

SECTION 262300 - LOW-VOLTAGE SWITCHGEAR

A. GENERAL

2.1. RELATED DOCUMENTS

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

2.2. 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
 8. 263525 " Harmonic Suppression"
 9. 264313 "Surge Protection "
 10. 260573.13 "Short Circuit Studies "
 11. 260573.16 "Coordination Studies"
 12. 260573.19 " Arc Flash Hazard Analysis"
- 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 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.

Commented [BG1]: Appended with respect to Eaton suggestion : it, 8,9,10,11,12

2.3. 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.

2.4. 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.

2.5. 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.
1. Vibrations performance: All Switchgear shall be certified for vibration performance according to IEC 60068-2-57.
 - 2.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.
- D. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

2.6. 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.

2.7. 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.

2.8. 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 licensed 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, watt-hour 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. IEC 61439, -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 control gear -Switches, disconnectors, switch-disconnectors and fuse-combination units
 11. BS EN 61439-1 -Low-voltage switchgear and control gear 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. IEC 60068-2-11 -Basic environmental testing procedures-Part 2 : Tests-test Ka : Salt mist.
 21. IEC 60068-2-30 -Basic environmental testing procedures -Part 2 : Tests-test Db and guidance : Damp heat.
 22. IEC 60439-1 -Low voltage switchgear and controlgear assemblies -Part 1 : Type tested and partially type tested assemblies
 23. IEC 60529 -Degrees of protection provided by enclosure (IP Code)
 24. IEC 61439 – 1:2020 and IEC 61439-2 (2020)
 25. IEC 60068-3-3 & IEC 60068-27_Seismic compliance (AG2 & AG5)
 26. IEC 60947-9-1:2019 - Low-voltage arc quenching devices,
 27. IEC/TS 63107:2020 Integration of internal arc-fault mitigation systems in power switchgear and control gear assemblies (PSC Assemblies)
 28. Enclosed low voltage switchgear & control gear assemblies guide for testing under conditions of arcing due to internal fault: IEC/TR 61641 (V3)
 29. IEC 62262: Mechanical impact strength. IEC 61641 3rd edition or greater: testing of ASSEMBLIES under conditions of arcing in air due to an internal fault for 0.3 sec

Commented [BG2]: Appended following Eaton Comment (item 27 , 28, 29, 30, 31

- G. Except where detailed in the Specifications, all components and equipment in
- H. 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.

2.9. SOURCE QUALITY CONTROL

- A. Testing: Test and inspect low-voltage switchgear according to IEC 61439 Draw out 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
 - 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.
- D. Low-voltage switchgear assembly will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Owner will witness required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

2.10. 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 condensation.

2.11. 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.

2.12. 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.
- C. Prior to start of manufacturing Contractor shall coordinate with the supplier with respect to Voltage drop constraints , Short circuit study , coordination and discrimination study and detailed Arc assessment study for low voltage panels. Refer to specification relevant sections as mentioned in section 1.2 / b of this document.

Commented [BG3]: Item added as per Eaton recommendation.

2.13. 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 it is 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 IP54 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 metal clad switchgear shall be IP40 as per IEC 60529, unless otherwise specified.

2.14. MAINTENANCE AND REPAIR

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

2.15. 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.

2.16. 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.~~
 4. Also, the following spare parts for low voltage included in the table below:

<u>Spare Parts List for Low Voltage Panel Boards</u>		
-	<u>Description</u>	<u>Qty.</u>
1	<u>LED Pilot Light</u>	10%
2	<u>Photocell</u>	
3	<u>HRC BLADE TYPE CATRIDGE FUSE</u>	
4	<u>Fuse</u>	
5	<u>Fuse Puller</u>	
7	<u>Surge Arrestor</u>	
8	<u>Hygrostate</u>	
9	<u>Multifunctional Relay</u>	
10	<u>DIGITAL WEEKLY/ASTRONOMIC TIMER</u>	
11	<u>FAN&FIL TER. 230VAC</u>	
12	<u>FILTER FOR FAN.</u>	
13	<u>Contactors</u>	
14	<u>Relays</u>	
15	<u>Any other Accessories Recommended by Manufacture</u>	
16	<u>Circuit Breaker (16A to 100A)</u>	
17	<u>Micrologic Trip Unit</u>	5%
18	<u>Circuit Breaker (125 A or higher)</u>	
19	<u>Power Meter</u>	
20	<u>Push Button</u>	
21	<u>Any other Accessories Recommended by Manufacture</u>	-

-	<u>Lighting Fixture</u>	
1	<u>Lighting Fixture</u>	<u>5%</u>
2	<u>Drivers</u>	<u>10%</u>
-	-	-
-	-	-
	<u>Wiring Devices</u>	
1	<u>Power Outlets</u>	<u>5%</u>
2	<u>Ligh switches (Each Type)</u>	
3	<u>Isolator Switches</u>	<u>5%</u>

5. _____

- 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.

B. PRODUCTS

2.1. 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.

2.2. 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. Certification complying to IEC 61439-1/2 shall be needed.

C. This section shall be reviewed in conjunction with single line diagram and floor plans for proposing appropriate physical and general arrangements.

B.D. _____

2.3. 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.
- D. Rated impulse withstand voltage U_{imp} [kV] : up to 12 kV

2.4. FABRICATION

- A. Factory assembled and tested and complying with IEC 61439 1 & 2, and IEC 61641.
- B. Indoor Enclosure Material: Steel.
- C. Outdoor Enclosure Material: Galvanized steel.
- D. Outdoor Enclosure Fabrication Requirements: Weatherproof; (IP 65) integral structural-steel base frame with factory-applied asphaltic undercoating; and each compartment equipped with the following features:
- E. Structural design and anchorage adequate to resist loads imposed by 200-km/h wind.
- F. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
- G. Louvers equipped with insect and rodent screen and filter; arranged to permit air circulation while excluding insects, rodents, and exterior dust.
- H. Hinged front door with padlocking provisions.
- I. Interior light with switch.
- J. Weatherproof duplex socket outlet.
- K. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.
- L. Aisle access doors with outside padlocking provisions and interior panic latches.
- M. Aisle space heaters operating at one-half or less of rated voltage, thermostatically controlled.
- N. Vapor proof fluorescent aisle lights with low-temperature ballasts, controlled by wall switch at each entrance.
- O. Ventilation louvers equipped with insect and rodent screen and filter and arranged to permit air circulation while excluding insects, rodents, and exterior dust.
- P. Finish: BS EN 61349 -1 & 2 manufacturer's standard finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
- Q. Section barriers between main and bus circuit-breaker compartments shall be extended to rear of section.
- R. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and Bus circuit breaker.
- S. Circuit-breaker compartments shall be equipped to house draw out-type circuit breakers and shall be fitted with hinged outer doors.
- T. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear.

- U. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
- V. Bus transition sections.
- W. Incoming line pull sections.
- X. Hinged front panels for access to metering, accessory, and blank compartments.
- Y. 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.
- Z. Set pull box back from front to clear circuit-breaker lifting mechanism.
- AA. Bottom: Insulating, fire-resistant material with separate holes for cable drops into switchgear.
- BB. Cable Supports: Arranged to ease cabling and adequate to support cables indicated, including those for future installation.
- CC. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
- DD. Main Phase Bus: Uniform capacity the entire length of assembly.
- EE. 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.
- FF. Vertical Section Bus Size: Comply with IEC 61439, including 15% allowance for spare circuit breakers and spaces for future circuit breakers, (see schematics for details).
- GG. Phase-and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
- HH. Use copper for connecting circuit-breaker line to copper bus.
- II. Contact Surfaces of Buses: Silver plated.
- JJ. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
- KK. 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.
- LL. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
- MM. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
- NN. Neutral Disconnect Link: Bolted, uninsulated, 6-by-50-mm copper bus, arranged to connect neutral bus to ground bus.
- OO. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
- PP. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.

QQ. Sprayed Insulation Thickness: 0.08 mm, minimum.

RR. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2.5. MAIN LV SWITCHGEAR

- A. Main switchgear shall be Form 4a Type 2 to BS EN 61439-1 with bottom ~~and top~~ entry ~~and bottom-and-top~~ exit and access to terminations from the rear only. All main LV switchgear shall be factory built and Fully Type Tested Assemblies to IEC 61439-1/2 . 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. Short circuit withstand current according to approved S.C. Calculations for 1 sec and SEC requirements.
- 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 ;
 - 1. Above 800A they shall be air circuit breakers to BS EN 60947-2+A2.
 - 2. Trays shall be prewired with auxiliary contacts for metering and monitoring of supplies and for future replacement of motorized ACB should the client wish to provide further automatic control as and when necessary.
- H. Selected ACB'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 ABC with shunt trips are identified on the single line drawings (if required).
- I. 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.
- J. Switches shall exhibit excellent trade resistance of isolator material in switch frame (CTV> 600C, IEC 60112+A1) to prevent flashover between phases.
- K. The contractor shall provide Castell key interlocks to ensure that there can be no access to the transformers 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.
- L. Provide terminals for external conductor, control and auxiliary circuits.
- M. Switchgear enclosure shall be rated IP41 minimum for indoor use.
- N. 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.

O. 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.

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

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

2.6. 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

2.7. AIR CIRCUIT BREAKERS

- A. Manufactured to BS EN IEC 60947-2+A2
 1. AC Interrupting medium: Air
 2. Number of poles: -as shown on drawings/schedules
 3. Utilization category: – B
 4. Enclosure degree of protection: -IP 41
 5. Withdrawable type.
- B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.
- C. All breakers above 800A shall be air circuit breakers (ACB's), utilization category B and to be equipped with below accessories/features:
- D. Electrically operated (equipped with 50V DC motor charged mechanism).
- E. 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.
- F. A communication module integrated inside the ACB with the communication protocol complying with the SCADA/BMS requirements.
- G. 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, / PC / LAPTOP the LV panel manufacturer shall provide all necessary terminations and equipment for interfacing with the PMCS system.
 - e. Complete with Castell interlocks as needed.
 - 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 substation.
 - 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.
- H. Electronic trip unit:
 1. The 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.
2. 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.
 3. Electronic trip unit with colored touch screen display with easy navigation and has the below protection functions:
 4. The protection against overload (L/49)
 5. The protection against short circuit, selective (S/50TD-51)
 6. The protection against short circuit, instantaneous (I/50)
 7. The protection against ground fault (G/50NTD-51N)
 8. Thermal memory for functions L and S shall be available.
 9. Trip unit shall be able to provide measurements according to EN50160 standard of the main power quality gauges, such as:
 - a. Voltage spikes.
 - b. Voltage sags.
 - c. Voltage micro interruptions
 - d. Harmonic analysis (voltage harmonics, current harmonics, THD) up to the 50th harmonic.
 - e. 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.
 10. Trip unit shall be provided with a data logger function that automatically records and stores the instantaneous values of all the currents and voltages.
 11. Trip unit shall provide the below information related to previous events:
 - a. Last 40 trips.
 - b. Type of protection tripped.
 - c. Current/voltage/frequency on the three phases according to the protection tripped.
 - d. Date, time and progressive number of trips.
- I. 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.
- J. 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.
 10. Provided with trip log, Electronic operations counter, wave form capture and breaker health monitoring.
- K. Arc quenching device protection shall be provided for all distribution boards rated 4000 A and above. The arc quenching device shall be type tested according to IEC 60947-9-1:2019 or latest with clearing time, 2 ms.
1. Arc-fault mitigation time in an assembly acc.to IEC/TS 63107:2020 sub-clause 10.101.4. At the lowest threshold setting, acc.to IEC/TS 63107:2020 sub-clause 10.101.2
- L. 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.
- M. 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.
- N. Draw out 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.
- O. 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.

Commented [BG4]: Per Eaton recommendation

- P. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of draw out mechanism.
- Q. Operating Handle: One for each circuit breaker capable of manual operation.
- R. Electric Close Button: One for each electrically operated circuit breaker.
- S. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.
- T. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.
- 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. 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.

ACCESSORIES

- Y. 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.
- Z. 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.
- AA. Spare-Fuse Cabinet: Identified and compartmented steel box or cabinet with lockable door.
- BB. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

PROTECTION DEVICES INTERPOSING RELAYS AND INTER TRIPPING RELAYS

- CC. The Protection trip units shall be micro-processor-based type for highest protection accuracy against overload, short time, instantaneous and earth fault. They shall be integrated as part of the circuit breaker. The trip unit shall have a wide adjustment range to allow flexibility of the setting on site. The trip unit shall measure the true RMS value of any waveform of current. The trip unit shall be equipped with a push to reset mechanical indicator, for anti-pumping function.
 - 1. Trip units shall have communication/test port for checks on electronic and tripping mechanism operation.
 - 2. The following monitoring functions shall be integral parts of electronic trip units:

- a. Prewarning LED for load indication lighted above 90 % of the adjusted threshold I_r
 - b. Warning LED for load indication lighted above 105 % of the adjusted threshold I_r
 - c. Measurement Function:
 - d. The trip unit shall offer measurement (including energy).
 - e. Breaker shall have embedded measurements with Active energy metering Class 2 for metering applications.
- 3.
4. A minimum of the following measurements shall be included in the ACB protection trip unit.
- a. Currents, Voltage, Power , Energy
 - b. THDi, THDv KVA, KVAR & Power factor
5. Accuracies of the entire measurement system, including the sensors: shall be.
- a. Current: 1.0%
 - b. Voltage: 1.0 %
 - c. Power and energy
- DD. Manufactured to IEC / BS EN 60255 – 1 Measuring relays and protection equipment's common requirements.
- EE. Housing
- 1. Flush panel-mounting type.
 - 2. House all protection relays, excluding motor protection relays, in draw out cases.
- FF. Reset type
- 1. Interposing relays -Automatic reset type
 - 2. Inter tripping relays -Manual reset type

Commented [BG5]: A and B appended per Eaton suggestion

VOLTAGE SENSING RELAYS

- GG. 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.

TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES

- HH. Provide a panel mounted heavy duty, spring return trip/close switch on circuit breakers fitted with solenoid or motorized spring closing mechanisms.
- II. 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.
- JJ. 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

CURRENT TRANSFORMERS

- KK. Comply with BS EN 61869-2
- LL. Provide separate current transformers for each protection device and instrumentation.
- MM. 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.
- NN. Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.
- OO. Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

INSTRUMENTS AND METERS

- PP. Standards
 - 1. Comply with BS EN 60051 for voltmeters, ammeters, wattmeter's, 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.
- QQ. Protect wiring to voltmeters by separate fuses.
- RR. Protect potential coils of wattmeter, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.
- SS. Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated.
- TT. Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full-scale deflection.
- UU. Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

INDICATOR LIGHTS

- VV. Supply lamps of same type throughout. Provide indicator lamps with lamp test facility.
- WW. Supply interchangeable indicators for respective units.
- XX. Protect wiring to indicator lamp units by separate cartridge fuses.
- YY. Lens color in accordance with BS EN 60073.
- ZZ. 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)

AAA. 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

FRAMEWORK

BBB. 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.

CCC. Finish

1. Frameworks mounted inside the building manufacturer's standard finish.
2. Frameworks mounted outside building hot dip galvanized to BS EN ISO 1461.

DDD. Supply cadmium or zinc-electroplated bolts, nuts, washers and screws.

CABLE TERMINATIONS

EEE. Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated.

FFF. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.

GGG. Provide nonferrous metal glanding plates for single core cable terminations

AUTOMATICALLY CONTROLLED CAPACITOR BANKS

HHH. Refer to section 263533 for details.

TRANSIENT VOLTAGE SUPPRESSION DEVICES

III. Surge Protection Device Description: IEC 61643-11 compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sinewave 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. Integrals 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.

JJJ. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase Surge protection devices. The Withstand Capabilities: IEC 61643, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

Withstand Capabilities: IEC 61643, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

KKK. 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.

LLL. 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.

SWITCHGEAR AND CONTROLGEAR ACCESSORIES

MMM. Provide switchgear and control gear accessories as shown on drawings/schedules.

NNN. Provide locks and padlocks, one for each ACB..

OOO. Provide insulating mats in front of each main LV switchgear.

PPP. Provide switchgear operating tools for each main LV switchgear as manufacturers standard.

QQQ. Provide 5 spare fuses/, s/MCB,s for each type and rating of protective device.

FIXING

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

ACCESS:

SSS. Ensure that clearance in front of switchgear and control gear is not less than 1m, or as indicated.

MARKING AND DRAWING:

TTT. Number terminals, cables, and component parts to correspond with manufacturer's certified drawings.

CABLE TERMINATIONS:

UUU. 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!

LOGGING MULTIMETERS

VVV. Provide LCD display logging multimeters on each section of LV Switchgear, 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)

WWW. 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)

XXX. Readings to be selected via keypads on the front of the multimeters.

YYY. The meters shall provide true RMS readings irrespective of waveform, to class 1.0 accuracy.

ZZZ. 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.

AAAA. 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.

BBBB. 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.

CCCC. 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.

DDDD. Networking shall be carried out using RS485 protocol or another suitable means of transferring data accurately and immediately.

EEEE. 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.

FFFF. The contractor should not underestimate the importance of this facility and the required reliability of its operation.

EQUIPMENT ISOLATORS

GGGG. Where equipment is not provided with integral isolator, provide isolator to allow safe operation and maintenance of equipment including all motors, hot water cylinders, fan coil units, mechanical services, etc

HHHH. All hot water cylinders shall be provided with double pole isolators for single supplies and triple pole and neutral isolators for three phase supplies, to isolate all live conductors.

COMPONENTS

IIII. Instrument Transformers: Comply with BS EN 61869-2.

1. Potential Transformers: Secondary voltage rating of 110V and accuracy class of 0.5/3 with burdens of W, X, and Y.
2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

JJJJ. Multifunction Digital-Metering Monitor: Provide Microprocessor-based unit suitable for three- or four-wire systems for each main and sub main LV panel, and with the following features:

1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600V.
2. Switch-selectable digital display with the following features:
 - a. Phase Currents, Each Phase: Plus, or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus, or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus, or minus 1 percent.
 - d. Three-Phase Real Power: Plus, or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus, or minus 2 percent.
 - f. Power Factor: Plus, or minus 2 percent.
 - g. Frequency: Plus, or minus 0.5 percent.
 - h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus, or minus 2 percent.
 - i. Accumulated energy, in kilowatt hours, plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
3. Provide Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to Division 26 Section "Electrical Power Monitoring and Control."
4. Mounting: Display and control unit that is flush or semi-flush mounted in instrument compartment door.

KKKK. Relays: Comply with IEC 60044-1, integrated digital type; with test blocks and plugs.

LLLL. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with IEC 60044-1.

1. Install cable termination compartments in each phase of circuit.
2. Coordinate rating with circuit voltage.

MMMM. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.

NNNN. Fungus Proofing: Permanent fungicidal treatment for switchgear interior, including instruments and instrument transformers.

OOOO. Control Power Supply: DC battery system.

PPPP. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Conductors are sized according to manufacturer's requirements for duty required.

IDENTIFICATION

QQQQ. 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.

RRRR. 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.

C. EXECUTION

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.

INSTALLATION

B. 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.

- C. 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. Seismic tested product shall comply with IEC / EN 60068 OR IEEE 344 – 2017 , whichever is stringent. 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."
- D. 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.

IDENTIFICATION

- E. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- F. 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.
 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

CONNECTIONS

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

FIELD QUALITY CONTROL

- I. 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.

- J. 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.
- K. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- L. Perform the following field tests and inspections and prepare test reports:
1. Perform each visual and mechanical inspection and electrical test stated in IEC 61439, and as required by local Utility company regulations. Certify compliance with test parameters. Perform IEC 61439, 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.
- M. 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.

ADJUSTING

- N. 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).

CLEANING

- O. 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 the original finish.

PROTECTION

- P. 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.

DEMONSTRATION

- Q. 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."

2.2. SCHEDULE OF SWITCHGEAR MANUFACTURERS

Source	Origin	Contact
(ABB)	KSA / EUROPE	
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 / Europe	
Eaton	KSA / Europe / USA	
RAWABI	KSA	
USSG_United Tech for Sub and S.Gear	KSA	
Or An Approved Equal		

2.3. SCHEDULE OF LOW VOLTAGE CIRCUIT BREAKERS MANUFACTURERS

Source	Origin	Contact
ABB SACE SPA	Italy	
Cutler Hammer USA	USA	
Siemens	Germany	
Eaton	USA / Europe	
Legrand	Italy	
General Electric	USA	
L&T Electrical & Automation	India	

ALBAWANI PROJ. NO. 62320
GA PROJ. NO. 2159017-003

LUCID MOTORS
AMP2 CBU
KAEC, JEDDAH - KSA

Source	Origin	Contact
Merlin Gerin	France	
Federal Electric	Turkey	
Schneider Electric	KSA / France	
Mitsubishi Elect. Corp.	Japan	
LG (LS)	South Korea	
Or An Approved Equal		

END OF SECTION 262300