
SECTION-21**MV SYSTEM****21.1 SCOPE OF WORK**

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, engineering, manufacture, quality assurance, quality control, shop assembly, shop testing, packaging & delivery at site including insurance, unloading, site storage and preservation, in plant transportation at site, erection / installation, testing supervision, pre commissioning, successful commissioning, performance and acceptance testing, handing over to Employer and warrantee for two years of MV switchgear as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation. The scope of work covered under this section shall be read in conjunction with General Technical specifications, Chapter-1.

21.1.1 Detailed Scope of Work

The scope of work shall be a comprehensive functional system covering all supply and services including but not be limited to following:

21.1.1.1 11 kV Switchgear

3-phase, 50 HZ, 11 kV switchgear systems shall consist of two (2) sets of boards ,one at Power house & other at switchyard, 630A,16kA rating .

21.1.1.2 33 kV Switchgear

3-phase, 50 HZ, 33 kV switchgear systems shall consist of two (2) sets of boards, of 630A, 25kA rating each, at Dam and Switchyard.

21.1.1.3 Control, monitoring and related items and services

Co-ordination and provision of necessary contacts and/or ports for integration with plant SCADA system.

21.1.1.4 Common Supplies and services

- i. A suitable trolley mounted earthing device shall be provided which, when in circuit, earths the bus bars of feeder side of the breaker.
- ii. Drawings, documents and design calculations as per clause 21.6.
- iii. Shop, assembly, inspection & tests as per clause no. 21.7.
- iv. Packaging, handling and site storage as per clause no. 21.8.
- v. Delivery, installation and commissioning as per clause no. 21.9.

- vi. Tools and instruments as per clause no. 21.10.
- vii. Spare parts as per clause no. 21.11
- viii. Field/touch-up painting including all painting materials.

20.1.1.5 Completeness of System

Any other item (s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard (s)/best international practice.

Notes:

- i) All the above sets of boards shall be of indoor metal enclosed 11kV & 33kV switchgear type, complete with cubicles, Circuit breakers, protection, relays, metering instruments, bus-bar system, support insulators, cabling, internal wiring and other accessories, to complete the scope as per Single Line Diagram No SJVN/ARUN III/EM-2017-02 & SJVN/ARUN III/EM-2017-03 & detailed in the specifications. However, minor changes, if any to the enclosed SLD shall be done during detailed engineering; same shall also be taken care.

21.2 STANDARDS & REGULATIONS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards.

The relevant abstract (in soft / hard copy) of all referred standards shall be provided free of cost during engineering stage for facilitating review/ approval of submitted drawing/documents.

21.3 PARAMETERS & GUARANTEES

21.3.1 Scheme

The switchgear system is solidly grounded, 3 phases+TNS. The voltage level envisaged for Dam will be at two voltage levels i.e. 33KV & 0.415KV and for Power House & Switchyard it will have three voltage levels i.e. 33KV, 11KV and 0.415KV for MV/LV supply scheme.

The 33kV/11kV switchgear shall be required to handle all the power at 33kV/11kV level. The system offered for the 33kV/11kV switchgear scheme shall be as per MV Switchgear Single Line Diagram No SJVN/ARUN III/EM-

2015-02 & SJVN/ARUN III/EM-2015-03 including all required provisions for interlocking scheme.

21.3.2 Rating

System Description	11kV	33kV
Location & Type	Indoor, Metal Clad located in switchyard & Power House	Indoor, Metal Clad located in Dam and Switchyard
Type of earthing	Solidly earthed	Solidly earthed
System Requirement		
Rated system voltage	11 kV (rms)	33 kV (rms)
Highest system voltage	12 kV (rms)	36 kV (rms)
Rated frequency, Hz	50, - 5% to +3 %	50, - 5% to +3 %
Rated withstand Voltage to earth		
Power Frequency	28 kV	70 kV
Lightening Impulse (peak value)	75 kV _p	170 kV _p
Rated short time withstand current (rms) for 1 Sec for Busbar & VCBs	16kA	25kA
Rated Peak withstand current	40kA	63kA
Rated normal current for Busbar & VCBs	630A	630A
Control voltage	220 +10 % / -20%V DC	220 +10 % / -20%V DC
Auxiliary AC supply, 3 phase	415 ± 10% V	415 ± 10% V
Circuit Breaker		
Type	Vacuum draw out type	Vacuum draw out type
Operating mechanism	Motor operated spring charged	Motor operated spring charged

No. of interrupter unit per pole	1	1
First-pole-to clear factor	1.5	1.5
Rated current	630 A	630 A
Rated short circuit breaking capacity	16kA (rms)	25kA (rms)
Rated short circuit making capacity	63kA (peak)	63kA (peak)
Rated operating sequence	O-3min-CO-3min-CO	O-3min-CO-3min-CO
Control voltage	220 V DC	220 V DC
Normal voltage for operating mechanism i.e., charging motor	220 V DC	220 V DC
Current Transformer		
Current Ratio	As per Tender Drawings*	As per Tender Drawings*
Incoming feeders		
Outgoing feeders		
Accuracy class		
REF Protection	PS	PS
E/F and O/C protection	5P10	5P10
Metering	0.2	0.2
Potential Transformer		
Type of supply and earthing conditions	3 phase, star point solidly earthed	3 phase, star point solidly earthed
Transformation ratio	$11\text{kV}/\sqrt{3}/110\text{V}/\sqrt{3}/10\text{V}/\sqrt{3}$	$33\text{kV}/\sqrt{3}/110\text{V}/\sqrt{3}/110\text{V}/\sqrt{3}$
Accuracy Class		
Relaying	3P	3P
Metering	0.2	0.2

* Parameters and rating of CTs, PTs, relays has to be calculated by bidders through studies subject to purchaser approval.

21.3.3 Performance Guarantee

The MV switchgear along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

21.3.4 Current ratings and short circuit capabilities

The current ratings/ CT/PT ratings mentioned above & in the SLD are indicative only. However, the rated continuous current of any circuit connection or component shall correspond to the maximum current for which that connection or component is designed to carry continuously during operation, under the most unfavorable service conditions which shall be finalized during detailed engineering.

21.3.5 Temperature Rise

The A.C. distribution boards shall be designed to operate satisfactorily under the site conditions and the maximum temperature attained by any part of the equipment wherein service at an ambient temperature of 40 & - 5 deg.C. shall not exceed the limits specified corrected for the site conditions.

21.4 DESIGN AND CONSTRUCTION

21.4.1 Ac Distribution Boards

21.4.1.1 General

The 11 kV & 33kV switchgear shall be metal clad indoor cubicles free floor standing type.

All Distribution Board frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2 mm. Frames shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold-rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever necessary.

All Distribution Boards shall be of dust, vermin proof construction and shall be provided with a degree of protection of IP-52.

Hinged doors and removable covers shall be provided wherever necessary to allow access to all equipment. The frame of the cubicles shall be sufficiently sturdy and the metal sheeting of sufficient thickness to ensure safe transport, mounting and operation without deformation or bulging. Natural ventilation as required shall be provided. Distribution Boards shall be easily extendable on both sides, by the addition of the vertical sections after removing the end covers.

The AC distribution board cubicles should comply with the requirement of relevant international standards or Indian Standard providing minimum clearance between phases of the bus and live parts from metallic parts.

Continuous lifting angle or lifting hooks shall be provided to facilitate the installation of the cubicles. All identical circuit breakers and module chassis of same size shall be fully interchangeable without having to carryout modifications.

Adopter panels and dummy panels required to meet the various bus bar arrangements and layouts required shall be included in tenderer's scope of work. All sheet work shall be pretreated, in tanks, in accordance with relevant IS or international standard.

21.4.1.2 Compartments

Each cubicle shall be divided into sections, or compartments, housing the incoming, interconnecting or out going feeder Vacuum circuit breaker units, Bus PTs etc. respectively.

After isolation of power and control circuits connections it shall be possible to safely carryout maintenance in a compartment with the bus bar and adjacent circuits live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

Each VCB unit shall be mounted on a carriage assembly, constructed so that the unit can be removed and replaced while the buses are energized. The carriage shall have self-engaging definite position stops for disconnected, test and connected positions. All necessary means shall be provided for easy removal and handling of the unit.

21.4.1.3 Cable compartments

All feeders to and from the cubicle assemblies will be cables. The assemblies shall be accessible for the cables from bottom to each feeder circuit breaker via separate cable compartment. Solder less connectors shall be furnished for each power conductor entering the equipment. Provisions shall be made to clamp and fasten cables in the cable Compartment. Terminals for cable connection will be suitable for Aluminium cables.

21.4.1.4 Derating Of Equipments

The current ratings of all equipments as specified in rating clause are the minimum standards current ratings at a reference ambient temperature of 40 deg C as per relevant Indian Standards.

The Bidder shall indicate clearly the de-rating factors employed for each component and furnish the basis for arriving at these de-rating factors duly considering the specified ambient temperature of 45 deg.C.

21.4.1.5 Name plates

Each feeder shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc. Each section of an assembly shall have an identifying name plate placed near the top edge.

21.4.1.6 Wiring

All secondary and control wiring shall be done with stranded copper wires, current transformer secondary leads shall not be less than 4.0 mm². All control wiring within the assembly housing shall be installed at the manufacturer's premises.

All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

21.4.1.7 Bus bars

All the switchgear panels shall be provided with high electrical grade aluminium bus bar having continuous current rating of 630 Amps. The three phase bus bars shall be fixed in suitable configuration to minimize electro-mechanical stresses under short circuit conditions. All the bus bar joints shall preferably be silvered plated.

Inter panel insulating barriers shall be provided between bus bars of different units. The arrangement of bus bars shall be such as to provide facility for ready extension to additional units on either side. All bus bar and jumper connection shall be of high conductivity aluminium alloy of adequate size.

The cross section of the bus bar shall be uniform throughout its run and shall be adequately supported and braced to withstand stresses caused to the time of short circuit. Each phase shall be provided with separate support of non-hygroscopic, non-combustible, track resistant and high strength epoxy/fibre glass insulators. Where a common support is provided anti-tracking barrier shall be provided between the supports. All bus bar joints shall be provided with high tensile steel bolts, spring washer and nuts to ensure good contact at the joint. The minimum clearance in air between phases and phase to earth for entire run of horizontal and vertical bus bar shall be sufficient to withstand power frequency and impulse voltage withstand tests taking into consideration of the altitude correction factor.

21.4.1.8 Earth Bus

All panels shall be equipped with an earth bus securely fixed along with the inside of rear of panels. The materials and the sizes of the bus bar shall be at least 25x6mm copper unless specified otherwise. The buses shall be bolted to the frame of each panel in such a way as to make good electrical contact with each panel or section. The bolted contact surfaces between copper and aluminum shall be silver plated. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of the bidder. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

21.4.1.9 Instruments

Control switches and instruments shall be mounted on the circuit breaker compartment doors / front side of the panel.

21.4.2 Vacuum circuit breakers

21.4.2.1 General Requirements

The circuit breaker shall be of vacuum type suitable for indoor installation. The breaker shall be best modern in design and shall be supplied with all the associated equipments including fittings and wiring etc. The breaker shall be suitable for three phase auto re-closing operation.

The breaker compartment of the cubicle shall be designed to have fully draw out self contained truck arrangement with breaker mounted on the same.

The circuit breaker shall be provided with rapid and smooth interruption of current under all conditions completely suppressing all undesirable phenomenon even under the most severe and persistent short circuit conditions or when interrupting small leading and lagging currents. The detail of any device or special feature incorporated to limit or control the rate of rise of re-striking voltage across the circuit breaker contact shall be stated. The over-voltage caused by the circuit breaker switching on inductive and capacitive load shall not exceed 2.5 times the normal phase to neutral voltage. The total break time for the circuit breaker throughout the range of its operation duty shall be stated in the tender and it shall be guaranteed.

All parts of the circuit breaker unit shall be mechanically designed to withstand all mechanical, electrical and other stresses which may be experienced in the operation of the unit including those under short circuit conditions.

Bidder shall specify the number of switching operation of breaker at full breaking capacity and at normal load as per the latest IS/IEC standards.

The breaker shall be reasonably quiet in operation.

The interrupter shall be sealed for life with fluarc sealing as per IEC study group 17A Dec.1981, Type-III.

21.4.2.2 Vacuum Circuit Breaker

The circuit breaker shall comprise of three vacuum interrupters, one for each phase, each housed in separate ceramic enclosure for better electrical and mechanical properties. The three identical poles shall be mounted on a common base frame and contact system of these poles shall be mechanically linked to provide three pole gang opening/closing for all types of electrical faults. Each pole of the breaker shall be provided with vacuum interrupter sealed for life encapsulated by ceramic insulator and shall be interchangeable. The mechanical parts and linkage shall be robust and maintenance free over at least 30,000 operation except lubrication of pin articulated joints at intervals of 5 years or 5,000 operations. Parts requiring maintenance shall be easily accessible without requiring extensive dismantling of adjacent parts.

21.4.2.3 Operating Mechanism

The operating mechanism shall be capable of giving specified duty of the breaker (sequence of opening and closing). (O-3min-CO-3min-CO). The breaker shall also pass the operational test which ascertain the capabilities of operating mechanism. The motor compressed spring mechanism shall consist of a closing spring which is wound or compressed by an electric motor immediately after the breaker closes. The closing action shall also wind or compress a tripping spring and shortly after the breaker is closed both springs shall be wound. After the breaker has tripped, the tripping spring shall remain in the released position as long as the breaker is open, but the closing spring shall remain wound and ready for closing operation. The operating mechanism shall have all the necessary auxiliaries, apparatus for operation and supervision, like motor starter with thermal overload release, one closing coil, two trip coils, push button for local electrical operation, push button for direct mechanical tripping auxiliary switches, anti pumping contactors, operation counter, socket for inspection, lamp and heater with switch. In addition mechanical interlocking system for interlocking with other associated breaker shall be provided. Spring charging motor shall be standard single phase motor suitable for operation on 240 V A.C. supply. Provision shall also exist for one detachable handle for manual charging in the event of failure of auxiliary supply. The mechanism shall be suitable for remote operations. In addition auxiliary local operating mechanism shall be trip free.

- i) Operating voltage for closing/tripping coils shall be 220 VDC. The D.C. supply shall be available in Power House only.

- ii) Operating voltages for spring charging motor and heater elements shall be 240 VAC, 50 Hz. A.C supply.

21.4.2.4 Fixed and Moving Contacts

The fixed and moving contacts of the breaker shall ensure full contact during closing. The contact metallurgy and geometry shall be such as to enable it to conduct the rated current and short circuit current With minimum of contact burning and wear. Main contact shall have ample area and contact pressure for carrying rated current and rated short time current without excessive temperature rise. The contact material should be either chromium, or some other suitable material. The main contact should have low contact resistance and the mili-volt drop across the breaker contact should also be furnished along with the bid.

The breaker contact shall be designed such that diameter of the contacts and their stems are optimally matched to those of arc chamber and insulator. Contacts shall be such that arc does not remain stationary but keeps traveling by its own magnetic field.

21.4.2.5 Interrupter

Each pole of circuit breaker shall be provided with a vacuum interrupter sealed for life and encapsulated by ceramic insulators. The interrupter shall be provided with steel chromium arc chamber to prevent vaporized contact material being deposited on the insulating body. A further shield giving protection to the metal bellow shall be provided. The metal bellows shall follow the travel of the moving contacts to seal the interrupter against the surrounding atmosphere.

21.4.2.6 Recovery Voltage and Power Factor

The circuit breaker shall be capable of interrupting rated power with power frequency recovery voltage equal to the rated maximum line to line service voltage at rated frequency and at a power factor "equal to or not exceeding 0.15" as per IEC 56-1987. In case of multiple break circuit breaker, devices/method adopted to all the breaks shall be indicated and actual voltage distribution recorded during interruption tests shall be furnished with the bid.

21.4.2.7 Restriking Voltage

The breaker shall be suitable to withstand required Rate of Rise of Recovery Voltage (RRRV) & Transient Recovery Voltage (TRV) peak. The complete data for the phase factor, amplitude factor, etc. for the rate of rise of re-striking voltage shall be furnished in the tender.

21.4.2.8 Transformer Charging Circuit Breaking Capacity

The breaker shall be capable of interrupting inductive currents, such as those occurring while switching off unloaded transformers, without giving rise to undue over voltage and without re-strikes. The maximum over voltage value, which will not be exceeded under such conditions shall be stated in the tender.

21.4.2.9 **Shunt Capacitor Switching Capacity**

The maximum rating of single bank of shunt capacitors which can be switched by the circuit breaker without re-strikes shall be stated in the tender along with over voltage occurring during such switching.

21.4.2.10 **Out of Phase Switching**

The circuit breaker shall be capable of satisfactory operation even under conditions of phase opposition that may arise due to faulty synchronisation. The maximum power that the breaker can satisfactorily interrupt under "Phase Opposition" shall be stated in the bid.

21.4.2.11 **Tripping Coils**

The circuit breakers shall be provided with two trip coils and one closing coil. Moreover, one of the trip coil shall be used to trip the breaker on command. The trip coils shall be suitable for pre-closing and after closing trip circuit supervision.

21.4.2.12 **Trip Free Features**

When the breaker has been instructed to close by manual instructions by pushing of push button, the operating mechanism will start operating for closing operations, if in the meantime a fault has taken place and relay close the trip circuit of the breaker. The trip free mechanism shall permit the circuit breaker to be tripped by the protective relay even if it is under the process of closing. An anti-pumping device to prevent the circuit breaker from re-closing after an automatic opening when the device initially closing is maintained in the position for closing should be provided.

21.4.2.13 **Accessories**

Each circuit breaker assembly shall be supplied with the following accessories.

- i) Line and earthing terminals.
- ii) Control housing with:-
 - a) One auxiliary switch with adequate number of auxiliary contacts, but not less than 24 nos. (12NO+12NC) for each breaker. These shall be over and above the No. of contacts

used for closing, tripping and interlocking circuit of the circuit breaker. All auxiliary contacts shall be capable of use as "Normally Closed" or "Normally Open" contacts. There shall be provision to add more auxiliary contacts at a later date, if required.

- b) Operation counter.
- c) Position indicator (Close/Open).
- d) Necessary cable glands.
- e) Fuses.
- f) Manual trip device and local test push buttons.
- g) Terminal blocks and wiring for all control equipment and accessories.
- h) Adequate number of heaters for continuous operation to prevent moisture condensation in the housing of operating mechanism.

All parts of the breaker shall be easily accessible for inspection and maintenance. Not only the main insulator, connections, joints etc. shall be accessible but also adequate access shall be there for the auxiliary equipment like secondary plugs, sockets, switches, and release coil and terminal boards.

Complete set of robust mechanical interlocks shall be provided to safeguard against incorrect operation of the breaker. The minimum interlocks will be as follows:-

- a) The truck cannot be moved from either test to Service position or vice versa, when the circuit Breaker is "ON".
- b) The circuit breaker cannot be switched "ON" when the truck is in any position between test and Service position.
- c) Front part of the truck cannot be removed when the Breaker is in "ON" position.
- d) The low voltage plug and socket cannot be disconnected in any position except test/isolated Position.
- e) The truck cannot be moved inside the panel, when the LT plug and socket is disconnected.

In addition to above interlocks, the following safety Devices shall be provided:-

- a) Circuit breaker & sheet metal enclosure should be fully earthed.
- b) Self locking shutters should be provided which should close automatically when the truck is withdrawn to "TEST POSITION".

21.5 AUXILIARY SYSTEM AND MISCELLANEOUS COMPONENTS

21.5.1 Refer cl. no. 1.8 of GTS for Instrument Transformers, metering instruments, control and selection switches, push buttons, indicating lamps, HRC fuses, terminal blocks, name plates and labels, space heaters, control & secondary wiring etc.

21.5.2 Interlocks

Interlocking scheme shall be as per drawing no SJVN/ARUN III/EM-2017-02 & SJVN/ARUN III/EM-2017-03 for tendering purpose which shall be reviewed and finalized during detailed engineering

21.5.3 Automation of MV Switchgear

Necessary contacts / ports of MV Switchgear (e.g. CB on / off / trip, Voltage supervisions etc.) at Power House, Switchyard and Dam Site shall be envisaged for remote interfacing with the plant SCADA. Logic / program for automation of MV Switchgear shall be built in SACDA.

21.5.4 Protection of 11kV & 33kV Switchgear

The minimum protection for the 11kV & 33kV system shall be as per SLD Single Line Diagram SJVN/ARUN III/EM-2017-03 and shall be finalized during detail engineering stage. All the relays shall be of reputed make with proven performance. In accordance of above, the type of protection shall have to be got approved from the Employer before supply / despatch.

The Contractor has to revise/upgrade the system during detailed engineering if the offered system does not meet the entire requirement. The system should be state of art/latest model available at the time of supply. If the protection system mentioned in the awarded contract become obsolete at the time of supply, the Contractor shall offer a latest model without any extra cost to employer.

The relay used in protection system shall be of the numerical, and plug in type arranged in protection cubicles. All relays including all related devices, such as interposing transformers, tripping matrix and relays, test facilities, power supply units, etc. with all circuits shall comply with relevant IEC Recommendation. All major numerical relays shall have an inbuilt disturbance recorder and event recorder

21.6 DRAWING , DOCUMENTS & DESIGN CALCULATIONS

After award of contract, the contractor shall furnish all drawings, documents, design calculations, data, manuals & other necessary literature, pertaining to equipment offered by them & so specified under various clauses, in accordance with requirements stipulated in “clause 1.19 of Section – 1 i.e. General Technical Specification (GTS)”. A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand for approval of the purchaser as already explained in clause no. 1.19.6 of Section – 1 (GTS). The list of drawings & documents to be furnished for approval / reference shall not be limited to the following:-

- i) Drawings, documents, design calculations literatures, manuals etc. as per clause no. 1.19 of Section-1 (GTS)
- ii) Drawings, documents, design calculations, literatures, manuals as listed in Annexure – D of Section -1 (GTS) referred under clause no. 1.19.6
- iii) Detailed quality assurance plan, giving complete specifications of the materials and specifications relating to inspection and testing of materials and finished components.
- iv) All drawings having bearing on civil foundations, equipments foundation details and loads
- v) Arrangement, installation, foundation, plan, section, detailing of main equipment and sub-assemblies including control & instrumentation system.
- vi) All Electrical, Hydraulic & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of this section.
- vii) All manufacturing drawings not specifically covered under approval/reference category shall be submitted for record and facilitate inspection of the component in the shop and assembly at site.
- viii) Any other drawings, documents, design calculations, literatures, manuals etc. not covered anywhere in the specification, but required to be furnished for approval / reference of employer for suitability of design to fulfill the scope of work.

21.7 SHOP ASSEMBLY , INSPECTION & TESTS

21.7.1 Routine tests

Routine tests shall be carried out on all distribution boards and associated equipments; as per relevant standards.

Each switchboard shall be assembled at the manufacturer's works with all apparatus instruments & meters connected up and the various components shall be tested in accordance with the requirements of the relevant Indian Standard.. The following routine tests shall be performed on all the distribution boards, as per the relevant standards, not limited to:

- i) For switchgear assembly as per IEC 60694
 - a) Dielectric test on the main circuit
 - b) Tests on auxiliary and control circuits
 - c) Measurement of the resistance of the main circuit
 - d) Tightness test
 - e) visual checks
- ii) For Vacuum circuit breakers as per IS 13118 & IEC 60694
 - a) Dielectric test on the main circuit
 - b) Tests on auxiliary and control circuits
 - c) Measurement of the resistance of the main circuit
 - d) Tightness test
 - e) visual checks
 - f) Mechanical operating tests
- iii) For PTs as per IEC 60044
 - a) Verification of terminal markings
 - b) Power frequency withstand test on secondary winding
 - c) Power frequency withstand test between sections
 - d) Power frequency withstand test on primary windings
 - e) Partial discharge measurement
 - f) Determination of errors
- iv) For CTs as per IEC 60044
 - a) Verification of terminal markings
 - b) Power frequency withstand test on secondary winding
 - c) Power frequency withstand test between sections
 - d) Interturn overvoltage test
 - e) Power frequency withstand test on primary windings
 - f) Partial discharge measurement
 - g) Determination of errors
- v) Relays, MCBs, switches as per relevant standard.

21.7.2

Type test

Type test of MV LT system shall fall under the CAT-II (refer clause no 1.16 of GTS).

The type test report of following equipments to be submitted by bidder :

A) Distribution boards- Total assemblies as per IEC 60694

- i. Dielectric tests on main, auxiliary and control circuits
- ii. Radio interference voltage (RIV) test
- iii. Measurement of resistance of the main current path
- iv. Temperature rise tests
- v. Short-time withstand current and peak withstand current tests
- vi. Making and breaking tests
- vii. Tests to verify the degrees of protection of enclosures
- viii. Mechanical tests
- ix. Environmental tests

B) Circuit breakers as per IS 13118 & IEC 60694

- i. Dielectric tests
- ii. Radio interference voltage (RIV) tests
- iii. Temperature-rise tests
- iv. Measurement of the resistance of the main circuit
- v. Short-time withstand current and peak withstand current tests
- vi. Mechanical and environmental tests
- vii. Short-time withstand current
- viii. Short current making and breaking current
- ix. Switching tests

C) Potential transformers as per IEC 60044

- i. Temperature-rise tests
- ii. Lightning impulse test
- iii. Switching impulse test
- iv. Determination of error
- v. Short circuit withstand capability test
- vi. Radio interference voltage measurement (RIV)

D) Current transformer as per IEC 60044

- i. Temperature-rise tests
- ii. Lightning impulse test
- iii. Switching impulse test
- iv. Determination of error
- v. Short circuit withstand capability test
- vi. radio interference voltage measurement (RIV)

E) Relays, MCBs, switches as per relevant standard.

21.7.3

Field Tests

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least four (4) months before start of relevant testing.

21.7.3.1

Tests during installation and pre commissioning

At least following inspections/ tests shall be performed during installation and pre commissioning:

- Functional and operational tests,
- Measurement of the insulating resistance of the different power and control circuits, including cables, instruments and apparatus, against earth,
- Adjustment of the protection equipment,
- Calibration of releases,
- Contact resistance measurement of circuit breaker,
- Verification of interlocks: ensure that interlocks are correctly installed and that access is prevented to live portions of the system when interlocks are in place and that access is permitted when interlocks are removed,

21.7.3.2

Commissioning tests

At least following verifications shall be performed before and during energization:

- Insulation resistance measurement of each phase,
- Verification of component temperatures,
- Final adjustment of the protection equipment.

21.7.4

Performance Testing

After completion of commissioning tests and commissioning of complete system, MV Switchgear system shall be kept under charged condition for 72 hrs before taking over. The test service period of thirty (30) days shall reckon from the date of taking over. During this test service period, the system / installations must perform satisfactorily & if any defects are observed, same shall be rectified by contractor without any financial implication to employer.

21.8 PACKAGING, HANDLING & SITE STORAGE

The contractor shall be liable for all packing, handling and site storage of all the equipment till the installation is handed over to the Engineer in charge.

21.9 SITE INSTALLATION AND COMMISSIONING

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance.

The Contractor shall provide and install the concrete inserts/embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer.

The Contractor shall use anchor fasteners for installation of fixtures, mountings, conduits, cabling, panels etc. Chipping of concrete and/or taking support from reinforcement bars shall not be allowed.

21.10 TOOLS AND INSTRUMENTS**21.10.1 Tools for erection and Installation.**

The Contractor shall bring his own tools, devices, testing instruments / equipments to site in order to erect and install the complete equipment delivered under this section. These shall remain the property of the Contractor unless otherwise agreed to take over any / all of these at mutually agreed conditions.

21.11 SPARE PARTS

The spare parts mentioned here under are meant for use by the Employer during operation and maintenance stage and shall not be used as erection spares required during installation.

21.11.1 Mandatory Spare Parts

The Contractor shall supply the mandatory spare parts as per Schedule-III.

21.11.2 Recommended Spare Parts

The Contractor shall furnish the list of recommended spare parts at Schedule-IV.