SECTION- 2.2

HIGH VOLTAGE SWITCH GEARS

2.2.1 PREAMBLE

A. The scope of the HV switchgear cover the switchgear described in the contract document.
B. The HT switchgear shall serve primary electrical switchgear comprising of HT isolator, transformer and LT switchboards
C. The HT switchgear shall be provided with over current and earth fault protection and will be floor mounted.
D. Each breaker in the HT switchgear shall have the ability to monitor circuit breaker open, circuit breaker closed and auxiliary power supply and shall be of self powered microprocessor type and earth fault relay equipment.
E. The Contractor shall ensure the dimensions & weight of their switchgear shall be such that they may fit within the service elevator and can be routed from external to its final location along corridors.
F. **Electrical Service Provider** shall own and maintain the equipment and as such the Contractor shall prepare detailed technical submittals for approval by LODHA. A separate technical submittal shall also be required for submittal and approval to the Mumbai Chief Electrical Officer. The Contractor shall liaise with both parties to ensure the equipment is designed, manufactured and installed in line with relevant code and good practice. Submittal of this information shall be in line with the project schedule to achieve approval of the HT network.
G. Ensure all equipment and systems are to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.
H. The Contractor shall install systems strictly in line with manufacturers recommendations and shall ensure all works are in line with recommended EMC mitigation measures in IEC 61000-5 (Installation and mitigation guidelines).

2.2.2 SUMMARY

A. General: This section of specification defines the technical requirements for --KV Switchgear, as specified in accordance with the requirements of the Contract Documents and codes having jurisdiction.
B. Scope of work: Design, Manufacture, Assembly, Inspection, Testing at Manufacturer's Works, Delivery to Site, Installation and Commissioning of the High voltage Switchgear, complete as specified in the contract documents meeting the intents of the Tender to make the system completely operational. This specification shall be used in conjunction with all drawings, Schedule of requirement and BOQ attached. .
C. Switchgear with the following optional components, features, and accessories:
    - Aluminium tin-plated main bus.
    - Communication modules.
    - Potential free contacts.
    - Analogue instruments.
    - Relays.
    - Surge arresters.
    - Provisions for future devices.
    - Fungus proofing.
    - Mimic bus.

The equipment shall comply with the technical specification and guaranteed technical particulars specified herein. Any deviations to the specification shall be indicated clearly clause by clause

In the event of sectional delivery of the panels, the panels shall be tested for its integrity and the high pot test shall be carried out as per code.

A. Codes and Standards: The High voltage Switchgear shall be designed, manufactured and tested in accordance with the latest applicable sections of the IEC/BS/IS codes. Since IS Standards are originated from IEC standards, technical requirements listed in the latest IEC standards supersedes IS standards requirements which do not cover them.
B. Conflicts between referenced documents shall be identified to the Lodha **REPRESENTATIVE** in writing for resolution.

Circuit Breakers	IEC 62271, BS 5311 , IS 13118
Metal Enclosed switchgear	IEC298 , BSEN 62271-102 , IS 3427
Current Transformers	IEC 60044 , IS 2705
Voltage Transformers	IEC 60044, IS 3156
Arrangement for Switchgear Busbars, Main Connections and Auxiliary wiring	BS EN 62271-1, IEC 62271-1:2007, IS 5578, 11454,
Busbar Support insulators	IS 2544 , BS EN 60168:1995, IEC 60168:1994
Degree of Protection	IS/IEC 60947 , BSEN 60529
Electrical Relays for Power system protection	IS 3231, 3842 , BS EN 142 , IEC 60255
Electrical Indicating Instruments	IS 1248 , BS 89-9, EN 60051
High Voltage Fuses	IS 9385 , BS 2692 , IEC 60282
AC Electricity Meters	IS 1248, 8540, BS EN 62053-11:2003, IEC 145, 211
Specification for rods and bars for electrical purposes	IS 614
Code of practice for phosphating iron and steel	IS 6005 / BS EN ISO 9717:2013
Alternating current Switches for voltages above 1000 V	IS 9920 / IEC 62271
Toggle switches	IS 3452 / BS EN 60669
Earthing	IS 3043
Code of practice for selection, installation and maintenance of switchgear and control gear	IS 10118
Control switches	BSEN 60947

In general the order of precedence is: -

- Drawing(s)
- This specification
- Reference standards

2.2.3 SUBMITTALS

A. Product Data: For each type of switchgear and related equipment, include the following: Rated capacities, operating characteristics, furnished specialties, and accessories for individual [**interrupter switches**] [**circuit breakers**]. Time-current characteristic curves for over current protective devices, including [**circuit-breaker relay trip**] [**fusible**] devices & weight of the sections.

B. Danger/Warning labels shall have white lettering on a red background and shall be in English and Hindi. All other labels shall have black lettering on a white background. All labels shall be fixed by screws or rivets.

C. Shop Drawings: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
   - Tabulation of installed devices with features and ratings.
   - Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
   - Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
   - Floor plan drawing showing locations for anchor bolts [**and levelling channels**].
   - Ensure all the clearances inside the Switchgear are as per IS/BS.
   - Current ratings of buses.
   - Short-time and short-circuit ratings of switchgear assembly.
   - Nameplate legends.
   - Mimic-bus diagram.
   - Wiring Diagrams: For each type of switchgear and related equipment, include the following:
     1. Power, signal, and control wiring.
     2. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
     3. Schematic control diagrams.
     4. Diagrams showing connections of component devices and equipment.
     5. Schematic diagrams showing connections to remote devices
   - Seismic-Restraint Details: Signed and sealed by a qualified professional engineer.
     1. Design Calculations: Calculate requirements for selecting seismic restraints.
     2. Detail fabrication, including anchorages and attachments to structure and to supported equipment.
   - Spare part List.
   - Service person Contact Details
   - Documents shall comprise but not limited to the following :

A : Indicates that the documents to be submitted 7 days after the release of a purchase order

B : Indicates the documents to be submitted 10 days after the approval of the drawing.

			Required after Purchase Order			
	Engineering Data	Reqd With Bid	For approval		As built	
			Qty	Schedule Days	Qty	Schedule Days
1	Outline dimension drawing (required PO/ Contract issuance)	Yes	4	A	6	B
2	Heat dissipation calculations (required PO/ Contract issuance)	Yes	4	A	6	B
4	Cross sections with part description & Foundation dwg (required PO/ Contract issuance)	Yes	4	A	6	B
4	Completed Data Sheets (required PO/ Contract issuance)	Yes				
5	Logistics Schedule and Reassembly plan	Yes	4	A	6	B
5	Bill of Materials for scope of Supply (required PO/ Contract issuance)	Yes	4	A	6	B
6	Installation Drawings, Operation / Maintenance Manual				4	With dispatch
7	Priced Spare List for 2 years service	Yes				
8	Terminal point schedule / drawing		4	A	6	B
9	Control Schematic Diagram	Yes	4	A	6	B
10	Type test certificate for short circuit				6	At the time of

	breaking current of circuit breaker					inspection
11	Type test certificate for short circuit withstand.				6	At the time of inspection
12	Inspection Test Reports		4	A	6	At the time of inspection
14	Test Certificates for bought out items				6	
14	Quality Test Plan		4	A	6	

D. Manufacturer Seismic Qualification Certification: Submit certification that High voltage Switchgear, accessories, and components will withstand seismic forces (see 1.5 below). " Include the following:
   1. Basis for 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."
      b. 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 centre 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.

2.2.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing switchgear similar to those indicated for this Project and with a record of successful in-service performance.

B. Local Representative: Provide evidence that proposed equipment manufacturer has a locally established and authorized organization which can be called upon for professional advice and maintenance as may be required, and which can immediately supply spare parts to support day to day and emergency maintenance requirements. Failure to satisfy the Engineer may disqualify a manufacturer.

C. Service center: Capable of providing training, parts, and emergency maintenance and repairs at the Project site within 2 hours maximum response time, round-the-clock, 7 days a week.

D. Standards: Installation is to comply with relevant IEC and NEMA or equal Standards. Materials and components are to be manufacturer's latest commercially manufactured design, and the standards used are to be approved prior to manufacture.

E. Radio frequency interference (RFI) suppression is to be in accordance with CISPR and IEC 50091-2 recommendations.

F. Products shall be sourced either directly from manufacturer, or from authorized agent/representative.

G. Warranty: ---As per SCC & GCC

H. All MV equipment shall in general comply with the basic requirements of state electricity board.

I. Only certified technical personnel from duly certified agencies/firms shall be permitted to carry out the installation, testing and commissioning works.

2.2.4 INSPECTION AND TESTING AT MANUFACTURER PREMISES

A. The **Contractor** shall provide test certificates for each design and rating for Type and Routine test carried out on the High voltage Switchgear. Test shall be those listed in the relevant standards. Type test certificate(s) shall be provided.

B. The Lodha **Representative** reserves the right to witness the following test:-
   - Routine tests on all equipment as specified in the relevant standards (The Contractor shall arrange for one routine test to be witness apart from FAT).

C. The **Contractor** shall give two weeks notice of tests prior to commencement.

D. The Lodha **Representative** reserves the right to inspect High voltage Switchgear at the **Contractor**'s works at any time prior to despatch to prove compliance with specification.

E. All the expenses towards the Inspection or witnessing the testing of equipment by the Lodha **Representative** will be in the **Contractors** scope excluding boarding and lodging of Lodha Representative.

F. Test document to be furnished by the Manufacturer shall be as mentioned below.
   - For tests designated by symbol "A", the contractor shall furnish valid test certificates.
   - For tests designated by symbol "B", Test shall be carried out in presence of the Purchaser or Purchaser's authorized representative.

Sr.	Test Particulars (IEC 62271-1 / BS EN 62271-1)	Type Test	Routine Test
a	Assembly inspection	-	B
b	Operation test	-	B
c	Temperature rise tests for main circuits	A	-
d	Insulation Test	A	B
e	Power frequency voltage tests on main & auxiliary circuits	A	B
f	Impulse voltage test	A	-
g	Verification of making & breaking capacity of circuit breaker	A	-
h	Short time current withstand test on main circuit	A	-
i	Short time current test on earthing circuits	A	-
j	Verification of mechanical endurance of circuit breakers	A	-
k	Operation tests of auxiliary electrical devices	-	B
l	Measurement of resistance of main circuit of circuit breakers	-	B
m	HV Test	A	B
n	Verification of Wiring	-	B

2.2.5 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements (and type testing certification from ASTA/KEMA, manufacturers offering products that may be incorporated into the Work include, but are not limited to those listed in Section G.

2.2.6 HV SWITCHGEAR CONSTRUCTION

HV switch gear shall have followings:-

A. Metal-Enclosed Interrupter Switchgear:
- Ratings: Comply with standard ratings designated in above standard for maximum-rated voltage specified.
- Interrupter Switches: Stationary, gang operated and suitable for application at maximum short-circuit rating of integrated switchgear assembly.
- Rating: **refer to SLDs**, continuous duty and load break.
- Duty-Cycle, Fault Closing: **As noted on SLDs**
- Phase Barriers: Full length of switchblades and fuses for each pole; designed for easy removal; allow visual inspection of switch components if barrier is in place.
- Protective Shields: PI type to live components and terminals.
- Fuses: De-energized if switch is open.

- Electro-Mechanical Interlock: Prevent opening switch compartment door unless switchblades are open, and prevent closing switch if door is open.
- Window: Permit viewing switchblade positions if door is closed.
- Power Fuses: Comply with the following and with applicable requirements in NEMA SG 2 / IEC 60282-2:
- Indicator: Integral with each fuse to indicate when it has blown.
- Mounting: Positively held in position with provision for easy removal and replacement from front without special tools.
- Current-Limiting Fuses: Full-range, fast-replaceable, current-limiting type that will operate without explosive noise or expulsion of gas, vapour, or foreign matter from tube.

B. Metal-Clad, Circuit-Breaker Switchgear

- Ratings: Comply with IEEE C37.04..
- Circuit Breakers: Three-pole, single-throw, electrically operated, draw out-mounting units using three individual, **SF6 insulated vacuum quenched interrupte**r modules and including the following features:
  - Designed to operate at rated voltage to interrupt fault current within its rating within [**three**] [**five**] cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to-ground voltage of the system.
  - Contact-Wear Indicator: Readily accessible to field maintenance personnel.
  - Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.
  - Current Rating of Main Circuit Breaker: **As per the schematic.**
  - Continuous Current Rating of Feeder Circuit Breaker: As per schematics.

C. **Operating Mechanism:** Motorised Breaker, electrically charged, mechanically and electrically trip-free, stored-energy operated.

- Closing speed of moving contacts to be independent of both control and operator.
- Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment.
- Control Power: [**110**] Volt Dc for closing and tripping.
- Provide shunt trip capability independent of over current trip.

***Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.**

D. Indoor Enclosure: Interlocked based LSC2A with PM partition class, IAC A FLR 50 kA, 1 s (to IEC 622771-200), 2mm Sheet Steel.

Each compartment shall have the following features:

a. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
b. Louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.
c. Hinged front door with locking provisions.
d. Interior light with switch.
e. Duplex receptacle.
f. Power for heaters, lights, and receptacles to be provided

E. Retain subparagraph and associated subparagraphs below for weatherproof internal aisle construction.
F. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.
G. Bus Transition Unit: Arranged to suit bus and adjacent units.
H. Incoming-Line Unit: Arranged to suit incoming line.
I. Outgoing Feeder Units: Arranged to suit distribution feeders.
J. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.
K. Key Interlocks: Arranged to effect interlocking schemes indicated.
L. Provisions for Future Key Interlocks: Mountings and hardware required for future installation of locks, where indicated.

2.2.7 COMPONENTS

1. Main Bus: [Aluminium]; full length of switchgear.
   All nuts & bolts shall be a uniform length and Cadmium/ Tin coated. Special care shall be taken for this item and manufacture's recommendation shall be followed.
   Ground Bus: Aluminium, silver plated or Aluminium tin plated.
   Bus Insulation: Covered with flame-retardant insulation.
   Instrument Transformers: Comply with IEEE C57.13.
   Potential Transformers: Accuracy class of 0.4 with burdens of W, X, and Y.
2. Coordinate subparagraph below with Drawings.
3. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.
   Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems, with the following features:
   Inputs from sensors or 5-A current-transformer secondary and potential terminals rated to 600 V.
   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 megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
4. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication. Co-ordinate for interface details with other system contractors. Provide provision as per requirement.
5. Potential free contacts - or soft integration port with relevant interface software as required - shall be provided for BMS interface.
6. Mounting: Display and control unit that is flush or semi flush mounted in instrument compartment door.
7. Protective Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.
8. All the Control cables & the Power cables shall be FRLS.
9. All the panel section shall have lifting lugs/ eyes.
10. Control Power Supply: 110volt DC battery system.

2.2.8 PROTECTIVE RELAYS, DEVICES AND AUXILIARIES

A. Protective Relays: Solid state, static, sealed type, having high immunity to electric field, with modular design, suitable for operation at 40 deg. C ambient temperature, mounted in dust-tight steel enclosures with cover, with self supervision system test buttons for testing without removing from case, and built in self regulated power supply unit and installed where shown on the Drawings. Adjustments and settings are to be accessible and visible from front of relay.

B. Solid State Relay: Provide with D.C. power from the switchgear power supply, and provide with a pilot LED which is to be lit under healthy operating conditions. Relay is to be provided with a self supervision system which upon power supply interruption or a fault condition is to switch off the LED and to initiate an alarm. The rated current and voltage for current & voltage sensing relays are to match that of the corresponding current and voltage transformers of the switchgear respectively. The continuous output rating of the output contacts is not to be less than 10A.

C. Interference and test voltages of the solid state relays are to be as follows:

Insulation test voltage, terminal groups between themselves and the relay frame work as per IEC 60255-5: 2 kV, 50 Hz, 1 min.
Impulse test voltage, terminal groups between themselves and the relay frame work as per IEC 60255-3: 5 kV, 1.2/50 micro sec.
High frequency test voltage, terminal groups between themselves and the relay framework as per IEC 60255-6: 2.5 kV, 1MHZ.

D. Over Current Relay: 3 phase, non-directional, solid state type with two setting stages as follows:

Low setting stage for overload protection with current setting range of 50 percent to 250 percent of rated current and adjustable definite time and inverse time operation modes as per IEC 60255-3.
High setting stage (instantaneous) for short circuit protection with current setting range up to 4000percent percent of rated current.

E. Earth fault relay, non-directional, solid state type with two setting stages as follows:

- Low setting stage of 10 percent to 80 percent of rated current and adjustable definite time and inverse time operation modes as per IEC 60255-3.
- High setting stage (instantaneous) with current setting range up to 1000percent percent of rated current.

F. Restricted earth fault relay, on secondary of distribution transformers having a solidly grounded neutral, is to be high impedance, instantaneous differential type, current calibrated from 1percent percent - 20percent percent of phase current.

G. Under-Voltage And Over Voltage Relays: Single phase, solid state definite time type with the following setting ranges:

- Under voltage relay: 6 percent to 9 percent of rated voltage and 0.2 to 6 sec time delay.
- Over voltage relay: 80 percent to 9 130 percent of rated voltage and 0.2 to 6 sec time delay.

H. Under-Voltage And Phase-Sequence Relays: Under-voltage relay is to be time-delay type, with selectable time/voltage characteristics 0.1 - 1.0 seconds for settings between 60percent and 90percent of normal voltage, sensed at VT secondary. Combined under-voltage and phase-sequence relays are to be provided where specified or shown on the Drawings. Phase-sequence relay is to prevent operation (closing) of respective circuit breaker in case of non-conformance of phase rotation.

I. Auxiliary Relay: Suitably rated with sufficient number of N.O. and N.C. contacts for operation in conjunction with protective relays or control/interlocking requirements. Relay is to have two N.O. and two N.C. spare contacts.

J. Control power supply is to be complete system, including main LV switch, battery charger, sealed lead acid batteries with 10-year lifetime, racks and connectors, factory assembled and completely pre-wired to minimize field installation.

K. Auxiliary LV power is to be obtained from a self-contained control power transformer unit supplied with the switchgear, when specified or shown on the Drawings. Where two alternate sources of LV power are shown/ specified, an automatic transfer switch with manual over-ride and off- position is to be provided.

L. Batteries: Nickel cadmium type, of capacity sufficient to supply all MV switchgear auxiliary loads, relays, coils, lamps, alarms etc. for 8 hours, to close all circuit breakers in rapid succession, and trip all circuit breakers simultaneously with the charger off. Battery is to be heavy-duty type with transparent containers, maximum and minimum electrolyte level indicators and alarm initiating relay in case of D.C. output failure.

M. Battery: High rate discharge, heavy duty, industrial, high impact resistant, clear plastic encased, sealed lead-acid (gas recombination) type cells with automatically reclosing explosion proof safety vents.

1. Electrolyte specific gravity is not to exceed 1.25 when fully charged at 25 deg. C (77 deg. F).
2. Ampere-hour rating is to be sufficient for emergency period specified with all inverters operating at full rated output, to a discharge limit of not less than 1.65 V per cell.
3. Cells are to be normally maintained at 2.25 V per cell.
4. Guaranteed life is not to be less than 10 years, with a capacity drop down to not less than 80 percent under normal expected service.
5. Date of manufacture to be stamped on each battery

N. Terminal blocks to be provided are to be made of porcelain or certified high temperature (105 ^{0} C), non-inflammable, non-toxic hydrocarbon material. The materials are to be certified free of halons and fluorocarbons.

O. Terminal blocks used shall be 500 V class and certified by ASTA/ KEMA.

P. All terminals shall be of nickel-plated electrolytic copper and provided with clear identification labels to Engineer's approval.

Q. All control switches provided shall have KEMA / ASTA certification.

R. All control wiring shall be color-coded and shall be crimped with tinned copper lugs at all terminations. Bare terminals shall be shrouded with non-combustible materials.

S. All holding devices and hardware used shall in general be of the "captive" type, which cannot fall off accidentally when loosened.

ABBREVIATION FOR RELAY TYPE & THEIR REFERENCE

A. Specific Requirement (ANSI, IEEE C37.112 and IEC 60255-4):

1.	ANSI Type Designation	94	
	Function		Anti-pumping
	Type		Self reset
	No. of contacts		As required for control scheme
2.	ANSI Type Designation	95	
	Function		Trip Circuit Supervision in breaker On/OFF conditions
	No. of contacts		As required, to initiate Trip Circuit Unhealthy alarm
4.	ANSI Type Designation	86	
	Function		High speed Trip and Lock Out
	No. of contacts		As required. Hand reset type.
	Operating time		less than 20 ms
4.	ANSI Type Designation	51	
	Function (IEC: *I*p, *I*Ep)		4 Pole IDMT non-directional over-current elements
	Characteristics		Normal Inverse/Very Inverse/Extremely Inverse- site selectable
	Setting Range		
	- Current		50-200% of rated current
	- Time multiplier		0-1 sec in 0.2 steps.
5.	ANSI Type Designation	51N	

	Function (IEC: *I*p, *I*Ep)	1 Pole IDMT non-directional earth fault element, for use in residual Circuit of CTs
	Characteristics	Normal Inverse/Very Inverse/Extremely Inverse- site selectable
	Setting Range	
	- Current	20-80% of rated current
	- Time Multiplier	0-1 sec.
6.	ANSI Type Designation 51G	
	Function	1 Pole IDMT non-directional earth fault element for use in transformer neutral grounding circuit
	Characteristics	Normal Inverse/Very Inverse/Extremely Inverse- site selectable
	Setting Range	
	- Current	20-80% of rated current
	- Time Multiplier	0-1 sec in 0.2 steps.
7.	ANSI Type Designation 64R	
	Function	The relay shall be high impedance, circulating current type, stabilized against external faults. Over-voltage limiting devices shall be provided as required. The relay shall be used for Restricted Earth Fault protection.
	Operating time	Less than 20 ms
	Stability	Stable against external faults
	Setting Range	
	- Current	10-40% of rated current
8.	ANSI Type Designation 87	
	Function	Biased Differential protection with 2^{nd} and 5^{th} harmonic restraint
	Bias range	10-40%
	Application	Universal (for any vector group) The scheme shall not require ICTs for phase shifting or CT ratio correction. This facility shall be built into the relay.
	Stability	Stable against external faults
	Operating time	Less than 20 ms
9.	ANSI Type Designation 50	
	Function (IEC: *I*>, *I*>>, *I*>>>, *I*E>, *I*E>>, *I*E>>>)	4 Pole, highset, instantaneous overcurrent protection immune to 4^{rd} Harmonic current
	Characteristics	Instantaneous
	Setting Range	
	- Current	400-1600% of rated current
	Operating time	Less than 20 ms
10.	ANSI Type Designation 50N	
	Function (IEC: *I*>, *I*>>, *I*>>>, *I*E>, *I*E>>, *I*E>>>)	1 Pole, instantaneous, earth fault overcurrent protection
	Characteristics	Instantaneous
	Setting Range	
	- Current	20-80% of rated current
	Operating time	Less than 20 ms
11.	ANSI Type Designation 25	
	Function	**Check synchronization**

2.2.9 CURRENT TRANSFORMER

a. The current transformer shall comply with IEC 60185.

b. The current transformer shall be with double wound secondary voltage windings and shall be provided with a reversible label on the current transformer chamber to indicate which ratio is in use.
c. The current transformer shall be used exclusively for operating the kWh meters and shall conform to accuracy class 0.2 S of IEC 60044-1 for measuring current transformers.

2.2.10 VOLTAGE TRANSFORMER

a. The voltage transformer shall comply with IEC 60186.
b. Voltage transformers shall be epoxy insulated. The voltage transformer shall be protected on high voltage side by providing renewable fuses which shall be easily accessible. Fuses shall be provided also on the secondary side and the star point of the secondary side shall be earthed through a detachable link. Voltage transformers shall confirm to accuracy class 0.2 of IEC 60186 for measuring voltage transformer.

2.2.11 LABELS

A. HV Switchgear and associated equipment shall be identified by labels. Label designation shall be in accordance with the BOQ & Drawings. All removable components shall have a circuit label.

Description	Requirement
Material	Anodised Aluminium/ Trafolite
Engraving	Black engraving on white background
Size of the Label	To suit application / importance
Fixing	With self-tapping screws
Use	Main Panel, feeders and individual devices

B. Labels shall have black characters on a white background and be made of a non-corrodible material. Danger/warning labels shall be engraved with black letters on a yellow background, in English and Hindi languages.
C. Labels shall not be affixed by adhesive.

2.2.10 DELIVERY, STORAGE, AND HANDLING

A. In case handling obstacles are present, deliver in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Store so condensation will not form on or in switchgear.

C. Apply temporary heat where required to obtain suitable service conditions.

D. Handle switchgear using factory-installed lifting provisions.

E. Install certified “shock-guards’ on the equipment before shipping from the factory and to be retained in place till unpacked at site and inspected by Engineer, to ascertain whether the “shock-guard” has been activated by any shock/impact during shipment.

2.2.11 COORDINATION

A. Coordinate layout and installation of switchgear with other construction and room dimensions to ensure that a working safety clearance of at least 1100mm is maintained around the equipment unless specifically permitted otherwise. Advise the Engineer in case of conflict.

B. Coordinate size and location of concrete or mounting bases. Concrete, reinforcement, and formwork requirements.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Ensure sufficient space to remove and replace the equipment and include for all necessary civil works such as ramp, grading, etc.

2.2.12 EXECUTION

2.2.12.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected. Factory QA/QC checklist duly signed and stamped should accompany each supply

2.2.12.2 INSTALLATION

A. Anchor switchgear assembly to 4-inch (100-mm), channel-iron sill embedded in [**floor**] [100mm **concrete base**] and attach by bolting.
B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

2.2.12.3 CONNECTIONS

A. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values. Provide tabulated tightening values after installation and include calibration certification for torque tightening wrench. As required part/complete process shall be witnessed by Lodha Representative.

2.2.12.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows (All process to be witnessed by Lodha Representative):
1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
    1. Inspect switchgear, wiring, components, connections, and equipment installation. [**Test and adjust components and equipment.**]
    2. Remove and replace malfunctioning units and retest.

B. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear, Remove front and rear panels so joints and connections are accessible to portable scanner.

2.2.12.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

2.2.12.6 DEMONSTRATION

A. General: Manufacturer’s factory-authorized service representative to train Owner’s personnel in the operation of the Unit.

B. Equipment: Check operation of each unit with Owner's personnel present and before Substantial Completion. Determine that operational systems and devices are functioning properly.

C. Instruction: Instruct Owner's personnel in proper use, maintenance, adjustment, and repair of each system.

2.2.12.6 THE FOLLOWING BEFORE HANDING OVER:

1) All Technical Schedules duly filled-in and signed.
2) O&M MANUAL WITH BELOW DETAILS
   a. Outline General Arrangement, Sectional and Detail drawings for the Switchgear.
   b. Drawing showing the construction of the Switchgear and terminal arrangements with details of all accessories.
   c. Single Line Diagram showing all the auxiliary devices and their connection
   d. Details of Cable termination and fittings
   e. Details of anti-corrosion protection and painting specification
   f. Setting up Commissioning and Operating Instructions
   g. Maintenance Instructions including Schedules for preventive maintenance & Trouble Shooting Procedure
   h. Detailed Technical Specification & Catalogue
   i. Testing Schedule Procedures & All Test results duly signed off by the Lodha Representative. Complete recommended Spare part List including manufacturer's name and Catalogue Number with all required re-ordering information.
   j. A set of required maintenance tools.
   k. One set of Circuit Breaker replacement gantry/carriage.

DATA SCHEDULE FOR RING MAIN EQUIPMENT (To be filled by Contractors/Bidders)

A. RING MAIN UNITS/LOAD BREAK SWITCHES

Sr No	DESCRIPTION		LOAD BREAK SWITCH	CIRCUIT BREAKER
1	Rated Voltage	kV		
2	Rated Normal Current	A		
3	Busbar Rated Current	A		
4	Short-time (3s) current (minimum)	kA		
5	Number of Phases	-		
6	Insulating Medium	-		
7	Method of closing	-		
8	Method of opening	-		
9	Cable testing facility	-		
10	Padlocking facility	-		
11	Earth Fault Indicator and Current Transformer (where applicable)	-		
12	Monitoring of open & close status of switch	-		
13	Monitoring of vacuum / SF6 gas pressure	-		

(x) - To be provided

(-) - Not required
(1) - For a non-extensible ring main unit only one pressure indicator is sufficient.

A. RING MAIN UNITS/LOAD BREAK SWITCHES (cont'd....)

Sr No	DESCRIPTION	LOAD BREAK SWITCH	CIRCUIT BREAKER
14	**Cable:** (Cable is not in the scope of supply) a) Type - b) Size (cable box shall be to suit the cable) -		

(x) - To be provided
(-) - Not required

B. METERING UNITS

Sr No	DESCRIPTION		METERING UNIT
1	Rated Voltage	kV	
2	Busbar Rated Current	A	
3	Short-time (3s) current (minimum)	kA	
4	Number of Phases	-	
5	Insulating medium	-	
	METER		
6	Accuracy Class	-	
7	Type	-	
8	Cyclometer register:		
	a) Number of digits	-	
	b) Reading of last digit (extreme right)	- kWh	
9	Anti rotation device	-	
	VOLTAGE TRANSFORMER		
10	No. of Phases	-	
11	Accuracy Class	-	
12	Primary voltage	kV	
13	Secondary voltage	V	
14	Fuses on HV winding	-	
15	Fuses on LV winding	-	
16	Rated burden	VA	

(x) - To be provided.
(-) - Not required

B. METERING UNITS (cont'd....)

Sr No	DESCRIPTION	METERING UNIT
	CURRENT TRANSFORMER	
17	Accuracy Class -	
18	Primary rated current A	
19	Secondary rated current A	
20	Rated burden VA	
21	**Wiring Identity codes**	
	a) A.C. Phase Connections -	
	b) Connections to Earth -	
	c) A.C. Neutral connections earthed or unearthed either directly connected to primary circuit or connected to secondary circuit of current or voltage transformers, A.C. control wiring etc.	
	d) D.C. Control and indication circuits	
	e) D.C. Alarm circuits	

(x) - To be provided.
(-) - Not required

SITE ACCEPTANCE TEST FORMAT

Inspection and testing of Ring Main Units

a. Visual Inspection tests

1. Name plate details same as per drawings ……
2. Physical and mechanical condition satisfactory ……
3. Installation of the RMU satisfactory ……
4. Grounding is proper and adequate ……
5. CT ratios and ratings as per load currents ……
6. Tightness check with torque wrench done for accessible parts ……
7. Padlock arrangement available ……
8. Interlocking system operational ……
9. Sequencing of operations correct ……
10. Indicating and control devices are operational ……

b. Electrical Tests

(i) IR tests: 5.0kV for 1 minute across poles in open condition, and across poles-to-ground in closed condition.

Equipment	IR Value in M Ohms					
	Poles Open			Poles Closed		
	R	Y	B	R	Y	B
RHS Isolator						
LHS Isolator						
Circuit Breaker						

(ii) Contact Resistance Measurement

Equipment	Contact Resistance in μΩ					
	R		Y		B	
	Measured	Factory	Measured	Factory	Measured	Factory
RHS Isolator						
LHS Isolator						
LHS Earth Switch						
RHS Earth Switch						

(iii) Interlocks / Operations / Indications Check

……

(iv) Secondary Injection tests on the "in built" relay

Phase	**Relay setting (A)**	**Actual Pickup (A)**
R		
Y		
B		

(v) *Operational test on CBCT and earth fault indicator by Primary Injection

RMU Ref	**CBCT Ratio**	**Primary Current Injected (A)**	**Operation of E/F indicator OK/Not OK**

(vi) *Confirm that the CTs inside the RMU are tested externally

END OF SECTION- B 2.2