and trip logic diagram.
3. General arrangement of the switchgear showing all dimensions.
 4. Details of circuit breakers.
 5. Details of relays.
 6. Single line diagram of the switchgear.
 7. Details of current transformer and voltage transformer.
 8. Catalogues for all major components of the switchgear.
 9. Interlocking diagram.
 10. Detailed technical specification.
 11. Civil layout plan indicating power cable and control cable entry.
 12. Minimum clearances around the assemblies for ventilation and safety.
 13. Product Data on materials and components for use.
 14. All accessories required for the operation and maintenance of the switchgear shall be supplied.

姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日



15. Installation Instructions

C. Post Contract Samples

1. Not required.

D. Closeout Submittals

1. Comply with the requirements of Division 01 General , Section 017800 Closeout Submittals, and submit the following.
 - 1) Warranties.
 - 2) Operation and Maintenance (O&M) Manuals.

1.3 QUALITY ASSURANCE

A. General

1. Refer also to the requirements of Division 01 General , Section 014000 Quality Requirements.

B. Subcontractor's Qualifications

1. Subcontractors and Site operatives shall have a minimum of 5 years' experience in performing the type of Work specified in this Section and associated works of other Sections as applicable to the completion of the work.

C. Source of Supply

1. Obtain products from approved manufacturers having at least 10 years' experience of producing similar materials.
2. Acceptable manufacturers are to be firms regularly engaged in manufacture of all materials specified in this section of types and sizes required, whose products have been in satisfactory use under similar service conditions for not less than ten years. The manufacturer shall have Quality System in compliance with ISO 9001- 2000. Certificate of compliance issued by an independent agency shall be submitted.
3. Manufacturer and product shall be to the acceptance of the Engineer. The switchgear shall be designed, manufactured, tested and installed in accordance with the latest editions and amendments of IET, IEC , BS standards and in compliance with Authority Having Jurisdiction.
4. Manufacturers shall demonstrate that they can provide the following back-up service.
 - a The manufacturer/ supplier shall be able to enter into a 24 hours, 7 days a week, long term service and maintenance agreement with the Employer.
 - b The manufacturer and/ or his agent shall provide evidence of availability of spare parts in their local stock for proper operation and maintenance of the high voltage system.

- D. Standards: In addition to the requirements indicated on the Design Drawings, or specified in Division 01 General and Specification, the Work shall be in accordance with the following standards, codes and relevant statutory requirements.

1. ~~Saudi Building Code, SBC Standards.~~
 - a ~~SBC 401 Electrical~~
2. Saudi Arabian Standards Organization, SASO Standards.

姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)
资质证书号: A131002923
有效期至: 2025年03月16日



3. Saudi Electricity Company, SEC.
4. WATER & ELECTRICITY REGULATORY AUTHORITY
5. BSI Group, (BS) British Standards.
6. International Electro-technical Commission (IEC).
 - 1) IEC 60051-1 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts.
 - 2) IEC 60051-2 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 2: Special requirements for ammeters and voltmeters.
 - 3) IEC 60051-3 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 3: Special requirements for wattmeters and varmeters.
 - 4) IEC 60051-4 Direct acting indicating analogue electrical measuring instruments and their accessories title - Part 4: Special requirements for frequency meters.
 - 5) IEC 60051-5 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 5: Special requirements for phase meters, power factor meters and
 - 6) synchro scopes.
 - 7) IEC 60051 -8 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 8: Special requirements for accessories.
 - 8) IEC 60051-9 Direct acting indicating analogue electrical measuring instruments and their accessories - Part 9: Recommended test methods.
 - 9) IEC 60099-4 Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems.
 - 10) IEC 60255-1 Measuring relays and protection equipment - Part 1: Common requirements
 - 11) IEC 62271-100 High-voltage switchgear and control gear - Part 100: Alternating-current circuit breakers.
 - 12) IEC 60059 IEC standard current ratings.
 - 13) IEC 61869-2 Instrument transformers - Part 2: Additional requirements for current transformers.
 - 14) IEC 61869-3 Instrument transformers - Part 3: Additional requirements for inductive voltage transformers.
 - o IEC 60282-1 High-voltage fuses - Part 1: Current-limiting fuses.
 - p IEC 62271-200 High-voltage switchgear and control gear - Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
 - q IEC 62271-105 High-voltage switchgear and control gear - Part 105: Alternating current switch fuse combinations for rated voltages above 1 kV up to and including 52 kV.
 - r IEC 60445 Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors.
 - s IEC 62052-11 Electricity metering equipment - General requirements, tests and test conditions - Part 11: Metering equipment.
 - t IEC 62053-11 Electricity metering equipment (a.c.) - Particular requirements - Part

姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

资质证书号: A131002923
有效期至: 2025年03月16日



11: Electromechanical meters for active energy (classes 0,5, 1 and 2).

- u IEC 60529 Degrees of protection provided by enclosures (IP Code).
- v IEC 60617 Graphical symbols for diagrams.
- w IEC 62271-102 High-voltage switchgear and control gear - Part 102: Alternating current disconnections and earthing switches.
- x IEC 62271-103 High-voltage switchgear and control gear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV.
- y IEC 62271-104 High-voltage switchgear and control gear - Part 104: Alternating current switches for rated voltages higher than 52 kV.
- z IEC 62271-106 High-voltage switchgear and control gear - Part 106: Alternating current contactors, contactor-based controllers and motor-starters.

E. Mock-ups

1. Not required

F. Prototypes

1. Not required.

G. Quality Benchmark

1. Not required.

H. Preconstruction Testing/ Reports

1. Submit reports of independent tests demonstrating that the products and systems comply with the specified performance requirements.
2. Where test results for a material or product are not available, undertake testing to show compliance with the Specification at an independent testing laboratory acceptable to the Engineer.
3. The provision of testing data or the carrying-out of tests does not relieve the Contractor of his responsibilities regarding the performance requirements, durability or service life requirements.

I. Testing and Inspection

1. Test Reports: Provide test reports prepared in accordance with Specification requirements to the Engineer. Provide other tests reports necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system.

1.4 WARRANTY

A. General

1. Unless otherwise specified in the system descriptions, a minimum of 2 year warranty period shall be provided.
2. All components shall be covered by a single source warranty, fully guaranteed by the supplier.

1.5 MAINTENANCE

A. General

1. Provide Operation and Maintenance (O+M) manuals that detail the step-by-step

MEDIUM-VOLTAGE SWITCHGEARS (13.8KV)

中华人民共和国一级注册建筑师
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日

26 1300



procedures for installation and maintenance of all components. Include in the manuals the manufacturer's name, product/ material reference, service manual, parts list and brief descriptions of all equipment and their basic operating features, possible breakdowns and repairs, recommended spare parts.

PART 2 - PRODUCTS

2.1 SYSTEMS/ PRODUCTS

A. Type ELS-124 Medium Voltage Switchgear (13.8kV)

1. Description: A medium voltage switchgear shall include the design, manufacture, testing at workshop, insurance, transport, delivery to Site and installation, testing, commissioning, handing over and maintenance during guarantee period for 13.8kV feeders to the mv switchgear as indicated on the Design Drawings and complying to the Authority Having Jurisdiction.
2. MV switchboard shall be certified for the category of duty specified. In particular, the busbar system shall be type-tested and certified by a recognized international testing authority for its performance during the anticipated short circuit condition.
3. The Switchboards complete with all metering and instruments.
4. Supply all cables and connect between all switchboards and transformers making connections to switchboards described above and on the Design Drawings.
5. MV switchgears shall be interfaced with BMS systems for monitoring and controlling.

2.2 DESIGN CRITERIA

A. General

1. The design of the electrical system and equipment shall ensure that all operating and maintenance activities can be performed safely and conveniently. Even under extreme conditions of major short circuit or mal-operation there shall be no danger to persons in the vicinity of the assembly.

B. Ratings

1. The normal continuous rating of the complete switchgear shall be suitable for Site climatic conditions. The switchgear shall have following ratings:
 - a Rated voltage: 17.5kV.
 - b Service voltage: 13.8kV.
 - c Rated frequency: 60Hz.
2. Switchboards shall be rated on the basis of voltage, current, frequency and the symmetrical breaking capacity of incorporated MV automatic switching devices as defined in appropriate IEC publication 62271-100 or as indicated on the Design Drawings.
3. For standard voltages, frequencies and currents reference is made to IEC 60038, 60196 and 60059 respectively. High voltage, current-carrying components, shall furthermore be capable of carrying their rated current continuously at rated voltage and under specified service conditions without exceeding the permissible temperature limits when mounted in the completely assembled switchboards. Selected standard ratings for



switchboards are those listed in IEC publication 62271-100.

C. System Variation

1. All equipment and components of the MV boards shall be capable of continuous operation at their full current and voltage ratings and without detriment or malfunction at system continuous deviation of up to and including the following percentages of the normal values.
 - a Voltage: $\pm 10\%$.
 - b Frequency: $\pm 5\%$.
 - c Absolute total voltage and frequency variations: 10%.

D. Construction Requirements

1. Internal Arrangement

- a The switchboard shall be comprised of a busbar system and consist of one or more sections, each having one incoming feeder panel placed as indicated on the data sheets or single line diagrams of the electrical load. Each section shall be equipped with a busbar connected voltage transformer for metering supply, preferably to be mounted in the incoming feeder panel or in a separate measuring panel. In case the total load for metering and control exceeds the standard rating, a second busbar connected voltage transformer shall be provided for supply control only. Battery shall be provided for DC loads. The current rating of the incoming feeders and the busbars shall in general be of equal value for each part of a combined panel or as indicated on drawings. All incoming switches and buscouplers shall be equipped with facilities for padlocking both in the "in" and in the "out" position. The layout of the operational front and the location of the components of the assembly shall be arranged in a logical and systematic sequence and standardized throughout. Alphanumeric notation, in accordance with IEC 60445, shall be used for identification and marking of phases, conductors and terminals. The system of construction for the MV distribution shall be a factory built assembly of a standard, well tested design of the draw-out or fixed type as specified in equipment schedules. Interchangeable standardized components shall be used where feasible. It is preferred that spare compartments can be equipped to the maximum rating of the unit. All incomers, bus couplers and outgoing feeders shall be operated through three positions i.e. In-Out-Test. In all three positions, limit switches and indications shall be available for each position.

2. Housing/ Enclosure

- a The MV distribution shall be of the floor mounting cubicle type, metal enclosed with sufficient mechanical strength and be equipped with lifting facilities (eyebolts). The materials of construction shall be properly prepared and treated against rust or corrosion. The switchgear and controlgear shall be self-supporting and suitable for front entry and operation. In case of cable cellar, adequate bottom plates shall be provided which at least prevent access by rodents.
- b The degree of protection shall be in accordance with IEC publication 60529 and shall

be minimum as follows:
1) With closed doors: IP41.
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)
资质证书号: A131002923
有效期至: 2025年03月16日



- 2) With open doors: IP20.
- c Any further IP requirements allowable as per IEC or equivalent standards shall be specified on the data sheets.
- d All components requiring periodical maintenance shall be easily accessible.
3. Interchangeability
 - a Electrically identical components shall be of one type and make.
 - b Where withdrawable sub-assemblies are specified, these shall contain one or more components with identical functions and capacities shall be mechanically interchangeable. Where withdrawable sub-assemblies are specified with identical functions but of different capacities might be mechanically interchangeable provided the sub-assembly can be adapted easily for its new capacity.
4. Anti-Condensation Precautions
 - a Effective precautions shall be taken to prevent the formation of harmful condensation inside the enclosure, under either operating or non-operating conditions and service conditions. 230V - 1 phase space heaters shall be provided. The space heaters shall be controlled by a thermostatic switch and shall be wired to outgoing terminals. The heating device shall be of sufficient capacity to raise the internal temperature by 50°C above the ambient temperature. The heater shall be covered safely to avoid accidental contacts and heater terminals shall be adequately shrouded.
5. Arcing Faults
 - a Measures shall be taken to prevent the occurrence of internal arcing faults in accordance with the IEC requirements. The design and construction of the MV distribution shall be such as to provide the highest possible degree of personnel protection against radiation, overpressure and hot gases.
6. Insulation
 - a A Solid-Air-Solid insulation system where failure of one solid layer does not lead to voltage breakdown is required.
 - b Air Insulated Switchgear (AIS) as approved by SEC to be used for the insulation medium.
7. Insulation Level
 - a MV components of switchboards shall be suitable for an exposed electrical system with unearthed neutral, in accordance with IEC publication 62271-100.
8. Busbar Systems
 - a Busbars shall be of high conductivity electrolytic copper with joints by means of non-corrosive high tensile steel bolts, nuts and washers, and secured against loosening. Insulated busbars are preferred. Busbars shall be suitable for extension to the left or to the right as required. Busbars shall be accessible for maintenance purposes.
9. Compartments and Partitions
 - a Adequate compartments and partitions shall be provided to allow easy maintenance operation, e.g. fuse replacement, etc. Main circuit compartments shall always have individual overpressure reliefs.

2.3 PERFORMANCE REQUIREMENTS

A. General

MEDIUM-VOLTAGE SWITCHGEARS (13.8KV)

中华人民共和国一级注册建筑师
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日

26 1308



1. All components shall be capable of withstanding the dynamic, thermal and dielectric stresses resulting from the test duties specified in IEC publication 62271-100.

B. Temperature Rise

1. The temperature rise of the MV distribution and motor control center shall not exceed temperatures indicated in IEC 62271-100.

2.4 MATERIALS

A. MV Switching Devices

1. General
 - a MV switching devices shall be of fixed or draw-out type as indicated on the Design Drawings, tested and certified by an official authority to meet the requirements of the relevant Local Statutory Authorities regulations.
2. Type
 - a Switching devices shall be Vacuum type as indicated on the Design Drawings or in the equipment schedule.
3. Mechanical interlocks shall be provided on all boards to prevent connecting or disconnecting the circuit breaker while closed and to prevent the closing of the circuit breaker unless the separable contact are in full contact or separated by a safe distance. The type of switching device and its operating mechanism shall be selected in accordance with its duty and the number of load operations.
4. The operating mechanism shall be equipped with the following as a minimum:
 - a Push button for opening and closing.
 - b Mechanical position indicator for open and closed positions.
 - c Stored energy operating handle.
 - d Spring charge and discharged position indicator.
 - e System for automatic spring discharging when circuit breaker is extracted.
 - f Anti Pumping Devices (APD) to prevent pumping action of the mechanism.
 - g Number of closing counter.
 - h When the circuit breaker is removed completely or in test position all the HV connections, contacts and busbar in the panel shall be automatically covered by lockable safety earthed shutter.
 - i All circuit breakers of the same type shall be interchangeable.
 - j Trip coil and close coil shall operate at 110V DC supply.
5. The following switching devices shall be provided as a minimum:
 - a ON-OFF indicators.
 - b Motorized spring charging.
 - c Anti-pumping.
 - d Emergency 'OFF' pushbutton.
 - e Closing/ trip coil suitable for control voltage.
 - f Blocking for manual switch 'ON' facility.
 - g Breaker carriage earthing.
 - h Earth switch interlock.
 - i Padlock arrangement.



6. Control Mechanism
- a Rated voltages for closing, tripping, control and auxiliary circuits shall be selected from IEC 62271-100. Control mechanism of switching devices may be of the following types:
 - 1) Electromagnetically operated with DC control supply.
 - 2) Spring-operated hand charged in case of local control only.
 - 3) Spring-operated power charged.
 - b All switching devices shall open automatically, be trip-free and have their energy for the opening operation stored prior to the completion of the closing operation. Furthermore, they shall be provided with a local manual-operated tripping feature protected against inadvertent tripping. Power charged spring-operated mechanism shall not require more than 25 seconds for spring charging. Power charged spring-operated mechanism of remote controlled switching devices shall be charged when the switching device is in its normal service position. Switching devices for motor panels shall be protected against "pumping". All electrical charging and electromagnetic mechanisms as well as the closing control components shall be capable of operating when the auxiliary or control supply is between 85% and 105% of its rated value. Each switching device shall be provided with visual mechanical indicators, one marking the closed position with "I" and/ or a red flag and the open position with "O" and/ or a green flag, and in case of a stored energy closing mechanism one marking whether the operating mechanism is charged or discharged. These indicating devices shall be directly driven by the switching mechanism. The switchboard vendor shall ensure that all required information is available to him before preparation of his detailed logic / control scheme drawings.
7. Disconnections
- a Disconnections (isolators) are not permitted, even with safety interlocks, except when used for the separation of fixed and moving parts.
8. Earthing Devices
- a Earthing Devices to be integrally mounted only as per SEC. Portable shall not be used.
 - b Three-phase earthing facilities at the cable sides and for the busbar system of each section are required. For this purpose portable or integrally mounted three-phase earthing switching devices shall be provided for each type of MV switching device. These devices shall be capable of making and carrying the prospective short-circuit current at the point of earthing. The earthing devices shall be suitable for local, manual operation only. If portable earthing devices are provided, a minimum of two of each type is required. Depending on the design, padlock facilities for locking in the open and closed position shall be provided. When earthing devices are to be applied in a compartment it shall not be possible:
 - 1) To insert a portable earthing device in the closed position.
 - 2) Where withdrawable sub-assemblies are specified, insert a withdrawable switching device into the service position of the compartment concerned.
 - 3) To close a fixed-type switching device in the compartment concerned.
 - c The circuits shall not be earthed automatically, i.e. when withdrawing the switching



device the earthing device has to be inserted deliberately.

- d Outgoing circuits for motor starting may be earthed automatically when the switching device is being withdrawn.
 - e Clear instructions, preferably pictorial, shall be submitted showing the proper methods of how and where to fit the earthing devices.
9. Current Chopping
- a Switching devices shall not cause switching surge voltages which exceed the insulation level of the connected equipment. Vacuum switching devices shall be equipped with ZnO overvoltage protection devices.
10. Auxiliary Contacts
- a Each switching device shall be provided with at least 2 make and 2 break auxiliary contacts directly driven by the switching mechanism. These contacts shall be completely wired up to terminal blocks in the secondary terminal compartment.

B. Terminals

1. General

- a Each panel shall be provided with appropriate facilities for the independent terminals to connect the MV main cable and the LV auxiliary cables. The terminal compartments for MV and LV connections shall be effectively segregated in accordance with IEC 60298. The terminals shall be so arranged that all connections can be made safely, even when the assembly is energized. Suitable terminating facilities of adequate dimensions and thermal rating shall be provided for each conductor. Inside the compartments separate terminals or bolts, one for each cable, are required for earthing purposes. Efficient means to prevent strain on the actual conductors and cable connection shall be provided.

2. Terminals for MV Cables

a Three-core Cables

- a Cable termination shall be suitable for the specified cable.
- b For XLPE type cables dry type cable termination is required. When two or more cables are required, a suitable marshalling box may be required to obtain uncluttered straight terminal connections.

b Single-core Cables

- 1) The terminal box and its cable entries on a relevant panel shall be suitable for the specified cable. Single conductor entries shall be mounted in non-magnetic plates.
- 2) The end sleeves or glands shall also be of non-magnetic material.

3. Terminations for Auxiliary LV Cables

- a Terminal blocks fitted with tubular type contacts with non-loosening screws shall be provided for termination of auxiliary LV cables including that required for wiring between cubicles or panel sections. Crimped termination is required to terminal blocks to ensure sound contact. Clamping terminals are not allowed. Within the panel compartments suitable clamping devices shall be provided for securing of the cables. Terminals in current measuring circuits shall be special purpose with suitable bridging links and measuring facilities.
- b Specified auxiliary contacts for remote circuits shall be wired and connected to an



accessible terminal block in the vicinity of the cable entries. Termination compartments for auxiliary and control cables shall have adequate dimensions, with ample accommodation for the required number of terminals.

4. Two or more conductor terminations on one terminal are not acceptable unless the terminals are designed for more than one conductor. Metal cable glands suitable for the cables specified shall be included in the supply of the assembly.

C. Isolating Facilities

1. Isolating facilities shall be as per SEC.
2. Isolation of Main Circuits
 - a Switch panels shall be provided with safe means of isolating the circuit side from the busbar side. Panels containing combinations of fuses and contactor shall be equipped with isolating facilities permitting safe changing of fuses by hand.
3. Interlocks
 - a Interlocks in accordance with IEC 62271-200 shall be provided to prevent unsafe operation of the switchboard and shall comprise at least the following features.
 - b They shall permit operating the switching device only when:
 - 1) The isolating device is in fully operating position.
 - 2) The switching device is in a specifically provided test position with the isolating device in the closed position and the control and auxiliary circuits operative but with panel control facilities only.
 - 3) They shall mechanically interlock the isolating device in its closed position when the switching device is closed.
 - c Alternatively, they shall cause tripping of the switching device upon attempted operation of the isolating device.
4. Safety Shutter Devices
 - a The panel shall be fitted with a set of shutters to cover each 3-phase group of stationary isolating contacts, i.e. both on the busbar and on the circuit side. The shutters shall open or close automatically by a mechanical drive from the switching device when the latter is being racked in or out. Each set of shutters shall be equipped with padlocking facilities in its closed position. When padlocked, the shutters shall prevent access to the stationary isolating contacts.
5. Shutters on the busbar side shall be painted red and shall be clearly labeled "BUSBARS" in large white letters. Shutters on the circuit side shall be painted yellow and shall not be lettered.
6. Isolating Contacts for Secondary Circuits
 - a The connection in the secondary circuits between the fixed and the moving parts of panels shall be by means of self-aligning contact. These connections shall be maintained when the moving portion of the equipment is in the test position.

D. Protective Devices

1. MV Circuits
 - a For metering/ control circuits High-rupturing-capacity, short-circuit current-limiting fuses, shall be used exclusively and be in accordance with IEC 60282-1. Application of two or more parallel fuses per phase shall be subject to acceptance by the



Engineer.

2. LV Circuits

- a Industrial type cartridge fuses, in accordance with IEC 60269, shall be used for control, measuring and auxiliary circuits. Alternatively, miniature circuit breakers may be used for this purpose.

3. Breakers with Relays

a General Requirements

- 1) Selection of relays shall be in accordance with the relevant circuit requirements.
- 2) All protection relays shall be of static type and from a relevant Local Statutory Authorities approved manufacturer. Means shall be provided for secondary injection testing of relays without disconnecting wiring. Protective relays shall have hand-reset facilities and operational signals such as flag indications or other means of indication used on static type relays, e.g. light-emitting diodes. Non-tripping relays have only hand-reset facilities. Special precautions shall be taken in order that relays will not actuate accidentally owing to vibrations or shocks, e.g. by opening or closing of doors and switching devices. Preference shall be given to dustproof flush-mounted relays of the removable type, provided with calibrating and testing facilities. Current-carrying terminals of the relays shall be automatically short-circuited at withdrawal of the relays. MV motor protection shall be through comprehensive motor protection relay with provision for protection against negative phase sequence, earth fault, over load, stalling, RTD protection for alarms and trip to be incorporated.

b Over-current and Earth-fault Relays

- 1) Over-current and earth-fault relays, not being motor protective relays, shall have a rated current of 5A and shall be of the induction-pattern, inverse time-lag, and definite-minimum time type with the following characteristics:
 - a) Over-current elements shall have nominal current settings continuous variable from 50% to 200% of rated current.
 - b) The earth-fault elements shall have nominal current settings variable from 10% to 40%.
 - c) For both over-current and earth fault elements the setting of the characteristics shall be variable.
- 2) All relay elements shall have hand reset and a mechanical flag indicator or digital display.

c Under-voltage Relays

- 1) Where motor panels are incorporated, each busbar section shall be provided with an instantaneous under-voltage relay. The drop-out value shall be adjustable between 50% and 65% and the pickup value shall always be less than 85%. The under-voltage relay activates a time-delayed tripping relay for each motor. This tripping relay shall be selfresetting, and be equipped with one set of normally open position and be adjustable from 1 to 5 seconds.

d Over-voltage Relays

- 1) Over-voltage relay shall be a secondary relay that shall be connected to the voltage transformers of the protected object. The relay shall be provided with output relays for tripping and output relays for signaling purposes. The



- overvoltage stage shall be given definite time characteristic or inverse time characteristic.
- 2) The overvoltage stage protects the motors and transformers connected to the busbars.
 - 3) The over-voltage relay module shall measures the phase-to-phase voltages.
 - 4) The over-voltage stage provides an alarm signal when the overvoltage arises and trips the circuit breaker, if the voltage continues to rise.
- e Stand-by earth fault Relay
- 1) The relay connected to the current transformer provided in the LV side neutral the distribution transformer and having the same curve specification like the over-current functions shall be provided. The earth fault functions shall have current ranges from 20% to 80% adjustable in steps of 10% or less, CT secondary rating shall be 1A and shall have an accuracy Class 5P and accuracy limit factor equal greater than 20 in accordance with IEC 60044-1 and Authority Having Jurisdiction specification of CT.
- f Transformer Thermal Relay
- 1) Transformers will be provided with a temperature protection system connected to the LV windings. This will have adjustable settings giving remote alarm and trip facilities. Necessary auxiliary relays with sufficient contacts for trip/ alarm initiation and flag indication shall be provided in the protection panel in compliance with Authority Having Jurisdiction requirements.
- g Motor Protection Relays
- 1) Each relay combination shall be equipped with two auxiliary relays with flag indicators, i.e. one hand-resetting relay, indicating instantaneous tripping on short-circuits or earth faults, and one hand-resetting relay, indicating delayed tripping on overloads or single phasing.
 - 2) Numerical types of relays are preferred with the following features:
 - a) Compact design and modular construction.
 - b) Comprehensive self, monitoring and self-diagnostic.
 - c) Thermal overload protection.
 - d) Thermal pre-alarm.
 - e) Start authorization by detection of thermal state.
 - f) Under current protection.
 - g) Voltage protection.
 - h) Negative phase sequence protection.
 - i) Earth fault protection.
 - j) Locked rotor protection.
 - k) Starting time supervision.
 - l) Protection against successive starts.
 - m) Serial communication interface for on-line and off-line transmission of relay operation data, parameter setting, sequential events, fault recording, remote setting, etc.
 - n) Facility to hook up a remote PC for the data analysis.
 - o) Each relay shall be equipped with auxiliary relay, having indicators and hand reset button.

h Earth-fault Relays

姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日



- 1) For earth-fault protection of motors a single-element, hand-reset, flag-indicating or digital displayed, instantaneous earth-fault relay shall be provided. This relay shall have a nominal current of 1A and current settings variable from 10% to 40%.
- i Differential Relays
 - 1) Differential protection shall be provided for large motors, transformers etc. where specified in the data sheets or Design Drawings. Transformers with rating above 2MVA shall have differential protection.
- j Restarting Relays
 - 1) These relays shall be of the plug-in type.
 - 2) Restarting relay (RR)
 - 3) This relay shall have the following characteristics:
 - a) Voltage-dip detection level: 65% Un.
 - b) Voltage-restoration detection level: 89% Un.
 - c) Memory: 4.5s.
 - d) Immediate restart after voltage dips: <0.2s.
 - e) Delayed restart, adjustable between 0.1s and 30s, after voltage dips between 0.2s and 4s inclusive.
- k Timing Relay (TMR)
 - 1) This relay shall be of the slow-operating type, adjustable from 0.1s to 30s. Elements with multiple functions such as tripping and alarm duties shall have separate operating contacts for each function and be brought out to separate terminals.
- l The SCADA scope will include (but not be limited to):
 - 1) The complete engineering process as defined by the flowchart detailed in this specification.
 - 2) The contractor shall supply a complete and detailed communication architecture block diagram at tender stage.
 - 3) The supply, installation, cabling and configuration of complete SCADA gateway, that forms part of an integrated substation protection and control system based on the IEC61850 protocol.
 - 4) All engineering to interface gateway to the protection IED units, the internal SCADA programming and required software modification and testing to realise compatibility with the SCADA master station will be the responsibility of the Contractor.
 - 5) The supply of all diagnostic and configuration software and licenses for the Gateway system shall be included in the offer.
 - 6) The provision of training to SCADA technicians in the use of all related software and system configuration shall be included in the offer.
 - 7) Supply and installation of all multicore cabling between Gateway and non-IEC compliant substation devices. (Base offers on the use of 5 pair cable to each hard-wired panel or device).
 - 8) Factory acceptance testing of Gateway / gateway to Master station interface, confirmation of data quality flag support, time tagging support and overall control execution response time.

中华人民共和国一级注册建造师

姓名: 姜豪

注册号: 3100292-022

有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日



- 9) SCADA software, configuration systems, software engineering is included within the scope of this specification.
 - 10) All protection relay and SCADA configuration, programming and settings application will be the responsibility of the Contractor.
 - 11) Complete commissioning of all SCADA signals within the substation is included in the scope of the contract.
 - 12) Final end-to-end commissioning of the substation SCADA system to the grid power is included and will be done in conjunction with SEC.
4. Metering
- a All voltage and current transformers shall be cast resin type.
 - b Voltage Transformers
 - 1) Voltage transformers shall be in accordance with IEC 61869-3.
 - 2) Rating and Type
 - a) Rated primary voltage depends on system data, which shall be stated on the data sheets. The preferred secondary voltage of measuring and protection transformers shall be 110V. Rated output capacity of the transformers shall be matched to cover the burden required by the equipment connected, and preferably be selected from the range of standard values.
 - 3) Class of Accuracy
 - a) The measuring voltage transformers are Class 1.0.
 - b) Protective voltage transformers shall be of Class 5P.
 - c) The winding connection is depending on the metering and protection system connection.
 - 4) Protection at MV Side
 - a) Depending on manufacturer's practice and, whenever necessary, high-rupturing capacity, short-circuit current-limiting fuses shall be in accordance with IEC 60282-1; Fuses, if installed, shall be readily accessible and suitable precautions shall be taken to enable safe removal and replacement of fuses.
 - 5) Protection at LV Side
 - a) Industrial MCBs are preferred, miniature circuit breakers can be used. The connection between transformer and MCBs shall be as short as possible.
 - b) All protective breakers shall be capable of handling the inrush currents for all service conditions, without abnormal ageing or deterioration.
 - c) Voltage transformers for automatic voltage regulators shall have no fuses at all, but shall be connected within the protective zone of the differential protection of the generator.
 - 6) Protection Location
 - a) Depending on the requirements, the following general rules may serve as a guide to establishing the correct location of voltage transformers on the assembly.
 - b) For voltage detection, etc. a measuring transformer shall be connected to the busbar of each section.
 - c) In addition, however, measuring voltage transformers for incoming units, e.g. generator and main intake feeders, shall be connected on the supply side.

d) For the control supply of the switching devices of a section, preference is given to a voltage transformer connected to the busbar side of the section

中华人民共和国一级注册建造师

姓名: 姜豪

注册号: 3100292-022

有效期至: 2024年06月30日



资质证书号: A131002923

有效期至: 2025年03月16日



concerned.

c Current Transformers

1) Current transformers shall be in accordance with IEC 61869-2.

2) Rating and Type

a) Rated output capacity of the transformers shall be matched to cover the burden required by the equipment connected, and preferably be selected from the range of standard values.

b) Rated primary current shall preferably be selected from the range of standard values. Where required, the current ratio shall be stated on the data sheets.

c) Rated secondary current shall be either 5A or 1A; for remote metering only 1A is

acceptable.

d) Short-time thermal current rating of the transformers shall be 1s.

e) When the electrical system value requires a time duration of 3s, the current transformers shall be rated accordingly.

3) Class of Accuracy

a) The measuring current transformers shall be Class 1.

b) The over current factor "n" shall be less than 5 in order to prevent damage of instruments at maximum fault current.

c) Protective current transformers are to be Class 5 P.

4) Terminals and Connections

a) Secondary terminals of current transformers shall be wired up to a terminal block with short-circuiting links, located at an accessible place. One side of the secondary winding of each current transformer shall be connected at this terminal block to the earth bar.

d Ammeters

1) Ammeters shall be digital multifunction meter type and approved by the relevant Local Statutory Authorities. They shall have an element rated at 1 or 5 ampere.

2) Ammeters in the motor circuit shall have an overload scale of 5 times In.

e Voltmeters

1) Voltmeters shall be digital multifunction meter type and approved by the relevant Local Statutory Authorities.

f Watt-hour Meters

1) Watt-hour meters shall be digital multifunction meters type and approved by the relevant Local Statutory Authorities.

g kW Meters

1) kW meters shall be digital multifunction meter type and approved by the relevant Local Statutory Authorities.

2) The switchboard shall incorporate all necessary current and voltage transformers as required for the authority revenue meters.

h Power Factor Meters

1) Power factor meters measure in the number of phases as indicated on the data sheets. Power factor meters shall be digital multifunction meter type and

approved by the relevant Local Statutory Authorities.

i Counters

姓名: 姜豪

注册号: 3100292-022

有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日



- 1) Each switching device shall be provided with an operation counter.
5. Accuracy
 - a Ammeters and voltmeters shall be of Class 1.5 and watt-hour meters shall be of Class 2.5 as specified in IEC 60051 and IEC 62052-11/ IEC 62053-11. Power factor meters shall be class 1.5.
6. Auxiliary Circuits
 - a Auxiliary circuits shall be clearly grouped and be adequately protected. All current wires shall be at least 2.5mm² others 1.5mm² of the PVC type and be able to withstand 2500V impulse test. All wires shall be connected to terminals individually and clearly identified at both ends by ferrules of isolating material or plastic code markers in accordance with the wiring diagram (s).
 - b Connections shall be of non-loosening type.
 - c Color coding of secondary wiring shall be in accordance with IEC 60445. Wiring between two terminals shall be continuous; joints or interconnections are not allowed.
 - d To accommodate and support the secondary wiring, covered plastic channels, insulated tubes or plastic strips shall be used.
 - e Secondary wiring shall never be mounted direct to metal. The filling factor for channels shall not exceed 70%. Where supporting of a wire is not feasible the wire or part of it shall be as short as possible.
7. Protection of Control and Auxiliary Circuits
 - a All circuits shall be protected by miniature circuit-breakers of the airbreak-type.
8. Indication and Alarms
 - a Contacts for remote alarm shall be normally closed.
 - b Protective devices shall have protective action indication.
9. Mimic Diagram
 - a The front of the MV boards shall be provided with a plastic or equivalent line mimic diagram illustrating the main circuit and its components.
10. Emergency Stop
 - a Each motor shall be provided with an emergency stop facility which shall comprise of a red colored mushroom headed stay-put-twist to release push button. The emergency stop device shall be located adjacent to the motor.

E. Earthing

1. Earthing shall be in accordance with IEC 62271-200, color coding of protective conductors shall be in accordance with IEC 60445.
2. Main Earth Bar
 - a A main earth bar shall be fitted along the whole length of the switchboard. This shall be made from hard-drawn, high-conductivity copper and be capable of carrying the short-circuit rating of the board but have a cross section of at least 125mm². The earth bar shall be bolted to switchboard frame and equipped with convenient facilities for connecting of all parts of the switchboard which require earthing. Joints in the main earth bar shall be bare copper and bolted with galvanized steel bolts, nuts and washers, secured against loosening. For direct connection to the station earthing grid, earthing bolts (M12) with nuts and spring washers shall be provided at both



ends of the main earth bar.

3. Earthing Connections

- a In addition to ensure adequate electrical continuity between all metal parts of the switchboard and its cables and the main earth bar particular care shall be taken to ensure that:
 - 1) Housings of withdrawable switching devices shall be positively earthed in the service position by appropriate earthing connections.
 - 2) Band joints of compound-filled busbar chambers shall be suitably earthed to the frame of the switchboard.
 - 3) The earth connections of voltage transformers and current transformers shall be made directly from the terminal board to the earth bar.
 - b Means shall be provided of ensuring that the earthing connection of each withdrawable switching device and voltage transformer to the main earth bar is made prior to its primary connections.
4. An uninsulated electrolytic copper grounding bus sized for the rated short circuit current and running the entire length of the switchgear assembly shall be provided. Provision shall be made for extending the ground bus at either end without any need for cutting or drilling the copper bar.
5. Provision shall be made to terminate ground connection on each end of the ground bus by using bare ground conductor 120 mm² or 240 mm².
6. All hinged doors and panels shall be properly bonded by unspliced flexible wire or 10mm² Cu braids.
7. All devices or equipment shall be grounded as required. Each grounding connection to the ground bus shall be arranged so that each may be disconnected without disturbing the continuity of the ground bus or any other ground connection.
8. Drawout carriage of all removable elements shall have a direct ground connection with the switchgear ground bus through suitable flexible or pressure contact type connections designed to carry the rated fault current for the rated duration.

F. Battery Charging System (with dual chargers)

1. Battery and Chargers

- a 13.8kV switchgear shall be provided with a dc battery and charger. 8 to10 hours battery backup time shall be provided or in accordance with the requirements of Authority Having Jurisdiction.
- b The dc supply shall be rated for 110V DC. The voltage at load terminal shall not drop below 90% nor exceed 110% of nominal value during a battery discharge or with the charger operating in float/ boost mode.
- c The dc supply system shall be built in to a panel, which shall consist of battery bank, battery charger, voltage control unit for regulating the voltage, an earth fault detector, and MCBs.
- d Voltage control unit shall be rated for 150% of the entire switchgear load and it shall be independent from the circuits of the charger. Protection against over discharge of the battery shall be provided.

姓名: 姜豪

注册号: 3100292-022

有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日



- e The battery bank shall be minimum 100AH. Batteries shall be of Nickel - Cadmium type. The charger shall be rated for 150% of the entire switchgear load plus the boost charge current of the battery bank. The batteries shall be recharged in less than 24 hours after a discharge. The ac supply rating shall be 230V AC, 60Hz single phase and the output shall be 110V DC.
 - f The charger shall have ac input ON lamp, dc output voltmeter and ammeter, a lamp for indicating boost/ float charge. A lamp for indication of charger defective shall also be provided. The charger shall have a voltage regulation of + 2% of set value or better and have an output ripple content of less than 2%. Automatically switch in to the boost charging mode when battery is discharged beyond value and return back to float charge mode after recharging. The charger shall have built in over voltage protection and should have a soft start feature.
 - g The panels shall be free standing and made of steel. The panels shall be suitably painted with anti-corrosive paint to protect against the Site climatic conditions.
 - h The system shall be designed such that during normal mode, the charger shall be operating either in float charge or boost charge mode.
 - i At this time, the battery shall be charged as well as fed via voltage control unit to the connected load.
 - j When one charger module is failed, the charger shall continue to feed the connected load. While the charger is in service, it shall be possible to remove and replace the defective module by a new one without affecting the system operation.
 - k Only reputed Western Europe or USA or Japan makes of battery and charger shall be supplied by the Contractor.
 - l The battery charger shall be monitored on the BMS/ PCMS system for fault conditions.
 - m Each battery charger cubicle shall be provided with a dedicated single phase 230V circuit from an appropriate emergency backed local distribution board.
2. Each Panel shall include the following items:
- a One three-phase cable earth switch.
 - b One three-phase cast epoxy resin current transformers of required ratio.
 - c One three-phase voltage transformers with HRC fuses.
 - d One numerical microprocessor based metering, protection and control unit for Incoming.
 - e One Trip-Neutral-Close control switch.
 - f Additional auxiliary contacts, relays for remote monitoring and on/ off control through PLC.

G. Rating Plates and Nameplates

1. Switchgear shall have a rating plate permanently fixed in the front of the equipment giving at least the following information:
- a Rated voltage and frequency.
 - b Rated SC capacity and current capacity of busbars.
 - c Standard to which equipment conforms.
 - d Year of manufacture.
 - e Manufacturer's name, type and serial number.

MEDIUM-VOLTAGE SWITCHGEARS (13.8KV)

姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日

26 1308 20



f Weight.

2. All components (switching devices, contactors protection relays, instruments) shall be fitted with a rating plate in accordance with the relevant IEC requirements. All functional units shall be clearly labeled to identify the service. All relays, meters, switches etc. shall be labeled in accordance with the wiring diagrams. All labels shall be made of corrosive resistant material with indelible characters in the language of the local country. Rating plates shall be made of corrosion-resistant metallic material and have indelible inscriptions in the language specified in the requisition. Enameled plates are not acceptable.
3. Each panel shall be provided with nameplates, mounted on the front of a non-removable part. The labels shall be of black non-deteriorating material (e.g. Resopal or Traffolite) and shall permit inscriptions with characters in white in the language, specified in the requisition.

2.5 SOURCE QUALITY CONTROL

A. Testing

1. Standard factory tests shall be performed on each unit. Tests certificates shall be provided for the approval of the Engineer prior to shipment.

B. Finishing

1. The painting shall be suitable for the specified service conditions. Unless specified otherwise painting shall be in accordance with the manufacturer's standard. The manufacturer shall provide particulars of procedures paint and finish color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions

1. Examine areas for compliance with requirements for installation and conditions affecting performance of the Work. Identify conditions detrimental to a proper and timely completion and notify the Engineer of the unsatisfactory conditions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ELECTRIC SERVICE

A. Work by this Section for the Electric Service

1. Provide HV incoming feeders to the Site from existing relevant Local Statutory Authorities' network.
2. Provide all HV Switchboards with all specified control gear and accessories.
3. Provide HV interconnecting cabling between HV Switchboards and from HV Switchboards to the transformers.
4. Provide the sleeves through the exterior wall to accommodate the incoming primary service cables 13.8kV to the MV Switchboards.

- B. Be responsible for ensuring that the Engineer and the relevant Local Statutory Authorities having jurisdiction are informed 48 hours prior to their inspections of the sub-station

MEDIUM-VOLTAGE SWITCHGEARS (13.8KV)

姓名: 姜家
注册号: 3100292-022
有效期至: 2024年06月30日

资质证书号: A131002923
有效期至: 2025年03月16日

26 1308 21



construction. The schedule for inspection shall be as follows.

1. Before the floor or ceiling has been poured and with duct entry to the sub-station in position.
2. Upon completion of the ducts in sub-station including ventilation, drains and doors.
3. Upon completion of HV switchgear installation and prior to commissioning.
4. During and up to successful completion of commissioning and putting equipment in service.

C. Requirements

1. All work performed as part of this section for the electrical services shall conform to all requirements of the relevant Local Statutory Authorities.
2. Make all required arrangements with the relevant Local Statutory Authorities, perform all required work, obtain and pay for all required permits and certificates required by the utility in order to ensure that the electric service is installed and put into operation at the proper time.

3.3 INSTALLATION OF SWITCHBOARDS

A. General

1. Install MV switchboards as indicated on the Design Drawings and s per the manufacturer's recommendations.
2. Equip panel boards with suitable lugs or provisions to accommodate the main and branch conductors scheduled.
3. Turn over to the Employer upon acceptance of the Project, 2 No. keys for every panel board mounted in a key cabinet.

B. Erection

1. Assemblies shipped in transport units shall have these units clearly marked to facilitate assembly and erection at Site. Each transport unit shall be provided with hoisting facilities. Foundation and erection drawings, in the language as specified, bolts, foundation clamps, small material required for erection at Site shall be packed inside the transport unit.

C. Tools and Testing Equipment

1. Special tools and equipment required for erection, commissioning, maintenance and testing shall form part of the order and be shipped together with the assembly. Voltage detection and phasing sequencing equipment shall be offered as a separate item in the quotation. A suitable wall-mounting cabinet shall be provided for all such portable tools and equipment. Testing equipment for motor starting units shall be provided with local-on control facility.

3.4 SITE QUALITY CONTROL

A. Type Tests

1. Type tests shall be carried out in accordance with IEC 62271-200 provided that additional requirements specified (e.g., busbar insulation) are taken into consideration.
2. Certificates shall be available at the quotation stage. Certificates issued by independent



internationally recognized testing laboratories are required.

3. Impulse withstand-voltage tests
4. Power frequency withstand-voltage tests.
5. Temperature-rise tests.
6. Short time current tests.
7. Verification of making and breaking capacity.
8. Mechanical endurance/operation tests.
9. Internal arc tests.
10. Protection degree test to IEC 60529
11. Verification of degrees of protection for persons against contact with live and moving parts, internal arc test, protection degree test
12. Approved by certification that MVSWGR could withstand Seismic zone 2A requirement.

B. Routine Test

1. Before leaving the work the Contractor shall carry out the routine tests using the Specialist Manufacturer Testing Engineers and Technicians in accordance with the IEC 62271-200 on the total assembly or parts thereof when delivered with time intervals, and the results shall be recorded in a test report.
2. The Engineer and the relevant Local Statutory Authorities authorized representative shall witness the final routine testing. Notification shall reach the Engineer and Relevant local statutory authorities at least 10 working days before the testing takes place.
3. Inspection and tests shall be carried out on the complete assembled switchgear. Transportable units can be wired together instead of completing busbar joints.
4. The following checks and test shall at least be carried out.
5. Switchgear shall be visually inspected on technical execution and conformity with the latest issue of the approved drawings and with the order. Spot checks shall be made to verify:
 - a The degree of protection of the enclosure.
 - b The degree of protection within the compartments.
 - c The effectiveness and reliability of safety shutters, partitions and shrouds.
 - d The effectiveness and reliability of operating mechanisms, locks and interlock systems.
 - e The insulation of the busbar system.
 - f The creepage distances and clearances.
 - g The proper mounting of components.
 - h The internal wiring and cabling system.
 - i The correct wiring of main and auxiliary circuits.
 - j The suitability of clamping, earthing and terminating arrangements.
 - k The correct labeling of functional units.
 - l The completeness of the data on the nameplate.
 - m The availability of the earthing system throughout the switchgear.
 - n The interchangeability of electrically identical components.
 - o The non-interchangeability of mechanically identical but electrically different components.
6. Insulation resistance test, between each phase against earth, with the two remaining

中华人民共和国一级注册建筑师
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)
资质证书号: A131002923
有效期至: 2025年03月16日



phases connected to earth.

7. The insulation resistance tests shall be carried out with all manually operated and latched type switching devices in the service and closed position and all main fuses installed.
8. Dielectric test shall be carried out in accordance with IEC.
9. Testing of the mechanical and electrical operation of a number of functional units on random basis, including their control and protective devices.
10. The Engineer reserves the right to request an engineering and inspection testing for the entire HV installations to be carried out by an independent engineering testing company specializing in this type of work.

C. Coordination Study

1. The protective system devices have been selected such that protection is adequate and good coordination is possible; however, since differences do exist between manufacturers, some changes in trip ratings or relay settings may be necessary and shall be carried out at no additional charge to the Employer.
2. Carry out the following:
 - a Immediately upon award of the Contract and prior to the manufacturing of the switchboards, prepare a set of coordination curves and minimum 3 No. copies to the Engineer for his review. Make any changes as directed by the Engineer and/ or relevant Local Statutory Authorities having jurisdiction at no additional charge to the Employer. Obtain all necessary and required information from the relevant Local Statutory Authorities having jurisdiction to support this study.
 - b The time-current characteristic curves for the following shall be plotted:
 - 1) The relays and breakers protecting the incoming service.
 - 2) Main and feeder protective devices.
 - c Testing procedures shall be in accordance with the following relevant Local Statutory Authorities, British Standards Institution and International Electro-technical Commission IEC.

3.5 DEMONSTRATION AND TRAINING

A. Demonstration

1. Demonstrate to the Engineer the features and functions of the system and subsystems including labeling process.
2. Furnish the necessary trained personnel to perform the demonstration and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.
3. Arrange with the Engineer the date and times for performing the demonstrations.
 - a Training The Engineer will select date and time for demonstration.

B.

1. Instruct the Employer and designated representatives in the proper operation and maintenance of the system.
2. Conduct a training course for members of the operating and maintenance staff as designated by the Engineer.



3. The training course shall be given at the installation during normal working hours and shall start after the system is functionally complete but prior to final acceptance tests.
4. The field instructions shall cover all of the items contained in the accepted operating and maintenance manuals, as well as demonstrations of routine maintenance operations.

END OF SECTION

中华人民共和国一级注册建筑师
姓名: 姜豪
注册号: 3100292-022
有效期至: 2024年06月30日

工程设计出图专用章(电子)

资质证书号: A131002923

有效期至: 2025年03月16日

