

SECTION 262300 - LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in ac systems. (Main Distribution Switchgear -MDB)
- B. Related Sections include the following:
 - 1. Section 260500 "Common Work Results for Electrical"
 - 2. Section 260519, "Low-Voltage Electrical Power Conductors and Cables."
 - 3. Section 260553, "Electrical Identification."
 - 4. Section 260526, "Earthing and Bonding for Electrical Systems."
 - 5. Section 263600 "Transfer switches".
 - 6. Section 260548 "Vibration and Seismic Controls for Electrical Systems".
 - 7. Division 25 Section "Building Management System" for instrumentation and control.
- C. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to furnish, deliver, and install the Works as expressly described in the Contract Documents, or implied therefrom, and in accordance with the Contract. This Specification section intends that the work performed pursuant hereto be complete and acceptable in every respect for its intended purpose. It is further required that the provisions of this Specification section shall be complementary to and shall be correlated with, the requirements of the Contract. Nothing in this specification section shall limit the scope of Work as required by the Contract.
- D. Execute the Work in accordance with the intent and meaning of the Drawings and Specifications. Provide all accessories and other items essential for the proper performance and completion of the Work. Execute all Work, including the provision of necessary materials, which can be reasonably inferred, whether or not specifically shown or described in the Drawings and Specifications.
- E. If this specification conflicts with any applicable local or international codes or standards or conflict with any other requirements stated in the Contract Documents, then the more stringent requirement shall prevail.

1.3 DEFINITIONS

- A. ATS: Automatic Transfer Switches.
- B. SCADA: Supervisory Control and Data Acquisition.
- C. SEC: Saudi Electric Company, local electric utility company
- D. PMCS: Power Monitoring and Control System

- E. MDB: Main Distribution Board
- F. OEM: Original Equipment Manufacturer
- G. ACB: Air Circuit Breaker.
- H. MCCB: Molded-Case Circuit Breaker.
- I. RCCB: Residual Current Circuit Breaker.
- J. ELCB: Earth Leakage Circuit Breaker.
- K. RCBO: Residual Current Circuit Breaker with Overload Protection.
- L. SPD: Surge Protection Device.
- M. SLD: Single Line Diagram.
- N. THD: Total Harmonic Distortion.
- O. FAT: Factory Acceptance Test.
- P. SAT: Site Acceptance Test.
- Q. BMS: Building Management System.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each type of switchgear and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
 - a. Tabulation of installed devices with features and ratings.
 - b. Enclosure types and details.
 - c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
 - e. Current rating of buses.
 - f. Short-time and short-circuit current rating of switchgear assembly.
 - g. Nameplate legends.
 - h. Mimic-bus diagram.
 - i. Utility company's metering provisions with indication of approval by utility company.
 - j. UL listing for series rating of installed devices.
 - k. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

- C. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- B. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports.
- E. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Indicating Lights: Six of each type installed.
 - 2. Touchup Paint: 3 containers of paint matching enclosure finish, each 250 mL.

1.8 QUALITY ASSURANCE

- A. The design, construction, material and finishes of all LV switchgear and component parts will be suitable for the local climatic and operating conditions and as indicated in this specification and drawings
- B. Testing Agency: Employ a local licenced Electrical Testing Company, certified by the local utility company, to carry out all low Voltage Switchgear Testing. Upon completion of all testing and commissioning, all test results shall be presented to Local Utility Company for inspection and approval.
- C. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.
- E. Electrical Components, Devices, and Accessories: Shall be listed and labeled as defined in the Local Wiring regulations, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. The switchgear shall meet the recommendations given in the latest editions of the following standards :
 - 1. BS 4345 -Specification for slotted angles
 - 2. BS 7856 -Code of practice for design of alternating current, watthour meters for active energy (classes 1 and 2)
 - 3. BS EN 1011-2 -Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
 - 4. ~~BS EN 60439 -Specification for low-voltage switchgear and control gear assemblies~~
 - 5. BS EN 60947-2+A2 : 2013 -Specification for low-voltage switchgear and control gear. Circuit-breakers
 - 6. BS EN 61869-2 Instrument transformers Additional requirements for current transformers
 - 7. BS EN 60051 & IEC 61010-1 -Direct acting indicating analogue electrical measuring instruments and their accessories.
 - 8. BS EN 60073 -Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
 - 9. BS EN 60831 -Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1kV
 - 10. BS EN 60947-3+A1 -Low-voltage switchgear and controlgear -Switches, disconnectors, switch-disconnectors and fuse-combination units
 - 11. BS EN 61439-1 & 2 -Low-voltage switchgear and controlgear assemblies. General rules
 - 12. BS EN 61810 -Electromechanical elementary relays
 - 13. BS EN 62053-11 -Electricity metering equipment (a.c.). Particular requirements. Electromechanical meters for active energy (classes 0,5, 1 and 2)
 - 14. BS EN 62053-21 -Electricity metering equipment (a.c.). Particular requirements. Static meters for active energy (classes 1 and 2)
 - 15. BS EN 62053-22 -Electricity metering equipment (a.c.). Particular requirements. Static meters for active energy (classes 0,2 S and 0,5 S)
 - 16. BS EN 62053-23 -Electricity metering equipment (a.c.). Particular requirements. Static meters for reactive energy (classes 2 and 3)
 - 17. BS EN ISO 1461 -Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
 - 18. BS EN 61869-2 Instrument transformers Additional requirements for current transformers
 - 19. BS EN 60112+A1 : 2009 -Method for the determination of the proof and the comparative tracking indices of solid insulating materials
 - 20. IEEE C57.13 -IEEE Standard Requirements for Instrument Transformers –Description
 - 21. NECA 400 -Standard for Installing and Maintaining Switchboards (ANSI)
 - 22. IEC 60068-2-11 -Basic environmental testing procedures-Part 2 : Tests-test Ka : Salt mist.

23. IEC 60068-2-30 -Basic environmental testing procedures -Part 2 : Tests-test Db and guidance : Damp heat.
24. ~~IEC 60439-1 -Low voltage switchgear and controlgear assemblies -Part 1 : Type tested and partially type tested assemblies~~
25. IEC 60529 -Degrees of protection provided by enclosure (IP Code)
26. IEC 61641: Internal arc faults.
27. IEC 62262: Mechanical impact strength.

- G. Except where detailed in the Specifications, all components and equipment in LV power distribution boards shall be UL listed and preferably be from the same manufacturer. The switchgear shall comply with the requirements of BS, IEC and SEC.

1.9 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect low-voltage switchgear according to IEC 61439. Drawout circuit breakers need not be tested in the assembly if they are tested separately.
1. Dielectric Tests: Perform power-frequency withstand tests to demonstrate the ability of the insulation system to withstand the voltages listed in IEC 61439. The voltage is to be increased gradually from zero to the required test value within 5 to 10 seconds and shall be held at that value for one minute.
 2. Perform mechanical operation tests to ensure proper functioning of operating mechanism, mechanical interlocks, and interchangeability of removable elements that are designed to be interchangeable.
 3. Test the effectiveness of grounding of each metal-case instrument transformer frame or case.
 4. Verify that control wiring is correct by verifying continuity. Perform electrical operation of component devices to ensure that they function properly and in the intended sequence.
 5. Perform the control wiring insulation tests.
 6. Verify correct polarity of the connections between instrument transformers and meters and relays.
- B. All serial communications devices within the equipment shall be addressed at the factory and tested to verify reliable communications to the equipment's Ethernet gateway.
- C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.Low-voltage switchgear assembly will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Owner will witness required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.
- B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Refer to section 260500, Common Work Results for Electrical.
- B. Installation Pathway: Review Architects drawings and Structural engineer's drawings to understand pathway for moving switchgear into place.
- C. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Do not proceed with interruption of electrical service without Contract Administrator's written permission.

1.12 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.13 CORROSION PROTECTION

- A. The climate at the project site is particularly corrosive due to its proximity to the ocean, the resulting saline atmosphere, and the high average temperatures. The intense solar radiation is also a cause of accelerated aging of materials, as is the significant accumulation of fine sand and dust due to the nature of local soils. The Contractor will make all provisions necessary to propose, for the prior approval of the Company, and then to install, non-corroding products and materials where appropriate including aluminum, stainless steel, other non-corroding metals, and plastics. In the case where no alternative to steel or other oxidizing metal is possible (or where the specifications specifically indicate the use of steel), the steel or other material must be effectively protected against corrosion (by galvanization and/or protective paint coatings, for example) with an anti-corrosion guarantee of 10 years. In all other cases, the Contractor will be asked to modify if necessary the proposed product (even if a catalogue or manufactured item) and to replace the corroding-type materials by non-corroding materials.
- B. All outdoor equipment enclosures/material shall be weatherproof and all metal parts shall be corrosion and abrasion resistant, and the degree of protection shall be IP 54 as per IEC 60529. The degree of protection for all indoor equipment shall be IP41 as per IEC 60529. The degree of protection for medium voltage metalclad switchgear shall be IP40 as per IEC 60529, unless otherwise specified.

1.14 MAINTENANCE AND REPAIR

- A. Where practicable, use suppliers of materials, products and equipment having an office and maintenance service based in KSA.

1.15 WARRANTY

- A. Refer to Division 1, Section 017836 -Warranties.

- B. Unless otherwise stated in this specification section all materials, assemblies, components parts and workmanship shall be guaranteed against defect, damage, or non-conformity for a period of one (1) year from Final Acceptance.
- C. During the guarantee period the manufacturer shall make all necessary repairs or replacement to achieve conformity to the requirements of the Contract Documents.

1.16 EXTRA MATERIALS

- A. Spare Parts: Provide manufacturer's recommended spare parts for emergency replacement and/or three years' maintenance along with complete priced list of these spare parts, including, but not limited to, the following:
1. One set of fixed and moving contacts for every type of replaceable (consumable) contact set.
 2. One operating motor and/or coil for each type of electrically operated circuit breaker.
 3. Two sets of each type of indicating lights, fuses, LEDs, control switches, and similar devices subject to failure or breakage at any time.
 4. The contractor must provide spare parts about 10% minimum from the total amount of the supplied components.
 5. Also, the following spare parts for low voltage included in the table below:

Ten percent (10%) of the installed number (at least one of each type) has to be delivered (but not limited to) as spare parts for the following items:	Low Voltage Circuit Breaker
	Contactors
	Relays
	Protection Devices
	Lighting Fixtures
	Switched and Sockets
	Ammeters, Voltmeters
Two hundred percent (200%) has to be delivered as spare parts for the following items:	Ballast
	Lamps
	Fuses

- B. Tools and Instruments: Provide tools and instruments required for normal routine inspection and maintenance and testing of circuit breakers and protective devices as appropriate for type of switchgear supplied.

PART 2 - PRODUCTS

2.2 GENERAL

- A. The Contractor shall supply and install all main LV Main Switchgear; as indicated on the drawings and as required for safe maintenance of all equipment. All switch disconnect devices shall be suitable for their application, rated for the fault level at the point in the installation at which they are connected and to break the appropriate load of the equipment (load break), unless otherwise stated.

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Refer to section 3.10 & 3.11.
- B. All enclosures, switching and protection devices such as circuit breakers, switches, and isolators shall originate from a single reputable original equipment manufacturer (OEM). Panel assemblers, only officially authorized by the OEM, shall be acceptable.
- B.C. This section shall be reviewed in conjunction with single line diagram and floor plans for proposing appropriate physical and general arrangements.

2.4 RATINGS

- A. Nominal System Voltage: 400V, 3 phase, 60 Hz.
- B. Main-Bus Continuous Current Rating: refer to drawings and schedules.
- C. Short-Time and Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly as indicated on the drawings.

2.5 FABRICATION

- A. Factory assembled and tested and complying with BS EN- 61439- 1 & 2.
- B. Indoor Enclosure Material: Steel.
- C. Outdoor Enclosure Material: Galvanized steel.
- D. Finish: BS EN 61439- 1 & 2 manufacturer's standard finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
- E. Section barriers between main and bus circuit-breaker compartments shall be extended to rear of section.
- F. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and Bus circuit breaker.
- G. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
- H. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear.
- I. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
 - 1. Bus transition sections.
 - 2. Incoming-line pull sections.
 - 3. Hinged front panels for access to metering, accessory, and blank compartments.
 - 4. Pull box on top of switchgear for extra room for pulling cable, with removable top, front, and side covers and ventilation provisions adequate to maintain air temperature in pull box within same limits as switchgear.

- a. Set pull box back from front to clear circuit-breaker lifting mechanism.
 - b. Bottom: Insulating, fire-resistant material with separate holes for cable drops into switchgear.
 - c. Cable Supports: Arranged to ease cabling and adequate to support cables indicated, including those for future installation.
- J. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
 - 1. Main Phase Bus: Uniform capacity the entire length of assembly.
 - 2. Neutral Bus: 100 percent of phase-bus bar rating,. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
 - 3. Vertical Section Bus Size: Comply with BS EN- 61439, including 15% allowance for spare circuit breakers and spaces for future circuit breakers, (see schematics for details).
 - 4. Phase-and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
 - 5. Use copper for connecting circuit-breaker line to copper bus.
 - 6. Contact Surfaces of Buses: Silver plated.
 - 7. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
 - 8. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 6 by 50 mm.
 - 9. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
 - 10. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
 - 11. Neutral Disconnect Link: Bolted, uninsulated, 6-by-50-mm copper bus, arranged to connect neutral bus to ground bus.
 - 12. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
 - 13. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.
 - a. Sprayed Insulation Thickness: 0.08 mm, minimum.
 - b. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2.6 FRAMEWORK

- A. Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210 and BS 4345 respectively. Comply with BS EN 1011-2 for metal arc welding.
- B. Finish
 - 1. Frameworks mounted inside building manufacturer's standard finish.
 - 2. Frameworks mounted outside building hot dip galvanised to BS EN ISO 1461.
- C. Supply cadmium or zinc-electroplated bolts, nuts, washers and screws.

2.7 FIXING

- A. Fix all equipment independently of wiring system. Use cadmium or zinc-electroplated bolts, nuts, washers and screws.

2.8 MAIN SWITCHBOARDS / DISTRIBUTION BOARDS

- A. Main switchgear shall be Form 4a Type 2 to BS EN 61439-1 with Top and bottom entry and ~~bottom and top~~ exit and access to terminations from the rear or front only. All main LV switchgear shall be factory built and Fully Type Tested Assemblies to BS EN 61439-1. Testing shall be by a 3rd party accredited company, only KEMA, LOVAG or ASTA certified switchgear will be accepted. All LV Switchgear, sub main distribution boards and final circuit distribution boards shall be of the same manufacture.
- B. The MDB shall have internal arc withstand of at least 65KA/0.3Sec in accordance with IEC TR 61641 to ensure personnel protection in case of internal arcing inside the switchboard.
- C. The main switchgear fault level shall be as indicated on the drawings.
- D. Rated operational voltage 400V, tolerances as Utility requirements or local regulations.
- E. The switchgear shall be rated for the site ambient conditions given in spec section 260500.
- F. The incoming protective devices on main switchgear shall be motorized withdrawable air circuit breakers to BS EN 60947-2+A2
- G. The outgoing protective devices on main switchgear shall be TP/TPN molded case circuit breakers to BS EN 60947-2+A2 up to 800 A. Above 800 A they shall be air circuit breakers (With Drawable) to BS EN 60947-2+A2.
- H. Outgoing MCCB,s shall be of the fixed type Breakers shall be prewired with auxiliary contacts for metering and monitoring of supplies and also for future replacement of standard MCCB's with motorized MCCB's should the client wish to provide further automatic control as and when necessary. A blank plate shall be provided in the facia of each MCCB tray to enable the future provision of a kw hour meter should the client require this in the future.
- I. MCCB's up to 160A shall be adjustable thermal magnetic type. Above 160A all MCCB shall be with electronic trip units.
- J. Selected MCCB's shall be provided with motorized breakers and shall be interfaced with the SCADA control system to allow for automatic load shedding should this be necessary, motorized MCCB's or MCCB's with shunt trips are identified on the single line drawings (if required).
- K. Load break switches used as main isolators for switch gear and between separate busbar (bus section isolators) shall comply with BS EN 60947-3+A1 as well as other relevant standards quoted in this specification.
- L. Switches shall exhibit excellent trade resistance of isolator material in switch frame (CTV> 600C, IEC 60112+A1) to prevent flashover between phases.
- M. The contractor shall provide Castell key interlocks to ensure that there can be no access to the transformer's enclosure unless the MV and LV supplies relating to the transformer have been isolated. Keys shall be trapped in position when the breaker is closed.
- N. Provide terminals for external conductor, control and auxiliary circuits.
- O. Switchgear enclosure shall be rated IP41 minimum for indoor use.
- P. The following operations shall be performed when assembly is in service and under voltage:
 - 1. Visual inspection of switching devices and other apparatus.
 - 2. Settings and indicators of relays and releases
 - 3. Conductor connections and markings.
 - 4. Adjusting and re setting of relays, releases and electronic devices.

5. Replacement of fuselinks and indicating lamps.
6. Fault location by voltage and current measuring.

Q. The following shall be provided for maintenance of the assembly:

1. Provide space between functional unit or group and adjacent functional units or groups
2. Provide removable fastening devices such as locks, screws, etc. for parts likely to be removed for maintenance.

R. Integral surge protection devices are to be provided on each main LV switchgear as specified in the Power filter section of this specification.

S. MDB manufacturer/assembler shall provide all necessary interfaces, relays, transducers necessary for interface with the BMS as specified in the BMS schedules and/or shown on the project drawings/schedules unless stated otherwise.

T. MDB's shall be able to be monitored and controlled from BMS/SCADA system as per the requirements. Additionally, MDB functional units shall be able to communicate through internet/cloud platforms.

U. Switchgear shall be floor mounted rear or front access as indicated on the schedules and drawings.

V. All MCB and MCCB distribution boards/panels located within electrical rooms shall be installed within an enclosure constructed to provide an ingress of protection of IP41.

2.9 AIR CIRCUIT BREAKERS

A. Manufactured to BS EN 60947-2

1. AC Interrupting medium: Air
2. Number of poles: -as shown on drawings/schedules
3. Utilisation category : – B
4. Enclosure degree of protection: -IP 41
5. Style
 - a. Metal clad withdrawable type.
 - b. Provide automatic shutters to cover all live contacts when circuit breaker is isolated, with drawn or removed from housing.
 - c. Provide a padlock handle to lock circuit breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing.
 - d. ACB,s shall be automatically controlled and monitored via the PMCS system, the LV panel manufacturer shall provide all necessary terminations and equipment for interfacing with the PMCS system.
 - e. Complete with Castell interlocks
 - f. Complete with Restrictive earth fault protection
 - g. Digital temperature meters monitoring, Transformer temperature shall be provided and located on the ACB facia panel, meters shall be interfaced with the PMCS control system at each sub station.
 - h. Power logic meters shall be provided, these will also be located on the ACB facia panel, meters shall be interfaced with the PMCS control system at each substation.
6. Closing mechanism
 - a. Motorised mechanism.
 - b. 50V DC motor charged

B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each

circuit breaker; voltage and frequency ratings same as switchgear.

- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
1. Normal Closing Speed: Independent of both control and operator.
 2. Slow Closing Speed: Optional with operator for inspection and adjustment.
 3. Stored-Energy Mechanism: Electrically charged, with optional manual charging.
 4. Operation counter.
- D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment. Provide ground fault for 1000A and higher rated devices.
 2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
 3. Field-adjustable, time-current characteristics.
 4. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
 5. Three bands, minimum, for long-time-and short-time-delay functions; marked "minimum," "intermediate," and "maximum" in Arabic and English.
 6. Pickup Points: Five minimum, for long-time-and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
 7. Pickup Points: Five minimum, for instantaneous-trip functions.
 8. Ground-fault protection function with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
 - a. Three-wire circuit or system.
 - b. Four-wire circuit or system.
 - c. Four-wire, double-ended substation.
 9. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
- E. Trip unit shall be smart and able to be upgraded at any time with advanced measurements & protection functions using the embedded low energy blue-tooth connection and without changing existing trip unit. It shall be possible to update the firmware while the breaker is closed and in service.
- F. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.
- G. All breakers above 800A shall be air circuit breakers (ACB's), utilization category B and to be equipped with below accessories/features:
1. Withdrawable type.
 2. Electrically operated (equipped with motor mechanism).
 3. Electronic trip unit with colored touch screen display with easy navigation and has the below protection functions:
 - a. The protection against overload (L/49)
 - b. The protection against short circuit, selective (S/50TD-51)
 - c. The protection against short circuit, instantaneous (I/50)
 - d. The protection against ground fault (G/50NTD-51N)
 4. Thermal memory for functions L and S shall be available.
 5. Include N.O. and N.C. auxiliary contacts on switchgear as required for remote monitoring

- and control, plus 2 N.O. and 2 N.C. spare contacts.
6. A communication module integrated inside the ACB with the communication protocol complying with the SCADA/BMS requirements.
- H. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
 2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
 - a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
 - b. Disconnected Position: Primary and secondary devices and ground contact disengaged.
- I. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.
- J. Electronic trip unit shall be equipped with integrated communication module without the need of any external devices or gateways to support one or more of the common communication protocols (Modbus TCP/IP, Modbus RTU, Profibus, Device Net, Profinet, IEC61850, Ethernet/IP) with the ability to use two communication protocols simultaneously.
- K. Electronic trip units shall be capable of incorporating one or more communication modules for monitoring and control purposes. Additionally, it shall be capable of incorporating a cloud communication module to communicate the collected data to the electrical power monitoring/energy management system (EPMS/EMS) platform for analysis and visualization of power and energy parameters.
- L. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.
- M. Operating Handle: One for each circuit breaker capable of manual operation.
- N. Electric Close Button: One for each electrically operated circuit breaker.
- O. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.
- P. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.
- Q. ACB shall have the below measurement functions:
1. Voltage (RMS) with accuracy of 0.5%
 2. Current (RMS) with accuracy of 0.5%
 3. Frequency.
 4. Total active, reactive, and apparent power with accuracy of 1%
 5. Total active, reactive, and apparent energy with accuracy of 1%
 6. Power factor
 7. Peak factor.

- R. Trip unit shall be able to provide measurements according to EN50160 standard of the main power quality gauges, such as:
 - 1. Voltage spikes.
 - 2. Voltage sags.
 - 3. Voltage micro interruptions
 - 4. Harmonic analysis (voltage harmonics, current harmonics, THD) up to the 50th harmonic.
- S. Trip unit shall be provided with a data logger function that automatically records and stores the instantaneous values of all the currents and voltages.
- T. Trip unit shall provide the below information related to previous events:
 - 1. Last 40 trips.
 - 2. Type of protection tripped.
 - 3. Current/voltage/frequency on the three phases according to the protection tripped.
 - 4. Date, time and progressive number of trips.
- U. Undervoltage Trip Devices: Instantaneous, with adjustable pickup voltage.
- V. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.
- W. Shunt-Trip Devices: Where indicated.
- X. It shall be possible to connect the trip unit with touch screen display device installed in the front of switchboard that provides a real-time measurement of system parameters.
- Y. ACB shall be capable of incorporating an automatic synchronization function where the switching of two live sources is required.
- Z. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.
- AA. All information displayed directly on the trip unit display shall be possible to be displayed on a smartphone, tablet or PC using the front port of the trip unit and the appropriate communication cable.

2.10 MOULDED CASE CIRCUIT BREAKERS (MCCB's)

- A. Type tested to approved standards, totally enclosed, moulded case, constructed from high quality, high temperature resistant, tropicalized, moulded insulating materials, for normal operation at maximum temperature within enclosures at point of application, and provided with quick-make, quick-break, front operated single toggle type handle mechanism for manual operation of main contacts in addition to automatic operation under over-current conditions. MCCB's required to be electrically operated (equipped with motor mechanism) shall clearly be indicated on the project SLD and design drawings/schedules.
- B. Multi-Pole breakers shall have common integral trip bar for simultaneous operation of all poles. Ampere rating shall be clearly visible. All terminals shall be box lug or clamp type with set screws, suitable for copper or aluminum conductors.
- C. By means of the double insulation technique, moulded case circuit-breakers shall guarantee complete separation between the power circuits and the auxiliary circuits.
- D. Unless otherwise specified or shown on the drawings, moulded case circuit breakers shall be with thermal magnetic trip unit type for breakers up to 250 Amps and electronic type for higher ratings.
- E. Thermal magnetic circuit breaker trip units shall have bi-metallic inverse time delay characteristics on each pole, shall be ambient temperature compensated for 40°C, and shall be suitable for use in temperatures between -25 and +70.

- F. For ratings higher than 250A, solid state electronic trip units shall be used, it shall be equipped with colored touch screen display. Electronic trip units shall have long time delay settings between 0.4 and 1.0 times maximum trip rating, short time delay range of 1 to 10 times maximum trip rating with a maximum clearing time of 0.2 seconds, and instantaneous protection adjustable from 1 to 10 times continuous rating. Earth fault protection shall be built into trip unit where specified and shall be suitable for connection to external current sensor. Push-to- trip button shall be provided on cover for testing the trip unit.
- G. Switching Mechanism: quick-make, quick-break type, with positive trip-free operation so that contacts cannot be held closed against excess currents under manual or automatic operation.
- H. Tripped Position: When tripped automatically by over-current condition, operating mechanism of circuit breaker shall assume an intermediate position clearly indicated by the handle between on and off positions.
- I. Accessories: Circuit breakers shall be designed to accommodate standard attachments including shunt-trip, under-voltage release, combined auxiliary and alarm switches. Padlocking devices shall be provided, where shown on the drawings.
- J. MCCB's with rating 800A and above shall be utilization category B.
- K. Advanced version of the electronic trip unit with embedded metering functions shall be available, without the need of extra CT's or meters or increasing the dimensions of the circuit breaker to have the measurements of current, voltage, frequency, power, power factor, energy, and THD.
- L. All information displayed directly on the trip unit display shall be possible to be displayed on a smartphone, tablet or PC using the front port of the trip unit and the appropriate communication cable.
- M. It shall be possible to supply power either from top or bottom side without reduction in performance.
- N. Trip units shall be interchangeable starting from 160A.
- O. Electronic trip unit shall be smart and able to be upgraded at any time with advanced measurements & protection functions using the embedded low energy blue-tooth connection and without changing the existing trip unit.
- P. Electronic trip unit shall be equipped with integrated communication module without the need of any external devices or gateways to support one or more of the common communication protocols (Modbus TCP/IP, Modbus RTU, Profibus, Device Net, Profinet, IEC61850, Ethernet/IP) with the ability to use two communication protocols simultaneously.
- Q. Electronic trip units shall be capable of incorporating one or more communication modules for monitoring and control purposes. Additionally, it shall be capable of incorporating a cloud communication module to communicate the collected data to the electrical power monitoring/energy management system (EPMS/EMS) platform for analysis and visualization of power and energy parameters.

2.11 MINIATURE CIRCUIT BREAKERS (MCB's)

- A. MCB's shall be thermal magnetic non-adjustable type and comply with IEC 60947-2. For residential/household applications and similar installations, MCB's shall comply with IEC 60898 instead.
- B. MCB's shall be current limiting type, breaking capacity shall be as per the prospective fault level at the location of installation.

- C. MCB's shall be constructed from high quality, high temperature resistant, and 100% halogen free thermoplastics housing. Guaranteed duties and characteristics shall be submitted for temperatures above 30 deg C.
 - D. MCB's shall be compact construction type with din-rail mounting inside the enclosure to facilitate easy removal and mounting without disturbing other components in the distribution boards.
 - E. MCB's shall be suitable of operation of temperature -25 to +55 degree centigrade.
 - F. Tripping characteristics shall be consisting of delayed thermal and instantaneous magnetic tripping principle and characteristic of "B", "C", "D", or other tripping curves as per the requirements.
 - G. MCB's shall be available in 1P, 2P, 3P, 4P, 1P+N, 3P+N as per the requirements.
 - H. It shall be possible to connect incoming supply on either side of the terminals without reduction in short circuit performance.
 - I. MCB operating mechanism shall be effectively sealed, trip-free with indication for on-off positions, separate trip position indication.
 - J. MCB mechanism shall be suitable for a minimum of 10,000 operations.
 - K. MCB terminals/exposed parts shall be protected against unintentional contacts.
 - L. MCB shall have manual closing/opening in case of normal operation and automatic tripping on fault.
 - M. Multi pole MCB's shall be internally linked on the mechanism to ensure tripping of all poles simultaneously.
- A. Accessories like auxiliary contact, shunt trip, under voltage release, over voltage release, motor operator, and auto reclosing shall be available as per the requirements.

2.12 SWITCH DISCONNECTORS

- A. Switch disconnectors shall be non-fusible, single throw type, with utilization category as per IEC 60947-3 depending on load type, with arc quenching devices on each pole capable of interrupting at least six times its rated current and shall simultaneously interrupt power supply to all line conductors.
- B. Operating mechanism shall be quick-make quick-break type, with external operating handle mechanically interlocked with the door to necessitate disconnecting switch to be in OFF position for access to inside of enclosure. Means shall be provided for by passing the interlock. Position of isolating switch to be clearly on cover.
- C. Switch disconnectors shall be operated by an external handle that shall indicate the position of the contacts with complete reliability in all situations. If the contacts are welded together, the handle shall not reach the OFF position but shall remain between ON-OFF, maintaining the door interlock and preventing pad locking.
- D. It shall be possible to install switch disconnectors in any direction; horizontal, vertical, or even at the ceiling.
- E. Switch disconnectors provided for rotating machines shall have secure safe working condition for service personnel.

- F. The rating of switch disconnectors shall be valid in harsh ambient with pollution degree 3 according to IEC 60947.
- G. It shall be possible to connect two parallel cables to the terminals of the switch disconnector for easier installation and space saving. It shall be possible to mark the line and load terminals.
- H. All the terminals shall meet the requirements of IP20 degree of protection with separate terminal shrouds.
- I. All the metal parts shall be protected against corrosion.
- J. The contact surfaces shall be silver-plated to minimize contact resistance.
- K. Accessories such as terminal shrouds and auxiliary contacts shall be mountable without any special tools (i.e., snap on mounting).
- L. The auxiliary contacts shall be early break and late make silver-plated auxiliary contacts with self-cleaning function.

2.13 ARC FLASH DETECTION AND PROTECTION SYSTEM

- A. MDB's shall be equipped with an efficient and reliable arc detection and protection system to protect it against internal arcing faults inside the switchboard.
- B. Arc detection system shall consist of a central arc monitoring unit and a no. of light sensors/detectors distributed inside the switchboard to detect any light spark caused by an internal arcing inside the switchboard and transfer it to the arc monitoring unit which shall send a signal within a maximum of 1 mSec to trip the main breaker or branch breaker to disconnect the affected area of the switchboard.
- C. Light sensors shall be connected to the arc monitoring unit by means of fiber optic cables to avoid electro-magnetic disturbances.
- D. Light sensors shall not react for a light intensity lower than 3000 lux to avoid nuisance tripping.
- E. The light intensity for tripping shall also be constant regardless the length of the light sensor/detector.
- F. Optionally, an additional current sensing unit can be mounted if there is a risk of false trips caused by strong light hitting the sensors such as sunlight or camera flashes to avoid any unnecessary tripping.
- G. It shall be possible to identify where and when the arcing fault has occurred inside the switchboard and configure the detectors to trip different breakers accordingly to disconnect the affected area of the switchboard.
- H. The arc monitoring unit shall have communication via MODBUS RTU protocol to transfer the system data to BMS, SCADA, power monitoring, or energy management systems.

2.14 ACCESSORIES

- A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.
 - 1. Racking handle to manually move circuit breaker between connected and disconnected positions.
 - 2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without

- removal from switchgear.
- 3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

- B. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.
- C. Spare-Fuse Cabinet: Identified and compartmented steel box or cabinet with lockable door.
- D. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.15 PROTECTION DEVICES INTERPOSING RELAYS AND INTER TRIPPING RELAYS

- A. Manufactured to BS EN 61810.
- B. Housing
 - 1. Flush panel-mounting type.
 - 2. House all protection relays, excluding motor protection relays, in draw out cases.
- C. Reset type
 - 1. Interposing relays -Automatic reset type
 - 2. Inter tripping relays -Manual reset type

2.16 VOLTAGE SENSING RELAYS

- A. Provide single-phase inverse time undervoltage type voltage sensing relays to monitor the voltage between respective phases of supply.
 - 1. Mounting - Supply suitable for flush panel mounting with relay trip indication.

2.17 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES

- A. Provide a panel mounted heavy duty, spring return trip/close switch on circuit breakers fitted with solenoid or motorised spring closing mechanisms.
- B. Ensure contacts have a continuous rating of 10A minimum at between 30V to 250V ac and dc, and make and break duty rating of 30A at 250V ac or dc for a minimum period of 3 secs.
- C. Provide a local/remote panel mounted selector switch to select circuit breaker for local or remote closing. Ensure that selection of remote or local closing does not prevent circuit breaker tripping under operation of local or remote trip switch

2.18 CURRENT TRANSFORMERS

- A. Comply with BS EN 61869-2
- B. Provide separate current transformers for each protection device and instrumentation.
- C. Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

- D. Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.
- E. Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

2.19 INSTRUMENTS AND METERS

A. Standards

- 1. Comply with BS EN 60051 for voltmeters, ammeters, wattmeters, frequency indicators and power factor indicators.
- 2. Comply with BS 7856, BS EN 62053-11, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters, and BS EN 62053-23 for kVAhr meters.

B. Protect wiring to voltmeters by separate fuses.

C. Protect potential coils of wattmeters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.

D. Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated.

E. Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full-scale deflection.

F. Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

G. Digital Multifunctional Power Meter Units:

Digital multifunctional power meter units shall be provided where shown on the drawings and shall have the following features:

- 1. Unit shall be microprocessor based and shall support true RMS measurement.
- 2. Unit shall provide all the below electrical measurements:
 - a) Voltage (L-N), Voltage (L-L)
 - b) Current (L1, L2, L3, N)
 - c) Frequency
 - d) Power Factor
 - e) Active, Reactive and Apparent Power
 - f) Maximum Demand (active, reactive, and apparent power)
 - g) Active, Reactive and Apparent Energy
 - h) Total Harmonic Distortion for Voltage and Current
 - i) Current and voltage harmonics up to the 40th harmonic
 - j) Total operating hour counter
- 3. Unit accuracy shall comply with IEC 61557-12 and shall have the following minimum measurement accuracies:
 - a) Current, Voltage: 0.2%.
 - b) Active energy, Active power: 0.5%.
 - c) Reactive energy: 2%.
 - d) Reactive power: 1%.

- e) Frequency: 0.1%.
- f) Unbalance (current, voltage): 0.2%.
- g) Harmonics and THD: 1%.
- 1. Unit operating temperature shall be -25 to +75 deg C.
- 2. Unit user interface shall be a touch screen graphical colored display.
- 3. Unit shall be equipped with blue-tooth module for easy commissioning via mobile app.
- 4. Unit configuration shall be protected by password.
- 5. Unit shall support one or more of the communication protocols: Modbus RTU, Modbus TCP/IP, Profibus DP-V0, BACnet/IP.
- 6. Unit shall keep memory for historical data logging for up to one year of time.

Alternatively, if the breaker electronic trip unit shall have the above-mentioned metering features built-in into it and is supporting the above-mentioned communication capabilities, then no separate power meter shall be required.

2.20 ELECTRICAL POWER MONITORING/ENERGY MANAGEMENT SYSTEM (EPMS/EMS)

- A. The electronic trip units of the LV ACB's and MCCB's shall incorporate a communication module to communicate the collected data to the electrical power monitoring/energy management system (EPMS/EMS) platform for analysis and visualization of power and energy parameters.
- B. System shall collect data from the electrical devices in the field and store information in one system accessible via Cloud. System shall provide status, alarms, alerts, and maintenance indicators as per the preconfigured model for the electrical network.
- C. System shall have a web-based application with preconfigured widgets to provide real-time monitoring of electrical parameters and power consumption. The application shall also provide dashboards, trend graphs, historical performance, and data logging necessary for the analysis of energy consumption and electrical network performance over a selectable period of time based on the collected data. Data monitored and parameters measured shall depend on the electrical devices connected. Because the application is web-based, it shall be accessible on PC, tablet, or smartphone without the need for any special software.
- D. System shall be designed to monitor following data without storage limitations:
 - 1. Consumption measures:
(Currents, Voltages, Power, Energy, Power Factor, ...)
 - 2. Power quality data:
(THD, Voltage Unbalance, Voltage Spike/Swell/Sag ...)
 - 3. Maintenance data:
(Contact wear, Number of trips, Total no. of operations, ...)
- E. System shall be compatible to integrate with MV and LV electrical devices and it shall support multiple vendors for breakers and meters.
- F. System shall have high degree of flexibility enabling the addition of electrical devices in the future and the integration with the already installed devices with limited impact on existing architecture.
- G. System shall have a data logging interval of 30 seconds or less to ensure a fast reaction in case of warning or alerts and continuous measures for reliable efficiency analysis.
- H. System shall be able to send different alerts for each device as per the preconfigured setting through e-mail and/or SMS to the user.
- I. System shall include a module for evaluation of LV and MV breakers condition, it shall be based on mechanical and electrical data as well as environmental conditions to define accurate performance trend and predictive maintenance plan.

- J. System shall provide the last date of maintenance and propose next date for maintenance.
- K. Export of data and trends in excel shall be possible on-demand. It shall be possible to generate reports for all information managed or generate customized reports.
- L. Commissioning shall be easy with the simple use of a free software provided by the manufacturer. Automatic recognition of devices shall be ensured so that there will be no need for programming.
- M. System shall have embedded TLS protocol (Transport Layer Security) to provide encrypted communication and hence ensure the maximum communication security.
- N. It shall be possible to define different profiles for user with different access/view rights.
- O. It shall be possible to integrate and share the system data with other control platforms on site such as BMS, SCADA, or DCS using standard communication protocols and with the use of gateways as needed.

2.21 INDICATOR LIGHTS

- A. Supply lamps of same type throughout. Provide indicator lamps with lamp test facility.
- B. Supply interchangeable indicators for respective units.
- C. Protect wiring to indicator lamp units by separate cartridge fuses.
- D. Lens colour in accordance with BS EN 60073.
- E. Provide Indicator lamps on each LV board to indicate:
 - 1. Mains available (i.e. transformer live)
 - 2. Busbars Live (i.e. one per section indicating incoming transformer or generator ACB closed)

2.22 LOW VOLTAGE COILS RATING

- A. Ensure coils for switching relays, contactors and other applications are capable of withstanding inherent voltage drop within system without armature or switching apparatus dropping out of position

2.23 CABLE TERMINATIONS

- A. Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated.
- B. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.
- C. Provide non ferrous metal glanding plates for single core cable terminations

2.24 BATTERY AND CHARGER UNIT FOR MAIN LV SWITCHGEAR

- A. Input Supply 230 V single phase 60 Hz.
- B. DC Output
 - 1. Voltage 50 Volt 20% +10%
 - 2. Current as shown on drawings/schedules.
 - 3. Operating temperature range 10oC 45oC.

4. Charger type Thyristor or transistor.
5. Battery type :Lead acid (sealed) or Nickel Cadmium (maintenance free).
6. Cubicle (sheet steel) : Wall mounted or Floor standing as shown on drawings/schedules.
7. Cable entry: Top or bottom as shown on drawings/schedules.
8. Finish: Manufacturer's standard.
9. Colour: Manufacturer's standard.
10. Ventilation: Natural.
11. Facilities :
 - a. MCB input protection
 - b. Float charge.
 - c. Battery over discharge protection
 - d. Fuses for battery protection
 - e. MCB's for outgoing circuits, as shown on drawings/schedules
 - f. Automatic selection of boost charge.
12. Meters
 - a. Battery voltage
 - b. Charging current (dual scale for float and boost)
 - c. Output current.
13. Lamp indications
 - a. Supply on
 - b. Supply fail (monitor input terminals)
 - c. Float charge
 - d. Boost charge
 - e. No charge (when supply is on)
 - f. Battery voltage low
 - g. Battery voltage high.
14. Alarms (connected to operate a relay with shrouded 230V, 3A a.c. or 0.5A d.c. n/c volt free contacts, closed on any alarm, for remote indication circuit).
 - a. Supply failed
 - b. No charge (when supply is on)
 - c. Battery voltage low
 - d. Battery voltage high.
 - e. Volt free contacts for BMS connections

2.25 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, third edition, short-circuit current rating matching or exceeding the switchgear short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 100-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 10. Four digit, transient-event counter set to totalize transient surges.
- B. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
- C. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 400/230V, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 400Y/230V.
 2. Line to Ground: 800 V for 400Y/230V.
 3. Neutral to Ground: 800 V for 400Y/230V.
- E. Protection modes and UL 1449 SVR for 400V, three-phase, three-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 400 V
 2. Line to Ground: 1500 V for 400 V.
- 2.26 SWITCHGEAR AND CONTROLGEAR ACCESSORIES
- A. Provide switchgear and controlgear accessories as shown on drawings/schedules.
 - B. Provide locks and padlocks, one for each ACB and MCCB.
 - C. Provide insulating mats in front of each main LV switchgear.
 - D. Provide switchgear operating tools for each main LV switchgear as manufacturers standard.
 - E. Provide 5 spare fuses/MCCB,s/MCB,s for each type and rating of protective device.
- 2.27 MARKING AND DRAWING:
- A. Number terminals, cables and component parts to correspond with manufacturer's certified drawings.
- 2.28 CABLE TERMINATIONS:
- A. Terminate XLPE SWA LSF and MICS cables inside enclosure by securing cables to switchgear with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes
- 2.29 LOGGING MULTIMETERS
- A. Provide LCD display logging multimeters on each section of LV Switchboard, as shown on the drawings, to provide:
 1. Volts and current per phase
 2. kW
 3. kVA

4. kVAr
 5. Power factor
 6. Maximum Demand
 7. KWhr
 8. Frequency
 9. Total Harmonic Distortion (current and voltage)
- B. Where shown on drawings logging sub-meters shall be provided to monitor certain outgoing circuits and incorporate the data onto the power-monitoring network. They shall provide:
1. Volts and current per phase
 2. kW
 3. kVA
 4. kVAr
 5. Power factor
 6. Maximum Demand
 7. KWhr
 8. Frequency
 9. Total Harmonic Distortion (current and voltage)
- C. Readings to be selected via keypads on the front of the multimeters.
- D. The meters shall provide true RMS readings irrespective of waveform, to class 1.0 accuracy.
- E. The main multimeters shall log all alarm events. The following parameters shall be recorded:
1. At alarm pick-up
 - a. Event type
 - b. Date
 - c. Time
 - d. Most extreme reading during pick-up delay

2. During alarm drop out:

- a. Date
- b. Time
- c. Most extreme reading during alarm event.

- F. The main multimeters shall incorporate sufficient on-board memory to store a minimum of 8 days reading. The memory shall be capable of being extended to 40 days if required.
- G. The main multimeters shall include the facility to capture waveforms by sampling all current and voltage simultaneously, at a minimum rate of 64 times per cycle waveform. The waveform shall be stored in the memory for later retrieval. Waveform capture shall be triggered either internally by a defined alarm condition or externally.
- H. The main multimeters and sub-meters shall be capable of transmitting readings via the PMCS data network to a central PC. All metering shall be routed via network cabling to the main FIRE COMMAND control room where a PC shall be provided which shall show clearly all measured real time parameters in pictorial form. Note that this system will be used to monitor consumption demand within the site. Consequently, the system must be capable of being set up to log information over operator determined time periods and be accurate. The multimeter manufacturer shall supply the software.
- I. Networking shall be carried out using RS485 protocol or another suitable means of transferring data accurately and immediately.
- J. The meters shall provide volt free output alarm contacts for maximum demand power levels. A minimum of three alarm levels per parameter shall be able to be set.
- K. The contractor should not underestimate the importance of this facility and the required reliability of its operation.

2.30 IDENTIFICATION

- A. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.
1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
 2. Medium: Painted graphics, as selected by Architect/Engineer.
 3. Color: Contrasting with factory-finish background; as selected by Architect/Engineer from manufacturer's full range.
- B. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
1. Frame size of each circuit breaker.
 2. Trip rating for each circuit breaker.
 3. Conduit and wire size for each feeder.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Installation of LV switchgear shall be in accordance with manufacturer's written instructions and shall comply fully with the requirements of BS, IEC, SEC and recognized industry practices.
- B. Anchor switchgear assembly to 100-mm, channel-iron sill embedded in floor or concrete base and attach by bolting.
 - 1. Sills: Select to suit switchgear; level and grout flush into floor or concrete base as indicated on the drawings and schedules.
 - 2. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.
 - 3. Concrete Bases: (where indicated on drawings) 100 mm high, reinforced, with chamfered edges. Extend base no less than 75 mm in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components. Comply with applicable portions of NECA 400.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Diagram and Instructions:
 - 1. Frame and mount under clear acrylic plastic on the front of switchgear.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
 - c. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
 - 2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
 - 3. Complete installation and startup checks according to manufacturer's written instructions.
 - 4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
 - 5. Report results in writing.
- C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical test stated in BS EN 60439 and as required by local Utility company regulations. Certify compliance with test parameters. Perform BS EN 60439 tests and inspections for each of the following categories:
 - a. Switchgear.
 - b. Circuit breakers.
 - c. Protective relays.
 - d. Instrument transformers.
 - e. Metering and instrumentation.
 - f. Ground-fault systems.
 - g. Battery systems.
 - h. Surge arresters.
 - i. Capacitors.
 - 2. Remove and replace malfunctioning units and retest as specified above.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ACCESS:

- C. Ensure that clearance in front of switchgear and controlgear is not less than 1m, or as indicated.

3.7 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics according to results in Division 26 Section "Overcurrent Protective Device Coordination Study" and after proper coordination with protection settings of local electric utility company (SEC).

3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

3.11 SCHEDULE OF SWITCHGEAR MANUFACTURERS

Source	Origin	Contact
ABB	KSA	
Arabian Factory for Distribution Panel (Al-Fanar)	KSA	
East & West Factory	KSA	
Electrical PanelBoard Factory (EPBF)/HAWA Trading	KSA	
Mohammed Al-Ojaimi Factory	KSA	
Al Khalifa Factory for Metal Industries	KSA	
Siemens	Germany/KSA	
Schneider Electric	KSA	
Eaton	KSA	
RAWABI	KSA	
USSG_United Tech for Sub and S.Gear	KSA	
Or An Approved Equal		

3.12 SCHEDULE OF LOW VOLTAGE CIRCUIT BREAKERS MANUFACTURERS

Source	Origin	Contact
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ALBAWANI PROJ. NO. 62320
GA PROJ. NO. 2159017-003

LUCID MOTORS
AMP2 CBU
KAEC, JEDDAH - KSA

ABB SACE SPA	Italy	
Cutler Hammer USA	USA	
Siemens	Germany	
Eaton	USA	
Legrand	Italy	
General Electric	USA	
L&T Electrical & Automation	India	
Merlin Gerin	France	
Federal Electric	Turkey	
Schneider Electric	KSA	
Mitsubishi Elect. Corp.	Japan	
LG (LS)	South Korea	
Or An Approved Equal		

END OF SECTION 262300