# GUJARAT ENERGY TRANSMISSION CORPORATION LTD.

SARADAR PATEL VIDYUT BHAVAN,
RACE COURSE, BARODA – 390 007.

# TECHNICAL SPECIFICATION

# OF 220 KV, 132 KV & 66 kV $SF_6$ CIRCUIT BREAKER

GETCO/E/1, 2 & 6 TS – CB /R5 July 22

# GENERAL TECHNICAL REQUIREMENTS FOR 245 KV AND 145 KV SF6 CIRCUIT BREAKER

## 1.1 SCOPE:

**1.1.1** The scope covers design, engineering, manufacture, assembly, inspection and testing at manufacture's works, supply and delivery of SF6 circuit breaker's complete with structures, accessories, auxiliary equipment and mandatory spares specified herein for their satisfactory operation in various sub-stations of our system.

**1.1.2** It is not the intent to specify completely here all the details of design and construction of the circuit breaker's, however, the breaker's shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of performing in continuous commercial operation up to the guarantee in manner acceptable to the GETCO who will interpret the meanings of drawings and specifications and shall have power to reject and work or material which in his judgment is not in accordance therewith. The circuit breakers offered shall be complete with all components necessary for their effective and trouble-free operation. Such components shall be deemed to be within the scope of the Bidder irrespective of whether they are specifically brought out in this specification and / or in the commercial order or not. It should also be type tested and supposed to pass all accepted tests as per IEC/IS.

## 1.2 STANDARDS:

**1.2.1** The circuit breakers shall conform to the latest revisions with amendments available at the time of testing of relevant standards, rules and codes, some of which are listed herein for ready reference.
Equipment meeting with the requirements of any other authoritative standards, which ensures equals or better quality than the standards mentioned herein may also be offered. In that case, salient points of difference between the standards adopted and the specified standards

shall be clearly brought out in the bid and shall be considered acceptable, if found justified after due technical evaluation.

| SR. NO. | STANDARD | TITLE |
|---|---|---|
| 1 | IEC-62271-100 | Specification for alternating current circuit breakers |
| 2 | IEC-60376 | Specification and acceptance of new supply of sulfur hexafluoride |
| 3 | IS-2147 | Degree of protection provided for enclosures for low voltage switch gear and control gear. |
| 4 | **IS 375** | ***Marking and arrangement for switchgear bus- bar, main connections and auxiliary wiring.*** |
| 5 | IS-325 | Specification for three phase induction motors |
| 6 | IS-2629 | Recommended practice for hot dip galvanizing of iron and steel |
| 7 | **IEC 62155** | High voltage porcelain bushing |
| 8 | **5561** | Specifications for clamp connectors |
| 9 | IS-2062/2016 | Specifications for GI /SS nit bolt ,washer |

The components & accessories to be used in the manufacture of circuit breaker shall conform to relevant Indian Standards/the standard specified under respective clause in this specification.

## 1.3 DOCUMENTATION:

1.3.1 All drawings shall confirm to International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS: 11065. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

1.3.2 List of Drawings and Documents

The bidder shall furnish a set of relevant descriptive and illustrative published literature, pamphlets and the following drawings for preliminary study along with offer.

a General outline drawings showing dimensions and shipping weights, quantity of insulating media **with all technical parameters** etc.

b Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, **insulators**, contacts with lifting dimensions for maintenance.

c Drawings showing control cabinets and circuit diagrams for operating mechanism.

d Schematic diagrams for all the control, supervision circuitries and auto reclosing (single phase and three phases).

e Structural drawings and loading data for support structures.

f Foundation plan and loading data and foundation design.

g Drawings showing the complete operation cycle of the circuit breaker with description.

h Drawings showing the details of complete opening and closing operation.

**i Rating Plate**

**j Terminal connector**

**k MQP**

**l FQP**

**m Erection, operation & maintenance manuals.**

**All the documents required shall be submitted over and above as indicated in Schedule – B of the specification.**

1.3.3 The successful Bidder shall submit **three** sets of final version of all the above drawings for purchaser's approval within 2 weeks of placement of order. The GETCO shall communicate his comments / approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit two copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, sent

two sets of approved drawings in hard copy and one soft copy (in AUTOCAD format) to each consignee with each breaker and similar to CE (PROJECTS), GETCO, Corporate Office, Sardar Patel Vidyut Bhavan, Baroda - 390005.

1.3.4 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

1.3.5 Approval of drawings/ work by the GETCO shall not relieve the supplier of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of supply and GETCO shall have the power to reject any work or materials which, in his judgment, is not in full accordance therewith.

a) The precise procedure to be adopted by maintenance personnel for handling equipment which are exposed to the products of arcing in SF6 gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, methods of disposal of circuit breaker cleaning utensils and other relevant matters.

b) A complete catalogue on operation analyzer satisfying all the requirements stipulated in this specification should be provided.

c) The Bidder shall furnish along with the bid, curves supported by test data indicating the opening time under close & open operation with combined variation of trip coil voltage.

d) All duty requirements shall be providing with the support of adequate test report to be furnished along with the bid failing which the bid likely to be rejected.

e) 245 KV SF6 circuit breaker shall also be suitable for 25 MVAR to 50 MVAR reactor switching duty and relevant type report shall be furnished.

1.3.6 The bidder may submit any other drawing found necessary in addition to the drawings stated above.

## 1.4 GENERAL DESIGN FEATURES OF CIRCUIT BREAKERS:

**245/145/72.5kV circuit breakers offered would be of Sulphur hexafluoride (SF6) type and of class C2-M2 as per IEC.**

**The circuit breaker shall be complete with operating mechanism, marshalling box, piping, inter-pole cables, cable accessories like glands, terminal blocks, marking ferrules, lugs, pressure gauges, density monitors (with graduated scale), galvanized support structure, platform with ladder for CB and all other accessories required for carrying out all the functions of the CB.**

**All necessary parts to provide a complete and operable circuit breaker installation such as terminal pads, control parts and other devices shall be provided.**

**The support structure, platform & ladder of circuit breaker shall be hot dip galvanized. Exposed hardware items shall be hot dip galvanized or Electro-galvanized.**

**The circuit breakers shall be designed for use in the climatic & isokeraunic conditions as given (cl. 2.2).**

**For 66 KV,132kV & 220 KV CB**, the mounting dimensions for structure to be supplied for CB shall be matched with the mounting dimensions mentioned in attached standard foundation/base plan of GETCO. Alternatively, bidder can provide necessary steel frame work matching

the dimensions of breaker structure on upper side and dimensions of standard foundation plan at bottom side.

1.4.1.1 The circuit breakers shall be capable of rapid and smooth interruption of currents under all conditions completely suppressing all undesirable phenomena even under the most severe and persistent short circuit conditions or when interrupting small currents or leading or lagging reactive currents. The circuit breakers shall be 'Restrike-Free' under all operating conditions. The details of any device incorporated to limit or control the rate of rise of restriking voltage across, the circuit breaker contacts shall be stated. The over voltages caused by circuit breaker while switching inductive or capacitive loads shall not exceed 2.5 times the highest phase to neutral voltage. The actual makes and break times for the circuit breakers throughout the ranges of their operating duties shall be stated in the offer and guaranteed.

1.4.1.2 The arc quenching chambers shall have devices to ensure almost uniform distribution of voltage across the interrupters.

## 1.5 TEMPERATURE RISES:

The temperature rises and the maximum temperature on any part of the equipment when in service of site under continuous full load conditions and exposed continuously to the direct rays of the sun shall not exceed the permissible limits as per IEC latest publication, this shall not be exceeded when corrected for the difference between ambient temperature at site and the ambient temperature specified in the relevant specification. The correction proposed shall be stated in the bid and shall be subject to the approval of the purchaser.

**1.6 The circuit breaker shall have the following operating capabilities;**

(a) Shunt capacitor switching capacity,
(b) Breaking capacity for kilometric fault:
(c) Transformer charging current breaking capacity:
(d) Restriking voltage breaking capacity:
(e) Recovery voltage and power factor breaking capacity:
(f) Automatic rapid reclosing (three phase)

## 1.6.1 TRIP FREE OPERATION:

The circuit breakers shall be trip-free as per IEC62271-100.

## 1.7 TOTAL BREAK TIME

**The total break time as specified under this section shall not be exceeded under any of the following duties:**
**Test duties T10, T30, T60, T100a, and T100s (with TRV as per IEC: 62271-100)**
**ii) Short line fault L75, L90 (with TRV as per IEC: 62271-100)**

**The total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%), arc extinguishing medium pressure etc. While furnishing the proof of the total break time of complete circuit breaker, the effect of non-simultaneity between contacts within a pole or between poles shall be brought out to establish guaranteed total break time.**
**The values guaranteed shall be supported with the type test reports.**

## 1.7 GENERAL TECHNICAL REQUIREMENTS:

The circuit breakers operating mechanism shall have two nos. of tripping coils and one no. of closing coil for both 66 kV SF6 Gas CB for better reliability. There shall be separate contactor for each coil.

Exposed live parts shall be placed high enough above ground to meet the requirements of local safety codes.

a. The circuit breakers shall be suitable for outdoor operation under the climatic conditions specified in section-II of this specification.

b. The circuit breakers operating mechanism shall have two nos. of tripping coils and one no. of closing coil for both 66 kV SF6 Gas CB for better reliability. There shall be separate contactor for each coil.

c. Exposed live parts shall be placed high enough above ground to meet the requirements of local safety codes.

d. Any part of the breaker, especially the removable ones, shall be freely interchangeable without the necessity of any modification at site.

e. Breaker assemblies with bases, support structure for circuit breaker as well as for control cabinet, central control cabinet and bolts for control cabinet and central (except concrete foundations) terminals and operating mechanisms are included in the scope of supply.

f. Compressed SF6 gas, spring operating system in all respects, also included in scope of supply.

g. All necessary parts to be provided for a complete and operatable circuit breaker installation such as main equipment, terminal, control parts, connectors and other devices, whether specifically called for herein or not.

h. The circuit breaker shall be designed for high speed single and three phase re-closing 'in case of individually operated breaker and three phase re-closing for mechanically gang operated breaker.

i. Support structure of breakers shall be hot dip galvanized. All other parts like control cabinet, mechanism, housing shall be epoxy painted as per **shade 631 IS-5.** Bolts, nuts etc shall be hot dip galvanized/steel.

**All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610mm. Under marine environment, the fabricated structures shall have a minimum overall Zinc coating of 900 gm/square meter in case of 31 mm/kV creep age distance requirement.**

j. Circuit breaker shall be suitable for hot line washing.

k. The terminal pads shall be of aluminum alloy/copper. In case if terminal pads are of copper, then they will be silver plated with at least 50 microns' thickness.

l. The current density adopted for the design of the terminal pads shall, in no case exceed the following values. For copper pads 1.6 A/sq. mm and others 1.0 A/sq. mm.

m. All gasketed surfaces shall be smooth, straight and reinforced, if necessary to minimize distortion and to make a tight seal. The operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. The manufacturer shall guarantee that the gas leakage rate should not exceed 1 % p. a. failing which total cost of refilling the gas including service charges shall be borne by the supplier.

n. In the interrupter assembly, there shall be an absorbing product box to eliminate SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be fully compatible with SF6 gas.

o. SF6 density of circuit breaker shall be monitored and regulated by density monitor and pressure switches respectively in each pole. The SF6 gas density monitor shall be adequately temperature compensated. It will meet the following requirements:

**I.** It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by using suitable interlocked non-return couplings**.**

II. It shall damp the pressure pulsation while filling the gas service so that the flickering of the pressure switch contacts does not take place.

III. A gas pressure indicator shall also be supplied.

p. Facility shall also be provided to reduce the gas pressure within the breaker to a value not exceeding 8 millibars within 4 hours or less. Each circuit breaker shall be capable of withstanding- this degree of vacuum without distortion or failure of any part.

q. Sufficient SF6 gas shall be provided to fill all the circuit breakers installed. In addition to this 20% of the total gas requirement shall be supplied in separate cylinders as spare requirement.

r. Provisions shall be made for attaching an operation analyzer after installation at site to record contact travel, speed and making measurement of operation timings, preinsertion timing of closing resister, synchronization of contacts in one pole.

1.8.1 The bidder shall furnish complete literature regarding assembly, maintenance and charging procedures as applicable to SF6 breakers.

1.8.2 The supply shall cover necessary remote control switches., temperature compensated gas pressure switches which shall give an alarm or lockout operation of the breakers in case density of SF6 fall below a predetermined value or when the air pressure falls below the present values.

1.8.3 The bidder shall provide the following **spare parts for SF6 gas circuit breakers** for each breaker free of cost.

| | | |
|---|---|---|
| *i)* | *SF6 gas together with gas cylinder* | *20 % of total SF6 gas in Cylinder of any size with manufacture's certificate for quality of SF6 gas and certificate of explosive for cylinder.* |
| *ii)* | *Trip coil per CB* | *2 no for 66 KV & 132 KV and 6 nos for 220 KV* |
| *iii)* | *Closing coil per CB* | *1 no for 66 KV & 132 KV and 3 nos for 220 KV* |

1.8.4 One set of special tools, if any, required for assembly gas charging and maintenance of the SF6 circuit breakers shall be supplied per substation. Quantity shall be decided by purchaser, if deemed fit. The prices of the same may be quoted alongwith list separately.

1.8.5 Tests:

Besides the tests on SF6 circuit breakers as per the latest IS/IEC, the certificate of following tests shall be submitted for the SF6 gas:

a) Toxicity test
b) Moisture Test
c) Tests to determine the quantities of air, CF4 and free acid in the gas.

## 1.9 INSULATION OF THE CIRCUIT BREAKER:

1.9.1 The insulation to ground, the insulation between open contacts, and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily dielectric test voltages corresponding to basic insulation level specified in Clause 2 (8) of this specification.

1.9..2 The minimum clearances in open air shall be as follows, unless the apparatus is impulse tested after complete assembly as type tested (drawing of type tested breaker shall be submitted duly stamped by testing authority).

| | | | |
|---|---|---|---|
| Minimum clearance between | 220 KV | 132 KV | **66 kV** |
| Phase (mm) | 4500 | 2100 | **790** |
| Minimum clearance between live | 5500 | 4600 | **4000** |
| Parts & ground (mm)(up to plinth) | | | |

## 1.10 BUSHINGS AND INSULATORS:

1.10.1 The basic insulation level of the bushings and insulating porcelain shall be as specified and shall be suitable for installation in climatic conditions specified in of this specification. The hollow insulators shall confirm to the latest edition of **IS:62155**. The porcelain used shall be homogeneous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation. All bushing of identical ratings shall be interchangeable. The puncture strengths of the bushing shall be greater than their flashover values. The bushing shall be entirely free from radio disturbances when operating at a voltage up to the maximum system voltage and shall also be free from external and internal corona. The compressive and cantilever strength shall conform to the relevant standard.

## 1.11 CONTACTS:

1.11.1 All making and breaking contacts shall be sealed free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacements due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

Main contacts shall be first to open and last to close so that there will be little contact burning and wear.

If arcing contacts are used, they shall be first to close and last to open. They shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, the main contacts shall be easily accessible for inspection and replacements. Tips of arcing contacts shall be made of Tungsten alloy/Graphite and main contacts shall be silver plated or have tungsten alloy tipping.

1.11.2 Breaker shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life of the material used. The temperature shall not exceed that indicated in IEC under specified ambient conditions.

**1.11.3 The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage for 8 hours at zero-gauge pressure of SF6 gas due to the leakage. The breaker should be able to withstand all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. 2 p.u. across the breaker continuously, for validation of which a power frequency dielectric with stand test conducted for a duration of at least 15 minutes is acceptable).**

1.11.4 If multi break interrupters are used these shall be so designed and augmented, that a uniform voltage distribution is developed across then. Calculations/test reports in support of the same shall be furnished along with the bid. The thermal and voltage with stands of the grading elements shall be adequate for the service conditions and duty specified.

## 1.12 OPERATING MECHANISM:

1.12.1 The circuit breakers shall be designed to operate from the control room and for local control ON/OFF switch at MK Box.

1.12.2 The circuit breakers shall have a mechanical open/closed indicator in addition to facilities for remote electrical indicator.

1.12.3 The operating mechanism shall be of spring charging type by electric control. The mechanism will be trip free electrically. The mechanism shall perform satisfactorily the duty cycles specified. specified in Clause 2 (25).

1.12.4 All the working parts in the mechanism shall be of corrosion resistance materials and all bearings which require greasing, shall be equipped with pressure grease fittings, mechanism shall be strong, quick in action and shall be removable without disturbing other parts of the circuit breakers.

1.12.5 The operating mechanism (spring operated) along with accessories shall be mounted in a weatherproof cabinet with hinged doors located near the breakers. The local control switch and the breaker position indicator shall be provided in this cabinet. The control circuit shall be designed to operate on 110 Volts or 220 Volts D.C. It shall be possible to adopt it to work on either of the voltage by changing the operating coils, necessary contactors and relay. The control circuit shall be designed to operate at the D.C. voltages specified in this specification. The closing coils shall be designed to operate satisfactorily at any control voltage from **85% to 110%** of the normal voltage and opening shall be designed to operate satisfactorily at any control voltage from **70% to 110%** of the normal voltage.

However, even at **50% of rated voltage** the breaker shall be able to open. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications.

A heater shall be provided in the cabinet to prevent moisture condensation.

1.12.6 Necessary cable glands for the cables of the operating mechanism shall be provided.

## 1.13 AUXILIARY SWITCHES:

A minimum **twelve (12)** number (for 132KV & 220KV) and **Eight (8)** number (for 66 kV) of normally open and normally closed spare auxiliary switches contact both of the normally open and normally closed type shall be provided on each circuit breaker for use in remote indication over and above used in control scheme of the circuit breakers and for providing safety interlocking. If required, special contacts for use with trip coils and auto-re-closing operation shall also be provided. All auxiliary switches shall be placed in a weatherproof galvanized casing/epoxy painted casing and current rating of the switches shall be mentioned in the bid. Arrangement proposed for connecting control cables to the auxiliary switches should be clearly stated.

## 1.14 INTERLOCKS:

Necessary interlocks to prevent the closing or opening of the circuit breakers under low pressure and devices for initiating alarm shall be provided. Provision shall also be made to enable electrical interlocking of the isolator associated with the circuit breakers to prevent incorrect isolator operations, when the breaker is closed.

## 1.15 TERMINAL CONNECTORS AND EARTHING TERMINALS:

Terminal connectors as per **schedule –A** of Tender item description or as per **BOQ** shall be supplied. The terminal connector shall be suitable for both vertical and horizontal connections of the transmission line conductor or station bus bar. Suitable terminal earth connector must be compression type. The required bolts / nuts must be stain less steel with suitable check nut. Suitable terminal earth connector for earthing connections shall also be supplied.

## 1.16 TROPICALISATION:

All control wiring, electric motors and accessories shall by means of spray or dip coating, be protected against fungus growth and other harmful effects due to tropical environments.

## 1.17 GALVANISING:

All ferrous parts of breaker exposed to atmosphere shall be hot dip galvanized or epoxy painted. Bolts, nuts etc. hardware shall be hot dip galvanized or stainless steel.

## 1.18 TESTS:

### 1.18.1 Type Tests:

All the Circuit Breakers offered shall be fully type tested for following, as per **IEC-62271-100** as per latest edition at the NABL or Government approved laboratory of the eligible country.

The type test reports from NABL approved laboratory shall not be older than 10 (Ten) years ***and shall be valid as on the last date of submission of bid.***

- Lightning impulse withstand test
- Power Frequency voltage dry withstand test after Lightning Impulse test
- **Test to demonstrate the power frequency withstand capability of breaker in open condition at zero gauge & lockout pressure as per clause no. 1.11.3**
- Corona inception and extinction voltage test **(For 132 KV & 220 KV)**
- Temperature Rise and measurement of resistance test
- Short Time and peak current withstand test
- **Short Circuit Test duties**
  - *i. Basic Short circuit duty tests (T10, T30, T60, T100a, T100s)*
  - *ii. Short line fault test (L60, L75, L90)*
  - *iii. Single phase test*
- Out of phase closing test
- Line charging & switching current test

- Capacitor Current switching test
- Shunt reactor current switching test (for 220 kV Class)
- Mechanical Endurance test
- Tightness test
- Degree of protection for all cubicles
- **Seismic test**
- STC withstand test on terminal connector
- Temperature Rise & tightness test on terminal connector
- Tests on Auxiliary Switches
- **Test on hollow insulator of offered make as per IS:62155.**

The Bidder shall furnish one set of the type test reports for the Circuit breakers of the type and Design offered by him along with the bid.
The Type Test report shall not be older than 10 (TEN) years on the date of expiry of offer.

However, the purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative. For this purpose, the Bidder may quote unit rates for carrying out each type test.

**IMPORTANT NOTE:** In case of non-submission of some of the type test reports or type test reports of which validity is over, the bidder shall submit pending type test report/s from NABL accredited laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, free of cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid.

1.18.2 The following additional type tests are proposed to be conducted. The type tests charges for these tests shall be quoted along with other type tests as per IEC-62271 in the relevant schedule and the same shall be included in total bid price.

I. Out of phase closing test as per IEC-267 and IEC-271.
II. Line charging breaking current test. The breaker shall be able to interrupt the Line charging current with a test voltage of 1.4 pu instead of 1.2 pu as per IEC-271.

**III Shunt reactor current switching test (for 220 kV Class)**

1.18.3 ACCEPTANCE AND ROUTINE TESTS:

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of purchaser's representative. All tests report for acceptance / routine tests shall be submitted in ***spiral bound volume*** and got approved from the purchaser before dispatching the breaker.

**Following additional tests shall also be performed.**

In addition to above, speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto-re-closing and trip free operations under normal as well as limiting operating conditions (of control voltage) The tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at make-break operation and **dynamic contact resistance measurement (DCRM) etc.** This test shall be also performed at site.

*All the routine test reports for all the breakers and for all the insulators utilized shall be submitted with inspection report.*

1.18.4 **Pre –commissioning tests**

1. **Breaker closing and opening time.**
2. **Contact resistance measurement of main circuit. (CRM)**
3. **Dynamic Contact resistance measurement. (DCRM)**
4. **SF6 Purity & Dew Point Measurement**
5. **Insulation resistance of each pole.**
6. **Functional checking of control circuits interlocks, tripping through protective relays and auto reclose operation.**
7. **Trip free and anti-pumping operation.**
8. **Resistance of closing and tripping coils.**
9. **SF6 gas leakage check.**
10. **Operation check of pressure switches and gas density monitor during gas filling.**
11. **Checking of mechanical 'CLOSE' interlock, wherever applicable.**
12. **Check for annunciations in control room.**

*"The contractor shall ensure that erection, testing and commissioning of circuit breaker shall be carried out under the supervision of the circuit breaker manufacturer's representative. The commissioning report shall be signed by the manufacturer's representative.* ***However, service charges shall be paid as per GETCO ARC as per prevailing practice***

## 1.19 CONTROL:

1.19.1 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

1.19.2 Each breaker pole shall be provided with two (2) independent tripping circuits and coils each connected to a different set of protective relays with one set of pressure switch per pole and one number of density monitor per pole.

1.19.3 The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip push buttons/switch shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall be provided by the purchaser.

1.19.4 The trip coils shall be suitable for trip circuit - supervision. The trip circuit supervision relay would be provided by the purchaser. Necessary terminals shall be provided in the central control cabinet of the circuit breaker by the supplier. Trip circuit supervision shall be operative in both close and open conditions of the breaker.

1.19.5 Closing coil shall operate correctly at all values of voltage between 85% and 110 % of the rated voltage. Shunt trip shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on outdoor circuit

breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details, the offer is likely to be rejected.

1.19.6 The pressure switches used for interlock purposes shall have adequate contact ratings to be directly used in the closing and tripping circuits. In case. the contacts are not adequately rated and multiplying relays are used then the interlock for closing/opening operation of breaker shall be with no logic of the relay i.e. if dc supply to the interlock circuit falls then operation lockout shall take place.

1.19.7 For spring operated breaker mechanism box should be at a height such that one man can manually charge the spring from ground level/suitable platform shall be provided for easy operation.

1.19.8 The auxiliary switch of the breaker shall be preferably positively driven by the breaker operating rod and where due to construction features, same is not possible, a plug in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.

## 1.20 INTERLOCKS:

It is proposed to electrically interlock the circuit breaker with GETCO's associated air break isolating switches in accordance with switchyard safety interlocking scheme. The details of the scheme will be furnished to the successful bidder. All accessories required on breaker side for satisfactory operation of the scheme shall be deemed to be included in the scope of supply of this specification.

## 1.21 FITTINGS AND ACCESSORIES:

1.21.1 Following is a partial list of some of the major fittings and accessories to be furnished by supplier in the central control cabinet. Number and exact location of these parts shall be indicated in the bid.

a) Central control cabinet 'in accordance with Clause 1.31.10 complete with:

i. Cable glands

ii. Local /remote changeover switch

iii. Operation counter

iv. Gas pressure gauges

v. Fuses/MCB as required

vi. The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 12 terminals spare for owner's use.

b) Anti-pumping relay/Contactor. Rating and diagram plate in accordance with IEC incorporating year of manufacture.

1.21.2 All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade no.~~697~~ 631 of IS:5.

1.21.3 **Galvanizing**

All ferrous parts exposed to atmosphere of breaker shall be hot dip galvanized or epoxy painted. Bolts, nuts, etc. hardware shall be hot dip galvanized or stainless steel.

1.21.4 **Earthing**

The operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing

terminals suitable for bolted connection to MS flat to be provided by the GETCO for connection to station earth mat.

1.21.5 **Name and Rating Plates**

Circuit breaker and its operating device shall be provided with a rating plate or plates (**2 mm thick min**) marked with but not limited to following data:

a) Manufacturer's name or trade mark.

b) Type designation making it possible to get all the relevant information from the manufacturer.

**c) Type /designation of mechanism drive**

**d) Serial number and Year of manufacture.**

e) Rated voltage & Rated normal current.

f) Rated insulation level.

g) Rated frequency.

h) Rated short circuit breaking & making current.

i) First pole to clear factor.

j) Rated duration of short circuit.

k) Rated DC supply voltage of closing and opening devices with operating range.

l) Rated gas pressure for operation, alarm and lockout

m) Rated out of phase breaking current.

n) Rated supply voltage of auxiliary circuits.

**o) " Property of GETCO"**

**p) AT/purchase order number and project name**

The coils of operating devices shall have a reference mark permitting the data to be obtained from the manufacturer.

The rating plate shall be visible in position of normal service and installation. The rating plate shall be weather proof and corrosion proof.

### 1.21.6 Terminal Connectors

The terminal connectors shall meet the following requirements:

a) Terminal connectors shall be manufactured and tested as per **IS:5561**

b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

c) No part of a clamp shall be less than **12** mm thick.

d) All ferrous parts shall be hot dip galvanized confirming to IS:2633.

e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminum body.

f) Flexible connectors shall be made from tinned/copper/aluminum sheets.

g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

f) Connectors shall be designed to be corona free in accordance with the requirements stipulated in **IS:5561.**

**g)** The terminal connector shall be as per **schedule A of respective tender or tender BOQ.**

h) The terminal connector shall be compression type ~~to jumper side~~ / boltless type.

i) The required bolts and nuts must be stainless steel with suitable check nut.

1.21.7 **Fuses**

All Fuses**/MCBs** shall be of the HRC cartridge type, conforming to IS:2208 and suitable for mounting on plug-in type of fuse bases. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it shall be possible to change fuses with the circuit alive, without danger or contact with live conductor. Insulated fuse pulling handle shall be supplied with each control cabinet.

1.21.8 **Specification for Control Cabinets**

1. Control cabinets shall be of the free standing floor-mounting type in case where control cabinet and operating mechanism are separate.
2. Control cabinets shall be sheet steel enclosed and shall be dust weather and vermin proof. Sheet steel shall be at least 2.6 mm thick when control cabinets are specified for indoor use and at least 3.0mm thick when control cabinets are intended for outdoor operation. Control cabinets shall be provided with a hinged door and padlocking arrangement. The door hinges shall be of union joint type to facilitate easy removal. Door shall be properly braced to prevent wobbling.
3. Equipment and devices shall be suitable for operation on 240 V, 1 phase or 415 V, 3 phase, 3 wire or 4 wire, at frequency from 90% to 105% of normal 50 Hz.
4. Motors rated I KW and above being controlled from the control cabinet would be suitable for operation on a 415 V, 3 phase 50 Hz system. Fractional KW motors would be suitable for operation on a 240 V, I phase, 50 Hz supply system.
5. Fuses shall be HRC cartridge link type having prospective current rating of not less than 46 KA (rms). They shall be provided with visible operation indicators to show when they have operated. One fuse pulling handle shall be supplied for every ten fuses or a part thereof.
6. Push button shall be rated for not less than 6 Amps, 415 V A/C. or 2 Amps, **110/**220 V D.C. and shall be flush mounted on the cabinet

door and provided with appropriate nameplates. Red, Green and Amber indicating lamps shall be flush mounted and provided with series resistors to eliminate the possibility of short-circuiting of control supply in the event of using of lamps.

7. For motors up to 5 KW, contractors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 time the full load current of the motor at 0.2 p.f. For motors above 5 KW, automatic star delta type starters shall be provided. 3 pole contractors shall be furnished for 3 phase motors and 2-pole contractors for single-phase motors. Reversing contractors shall be provide with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provide. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS:2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class E or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage.

8. Single phasing presenter relay shall be provided for 3 phase motors to positive protection against single phasing**.**

9. Purchaser's power cables will be of 1100 volts grade stranded aluminum/Copper conductor. PVC insulated PVC sheathed single steel wire armored and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in supplier's scope of supply. Suitable brass cable glands shall be provided for cable entry.

10. **Vertical run of cables to the operating mechanism box shall be properly supported by providing the perforated closed type galvanized cable tray (Cable tray also to be supplied along with the Circuit Breaker) to be fixed as an integral part of the structures. The load of the cable shall not be transferred to the mechanism box/plug-in type terminal arrangement in any circumstances. Hanging or loose run of cable is not permitted.**

**The drawing of cable tray including fixing arrangement shall be incorporated in the GA drawing of CB also.**

11. **Wiring shall be done with stud type terminals and ring type lugs. More than two wires shall not be connected on each side of terminal.**
12. Wiring for all control circuits shall be carried out with 1100 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than **1.5 sq.mm**. At least 10% spare terminal blocks for control wire terminations shall be provided on each panel. The terminal blocks shall be ELMEX type. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the' designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity, which shall not be less than 10 Amps.
13. Separate terminal blocks shall be provided for terminating circuits of various voltage classes. CT loads shall be terminated on a separate block suitable for **4 sq.mm** and shall have provision for short-circuiting the CT secondary terminals. Stud type terminal connectors should be used for all CT circuits and main DC input.
14. Control cabinet shall be provided with 240 V, I-Phase 50 Hz, 20W fluorescent light fixture a suitably rated 240 V, I phase, 5 amps, 3 pin socket for hand lamps.
15. Strip heaters shall be provided inside each cabinet complete with thermostat (preferably 30 to 80 $^{0}$C setting) to prevent moisture condensation. Heaters shall be controlled by suitably rated double pole miniature circuit breakers.
16. Signal lamps provided shall be of neon screw type with series resistors, enclosed in bakelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body.
17. All AC control equipment shall be suitable for operation on 240 V, I phase 50 Hz system.

18. All doors, panels, removable covers and breaker openings shall be gasketed all around. All louvers shall have screens and filters. Cabinets shall be dust, moisture and vermin proof.

19. Spare marshalling kiosk should be provided for wiring if breaker pole is individually operated and it should be provided and reasonable height from ground and it should be tested with IP 55. the thickness of MK box should not be less than 3mm with rain shed arrangement.

20. Following minimum numbers of potential free contacts over and above the breaker scheme shall be provided to meet the requirements of SCADA:

***For total control, monitoring, supervision and operation from SCADA system potential free contacts shall be provided for each and every interface of Switchgear status, Control, Monitoring, Interlocking, Alarms, Troubles etc. and all other interfaces considered in LCC which are mandatory.***

**[I.] 66 kV, & 132 kV CB:**

1) Dual DC supply arrangement shall be provided.
2) Pressure switch shall be provided with following minimum numbers of potential free contacts for breaker gas monitoring *in SCADA / control panel* over and above provided for scheme.
   (a) SF6 gas pressure normal – *minimum* 1 NO or 1 NC plus one spare
   (b) SF6 gas pressure low – *minimum* 2 NO or 2 NC plus one spare
   (c) SF6 gas pressure lockout - *minimum* 2 NO or 2 NC plus one spare

3) Following minimum numbers of potential free contacts are required to be provided for breaker monitoring in SCADA / control panel; over and above provided for breaker scheme:

   (a) Breaker spring charge – *minimum* 2 NO or 2 NC plus one spare
   (b) Control supply DC1 & DC2 fail, Motor MCB Trip, CB AC supply fail indication contacts Plus one spare.
   (c) Local remote switch – *minimum* 1 local and remote plus one spare for each position i.e. Local & Remote
   (d) CB ready status for Auto reclose for 145 kV - *minimum* 1 NO or 1 NC plus one spare
   (e) *Other interfaces if any*

**In any condition scheme requirement shall be fulfilled.**

**[II.] 220 KV CB:**

1) Dual DC supply arrangement shall be provided.
2) Pressure witch shall be provided with following minimum numbers of potential free contacts for breaker gas monitoring status; over and above provided for breaker scheme:

   (a) SF6 gas pressure normal – *minimum* 2 NO or 2 NC plus one spare
   (b) SF6 gas pressure low – *minimum* 3 NO or 3 NC plus one spare
   (c) SF6 gas pressure lockout - *minimum* 3 NO or 3 NC plus one spare

3) Following minimum numbers of potential free contacts are required to be provided for breaker monitoring in SCADA / control panel; over and above provided for breaker scheme:

   (a) Breaker spring charge – *minimum* 3 NO or 3 NC plus one spare
   (b) CB ready status for Auto reclose -3NO or 3NC plus one spare
   (c) Pole Discrepancy Operated - *minimum* 3NO or 3NC plus one spare
   (d) Control supply DC1 & DC2 fail, Motor MCB Trip, CB AC supply fail indication contacts plus one spare.
   (e) Local remote switch – *minimum* one local & one remote plus one spare for each position i.e. Local & Remote
   (f) *Other interfaces if any*

**In any condition scheme requirement shall be fulfilled.**

1.21.9 **Motors**

1.21.10 Motors shall be "Squirrel Cage" three phase induction or universal type motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment.

1.21.11 **Sulphur Hexafluoride Gas (SF6 Gas)**

a) The SF6 gas shall comply with IEC-376, 376A and 376B and be suitable in all respects for use in the switchgear under the worst operating conditions.

b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations.

IS:4379 Identification of the contents of industrial gas cylinders.

IS:7311 Seamless high carbon steel cylinders for per manet and high pressure liquefiable gases.

The cylinders shall also meet Indian Boiler regulations and certificate should be submitted.

c) Test: SF6 gas should have been tested for purity, dew point, air, break down voltage, **hydrolysable fluorides**, water contents as per IEC:376, 376A and 376B and test certificates shall be furnished to GETCO indicating all the tests as per

**The quality of new filled-in SF6 gas shall meet the following requirements in line with IEC 60376.**

| Content | Specification | Analytical methods (for indication only, not exhaustive) | Precision |
|---|---|---|---|
| Air | 2 g/kg [note 1] | Infrared absorption method | 35 mg/kg |
| | | Gas-chromatographic method | 3 – 10 mg/kg |
| | | Density method | 10 mg/kg |
| CF4 | 2 400 mg/kg [note 2] | Gas-chromatographic method | 9 mg/kg |
| H2O | 25 mg/kg [note 3] | Gravimetric method | 0.5 mg/kg [note 3] |
| | | Electrolytic method | 2 – 15 mg/kg |
| | | Dew point method | 1 °C |
| Mineral oil | 10 mg/kg | Photometric method | < 2 mg/kg |
| | | Gravimetric method | 0.5 mg/kg [note 5] |
| Total acidity expressed in HF | 1 mg/kg [note 4] | Titration | 0.2 mg/kg |
| S02 | < 1ppmv | - | - |

**NOTE 1** 2 g/kg is equivalent to 1 % vol under ambient conditions (100 kPa and 20 °C [1]).
**NOTE 2** 2400 mg/kg is equivalent to 4 000 µl/l under ambient conditions (100 kPa and 20 °C [1]).
**NOTE 3** 25 mg/kg (25 mg/kg) is equivalent to 200 µl/l and to a dew point of –36 °C, measured at ambient conditions (100 kPa and 20 °C [1]).
**NOTE 4** 1 mg/kg is equivalent to 7,3 µl/l under ambient conditions (100 kPa and 20 °C [1]).
**NOTE 5** Depending on the sample size

**Reuse or recycling of removed gas:**

The supplier should provide guidelines or recommended practices for the reuse or recycling of SF6 gas removed from the equipment. These guidelines should be consistent with current industry practices, as they

pertain to the effect of SF6 on global warming; i.e. SF6 gas should be reused and recycled whenever possible and never be unnecessarily released into the atmosphere. Clear instructions shall be provided by bidder about handling, recycling & treatment of new and used SF6 gas.

**SF6 Gas filled inside GIS before charging is fresh SF6 Gas, hence it shall be considered as new Gas which shall be tested as per IEC 60376. Hence during commissioning measured purity, dew point, air, hydrolysable fluorides, and water contents shall be in line with IEC:60376, 60376A & 60376B.**

**Gas bottles should be tested for leakage during receipt at site.**

**Components may be filled with N2 for transportation and refilled with SF6 at site.**

## 1.22 TECHNICAL AND GUARANTEED PARTICULARS:

The bidder shall furnish all guaranteed technical particulars as called for in Schedule 'A' of this specification. Particulars which are subject to guarantee shall be clearly marked. Bids lacking information in G.T.P. are liable to be rejected.

# SPECIFIC TECHNICAL REQUIREMENTS

## 1 SCOPE:

This section cover the specific technical particulars, climatic and isoceraunic conditions and system particulars suiting which the circuit breakers shall be offered as per the General Technical Requirements in this specification, and the Schedule of Requirements specified herein for the various sub-stations.

## 2 TYPE AND RATING:

The 220KV, 132KV & 66 KV circuit breakers shall comply with the following technical requirements:

| | | | | |
|---|---|---|---|---|
| 1 | Nominal system voltage (KV) | 220 | 132 | **66** |
| 2 | Highest system voltage (KV) | 245 | 145 | 72.5 |
| 3 | Rated frequency (Hz) | 50 | 50 | 50 |
| 4 | Number of poles | 3 | 3 | 3 |
| 5 | Type | Out door SF6 | Out door SF6 | Outdoor SF6 |
| 6 | Number of poles | 3 | 3 | 3 |
| 7 | Type of operation | **Individually operated single poles. However 3 poles shall be Electrically gang operated)** | **Gang operated single poles** | |
| 8 | Basic insulation level<br>(a) 1.2 x 50 microsecond impulse withstand voltage (KVP) to earth<br>(b) One minute power frequency withstand voltage (KV rms) | 1050<br><br>460 | 650<br><br>275 | 350<br><br>140 |
| 9 | Rated normal current (Amp.) | 2000 | 1600 | 1600 |
| 10 | Rated short circuit breaking current (KA rms) | 40 | 40 | 31.5 |

| | | | | |
|---|---|---|---|---|
| 11 | Total break time for any current up to the rated breaking current (Cycle) | 3 | 3 | 3 |
| 12 | Closing time (Cycle) | 3 | 3 | 3 |
| 13 | Short time current carrying capacity for 3 Sec (KA rms) | 40 | 40 | 31.5 |
| 14 | Rated duration of short circuit (Sec) | 3 | 3 | 3 |
| 15 | Phase to phase spacing in the switchyard i.e. inter-pole spacing for breaker (mm) | 4500 | 2100 | 790 |
| 16 | Required ground clearance from the lowest line terminal (mm) **up to plinth level**<br>(a) If both the terminals are not in the same horizontal plane<br>(b) If both the terminals are in the same horizontal plane | 5500<br>5500 | 4600<br>4600 | 4000<br>4000 |
| 18 | Minimum height of the live part to ground level (mm)**(up to plinth level)** | 5500 | 4600 | 4000 |
| 19 | Operating mechanism | Spring charge | Spring charge | Spring charge |
| 20 | Rated transient recovery voltage for terminal fault | As per Clause of IS: 13118 | As per Clause of IS: 13118 | As per Clause of IS: 13118 |
| 21 | Rated line charging current breaking capacity (Amp) | As per IEC | As per IEC | As per IEC |
| 22 | Small inductive current breaking capacity | As per IEC | As per IEC | As per IEC |
| 23 | First pole to clear factor | 1.3 | 1.3 | 1.5 |
| 24 | Rated short circuit making current (KA rms) | 100 KA | 100 KA | 78.75 |
| 25 | Rated operating duty | O-0.3S CO-3min-CO | O-0.3S CO-3min-CO | O-0.3S CO-3min-CO |
| 26 | Automatic rapid reclosing | 1 phase and 3 phase | 3 phase | 3 phase |

| | | | | |
|---|---|---|---|---|
| 27 | Maximum acceptable difference at the instance of closing / operating of contacts | As per standard | As per standard | As per standard |
| 28 | Total minimum creepage distance (mm) for support insulator | 6125 | 3625 | 1810 |
| 29 | Control circuit voltage (Volt) | 220/**110** DC | 220/110 DC | 220/110 DC |
| **30** | **Rated Sf6 Gas pressure (AT 20°C)** | **—** | **----** | 5 kg/Cm2 min |

**Note: The values indicated are for specific creepage of 25mm/kV. In case of specific creepage of 31mm/kV specified in BOM/Tender, the Minimum Creepage distance values shall be considered proportionately**

## 3 EARTHQUAKE AND WIND DESIGN LOADS:

"Each circuit breaker including its supporting structure shall be designed to withstand repeated earthquake acceleration of 0.3 g for 66 kV and 0.5g (H) for 132KV & 220Kv CB and wind loads of 150 Kg/m2 on the project area (non- simultaneous) without damage to component parts and without impairments operation. Necessary type test reports for Seismic test shall be submitted with the bid."

## 4.0 AUXILIARY POWER SUPPLY:

4.1 The bidder shall quote in his bid estimated requirements of AC and DC power for equipment covered by this specification.

4.2 Power supply for auxiliaries will be available at 240 Volts single phase and 425 volts, 3 phase AC 50 Hz. The frequency can vary between 90% and 105% of normal frequency of 50 Hz. And voltage would vary from 110% to 85%-of the normal value.

DC supply at 110 Volts DC / 220 Volts DC 2 wire will be available from the Station Battery through the DC panels, DC supply is subject to variations of –15% to + 10%.

# 5. PACKING AND TRANSPORT INSTRUCTIONS

**Bidder shall ensure that all equipment covered by this specification shall be prepared for rail/road transport and be packed in such a manner as to protect it from damage in transit. The Bidder shall be responsible for and make good at his own expense any or all damage due to improper preparation and packing.**

**Loose material, e.g. Bolts, Nuts etc shall be packed in gunny bags and sealed in polythene bags with proper tagging.**

**Components containing glass shall be carefully covered with shock absorbing protective material such as 'Thermocol'.**

**All openings in the equipment shall be tightly covered plugged or capped to prevent dust and foreign material from entering in.**

**Wherever necessary proper arrangements for attaching slings for lifting shall be provided.**

**All spare parts shall be packed and treated for long storage at site.**

**Any material found short inside the intact packing cases shall be supplied by the Vendor/Contractor at no extra cost to the purchaser.**

**No material shall be dispatched without prior consent of the purchaser.**

## 6.0 ACTIONS REQUIRED FOR DEFECTS OBSERVED DURING DEFECT LIABILITY PERIOD (Warranty periods)

The actions required to be taken by OEM/contractor in case of defects observed in AIS type Circuit Breakers of ratings 66 kV to 220KV class during the warranty period (defect liability period) shall be as per following.

| | **Nature of problem** | **Corrective measures to be taken by OEM/contractor** |
|---|---|---|
| 1 | Blasting of interrupter/ pole column | Replacement of compete CB pole Including SF6 gas |
| | a. Abnormal DCRM and Travel Measurement<br>b. Contact assembly and internal component damage, misalignment not leading to complete failure of interrupter | Repair/replacement of affected assembly/ component based on repair procedure approved by QA |
| 2 | Crack in insulator, cementing joint of interrupter , pole column | Replacement of affected par |
| 3 | SF6 gas leakage from sealing and bolted joints. SF6 gas leakage detectable by any Leakage Detection Method | Rectification by replacement of gasket, O-ring, sealing, Interrupter or affected part to be replaced etc<br>If unable to arrest the leakage in 02 attempts, replacement of interrupter/column |
| 4 | SF6 gas purity for new gas ( before charging) as per IEC 60376 after charging as per **IEC60480** | Re-conditioning of gas.<br>If does not improve, complete evacuation of CB, replacement filter material and gas. |
| 5 | Pole/ break discrepancy (during O&M) Limits:<br>Break to Break (Opening/Closing) : max. 2.5 ms Phase to Phase (Opening) : max. 3.33 ms Phase to Phase (Closing) : max 5 ms | Rectification/replacement of affected parts |
| 6 | Static Contact Resistance: increase >50% from factory/ pre-commissioning value or 75 micro-ohm/ break whichever is lower | Rectification/ Replacement of pole |
| 7 | Drive mechanism assembly failure | Rectification/ Replacement of affected part |
| 8 | Trip/ close coil, density monitor, relays and contactors and components of common MB | Replacement of affected part |

Note: 1) Replaced/Repaired/Refurbished Equipment (or part of equipment) shall have 2 years' warranty without prejudice to contractual warranty period

2) The measurement at site shall be carried out as per GETCO standard Pre-commissioning procedures.

## SCHEDULE - A

# Guaranteed Technical Particulars for Circuit Breakers:

**The bidder must fill up all the points of GTP for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.**

1. Name of manufacturer
2. Manufacturer's type and designation of breaker
2.a Manufacturer's type and designation of mechanism

   *(as per Mech. Endu. test report)*
3. Governing standard
4. Rated Voltage (KV)
5. Maximum continuous rated service voltage (KV)
6. Frequency (Hz)
7. Class (indoor or outdoor)
8. Normal current rating (approx.)

   Under standard conditions

   Under site conditions

   Derating factor, if any, for site conditions
9. Short-time current rating (KA) for 3 sec
10. Rated short circuit breaking current
    a) Rated short circuit current (A.C. component) -at- KV
    b) Percentage D.C. component -at- KV
    c) Asymmetrical breaking current (including -at- KV
       D.C. component) KA nns.
11. Making capacity (KA peak) -at- KV
12. Total break time (milliseconds)

a) For interruption of 10% of the rated capacity

b) For interruption of 30% of the rated capacity

c) For interruption of 60% of rated capacity

d) For interruption of the full rated capacity

13 Arcing time (milliseconds)

14 Minimum reclosing rated interrupting capacity
from the instant of the trip coil energisation (milliseconds)

15 Minimum dead time

a) 3-phase reclosing (milliseconds)

b) I-phase reclosing (milliseconds)

c) Limit of adjustment of dead time for 3-phase reclosing

d) Limit of adjustment of dead time for I-phase reclosing

16. Rate of re-striking voltage for 100%, 50% or 30% rated capacity.

a) Amplitude factor

b) Phase factor

c) Natural frequency (Hz)

d)Rate of rise of re-striking voltage (KV/micro-sec.)

17. a) Recovery voltage when circuit breaker tested
at 100% rated breaking capacity (KV inst.)

b) Rate of rise of re-striking voltage at breaking

I. For 30% breaking capacity, (KV/micro seconds)

II. For 100% breaking capacity (KV/micro seconds)

c) Maximum over voltage factor of the circuit breaker when switching off

i) Unloaded transformers

ii) Loaded transformers

iii) Open circuited lines

18. When switching of synchronous systems

a) Max. Current (KA)

b) Max. Voltage of I pole (KV)

19. Maximum interrupting capacity under phase opposition condition (MVA)

20. Maximum line charging current breaking capacity without over-voltage exceeding

2.5 times the rated phase to neutral voltage (Amps.)

21. Maximum line charging current breaking capacity and corresponding over voltage recorded in test.

a) On supply side

b Online side

22. Maximum cable charging current breaking capacity and corresponding over voltage recorded in test

a) On supply side.

b) Online side.

23. Maximum shunt capacitor bank switching capacity (single bank) (MVA)

24. Maximum breaking capacity on kilometric faults (MVA)

25. Dry 1-minute power frequency test with stand voltage, for complete circuit breaker

a) Between line terminals and grounded parts (KV rms)

b) Between terminal with breaker contacts open (KV rms)

26. Wet I minute power frequency test withstand voltage for complete circuit breaker

a) Between line terminals and grounded parts (KV rms)

b) Between terminal with breaker contacts open (KV rms)

27. a) i) R.I.V. level at specified voltage

ii) Corona inception voltage (KV)

iii) Corona extinction voltage (KV)

b) Whether the circuit breaker is fixed trip or trip free

**SUPPORTING INSULATORS**

28. Make and type

29. Weight

30. Transport dimensions

31. Height above pole required to remove porcelain (mm)

32. Insulation class.

33. Visible corona discharge voltage.

34. Dry 1minute power frequency flashover voltage (KV rms)

35. Wet 10 sec. power frequency flashover voltage (KV rms)

36. 1.2/50 microsecond impulse flashover voltage (KV peak)

37. Nature of dielectric.

38. Total minimum Creepage distance (mm)

39. Minimum clearance in air

a) Between phases (mm) (Live parts)

b) Live parts & earth (mm)

c) Live parts to **Plinth** level (mm).

d) Center to center distance between phase (mm)

40 Permissible safe cantilever loading on installed porcelain (Kg.m)

40.a Permissible safe compressive strength of installed porcelain

## CONSTRUCTIONAL FEATURES :

41. No. of poles per circuit breaker

42. No. of break per pole

43. Length of contact travel (mm)

44. Total length of breaks per phase (mm)

45. Rate of contact travel

a) At tripping (millimeters/sec)

b) At closing (millimeters/sec.)

46 Type of devices if any used to obtain uniform voltage distribution between breakers.

47 Type of main contacts

48. Material of main contacts

49. Whether main contacts Silver plated (Yes/No)

- Thickness of silver coating on main contracts (mm)
- Type of arcing contacts & material
- Contact pressure on arcing contacts ($KG/m^2$)

50. Type of auxiliary switches

51 Material of switch contacts

52 Whether contacts silver plated (Yes/No)

53 No. of auxiliary switch contacts operating with all the three poles of a breaker

a) Which are closed when breaker is open (NC)

b) Which are open when breaker is open (NO)

c) Those adjustable with respect to the position of main contacts

54. No. of auxiliary switch contacts operating with individual pole of a breaker

a) Which are closed when breaker is open (NC)

b) Which are open when breaker is open (NO)

c) Those adjustable with respect to the position of main contacts

55. No. of spare auxiliary switch contacts operating with all three poles of a breaker

a) Which are closed when breaker is open (NC)

b) Which are open when breaker is open (NO)

c) Those adjustable with respect to the position of main contacts

56. No. of spare auxiliary switch contacts operative with individual pole of breaker

a) Which are closed when breaker is open (NC)

b) Which are open when breaker is open (NO)

c) Which are adjustable with respect to the position of main contact

57. No. of operations possible without maintenance

a) At full rated interrupting capacity

b) At 50% of rated interrupting capacity

c) At 100% of rated current

d) At 50% of rated current

58. Mounting flange details (PCD & Diameter)

59. Method of closing

a) Normal Electrical/Mechanical

b) Emergency Electrical/Mechanical

60. Type of closing mechanism (spring)

61. a) Normal voltage of closing

b) Pick up range, (Volts)

6 2. a) Power at normal voltage of closing mechanism (watts)

b) Power at 85% normal voltage (watts)

63. Type of tripping mechanism (spring)

64. Normal voltage of tripping coils (Volts)

'65. a) Power at normal voltage for tripping coils (watts)

b) Power at 70% normal voltage for tripping coils (watts)

66. Arc duration at 100% interruption capacity (ms)

a) Power at Normal voltage for tripping coils (watts)

b) Power at 70% normal voltage for tripping coils (watts)

67. Arc duration at 100% interruption capacity (ms)

a) Opening

68. Total length of the arc (mm)

69. Max. length of the arc (in sec)

70. Total interrupting time measured from instant of trip coil opening of main contact

71. Closing time measured from instant of application of power to closing device up to closing of main contact

72. Critical current (current giving the longest are when a break takes place) (KA)

73. Contingencies for which alarm provided

74. Design data for supporting structure

75. Weight of supporting steel structure per breaker

76. a) Weight of complete circuit breaker (Kg.)

b) Impact loading for foundation design, to include dead load plus impact value on opening at maximum interrupting ratings, in terms of equivalent static load (kg)

c) Overall dimensions:

Height (mm)

Width (nun)

Length (mm)

77. Descriptive leaflets enclosed

78. Rated pressure of SF6 gas in the circuit breaker (Kg. /$CM^2$)

79. Rated pressure of SF6 gas in the gas cylinders ($Kg/cm^2$)

80. Quantity of SF6 gas required per single pole unit (Kg.)

81. Quantity of SF6 gas per cylinder (Kg.)

82. Weight of empty cylinder (Kg.)

83. Quantity of absorbent required per pole (Kg.)

84. Recommended interval for renewal of absorbent in case of outdoor circuit breakers operating in tropical conditions

85. Chemical composition of the absorbent

86. Quantity of absorbent covered in the scope of supply (including spare quantity) (Kg.)

87. Limits of gas pressure for proper operation of circuit breaker

88. Pressure and temperature at which the temperature compensated gas pressure switch will

a) Give alarm ($Kg/cm^2$ $^0C$)

b) Cutoff ($Kg/cm^2$ $^0C$)

89. Name of SF6 suppliers and country of origin.

90. Quantity of SF6 gas supplied for

a) Actual use in breakers (Kg.)

b) As spare (Kg.) ( free of cost )

91. Chemical composition of gas

a) Qty. of air by weights (ppm)

b) Qty. of $H_2O$ by weight (ppm)

c) Qty. of CF4 - by weight (ppm)

d) Qty. of acid by weight (ppm)

92. Type of operating mechanism offered

93. Voltage and power supply system for which the temp. compensating gas pressure switch and other pressure switches are suitable.

94. Recommended overhauling intervals for

a) Circuit Breakers

b) Spring operating system.

95. Details of Control Cubicle

(a) Degree of Protection :

(b) Type and thickness of gasket :

96. Details of (counter)

97 Electrical (counter).

**98 Spares supplied free of cost with each C.B**

| | | | |
|---|---|---|---|
| i) | SF6 gas | 20% of total gas in separate cylinder | Yes/No |
| ii) | Trip coil | 1 set | Yes/No |
| iii) | Closing coil | 1 set | Yes/No |

**99** Special tools, required for assembly gas charging and maintenance of circuit breakers Yes/No

100 *Terminal connector*

(Bimetallic compression type)

## SCHEDULE – B

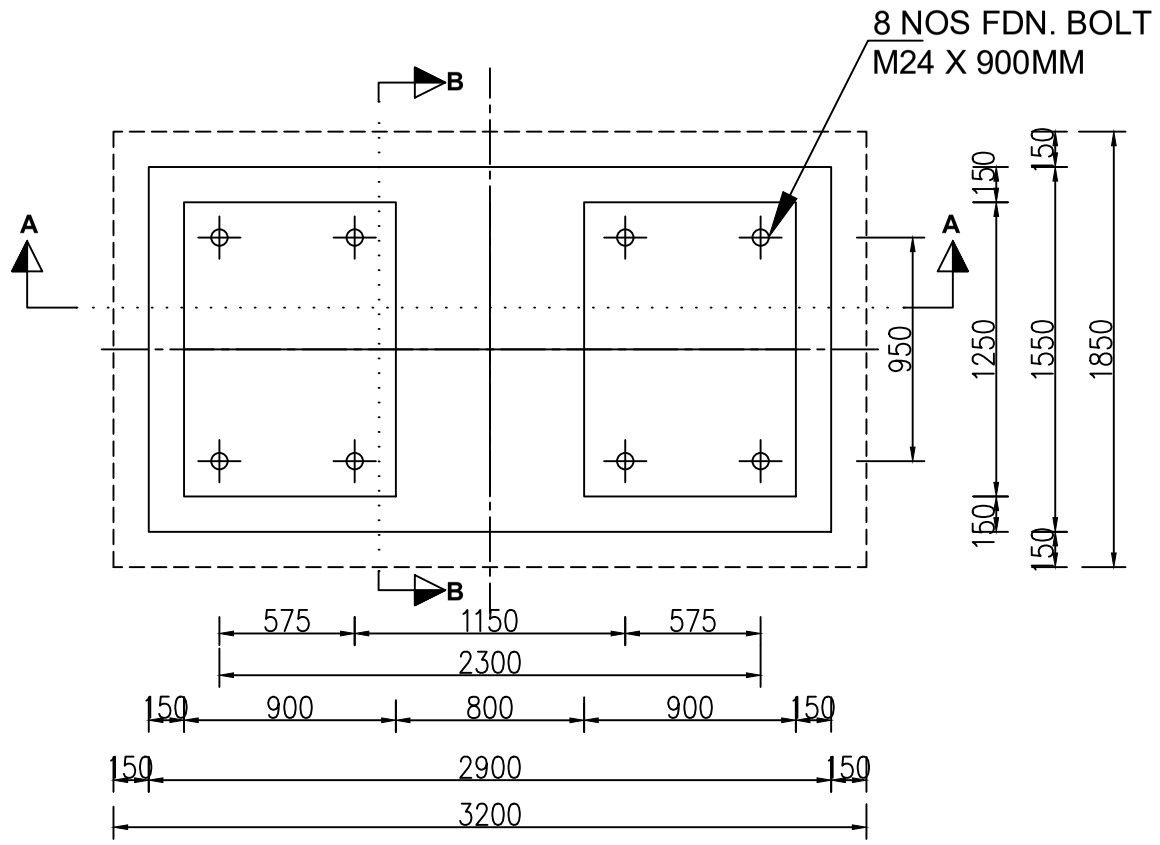
## List of documents attached with technical bid:

Bidder shall invariably attach the following documents and clearly marked and duly flagged in technical bid. In absence of these documents offer will be evaluated as a non submission.

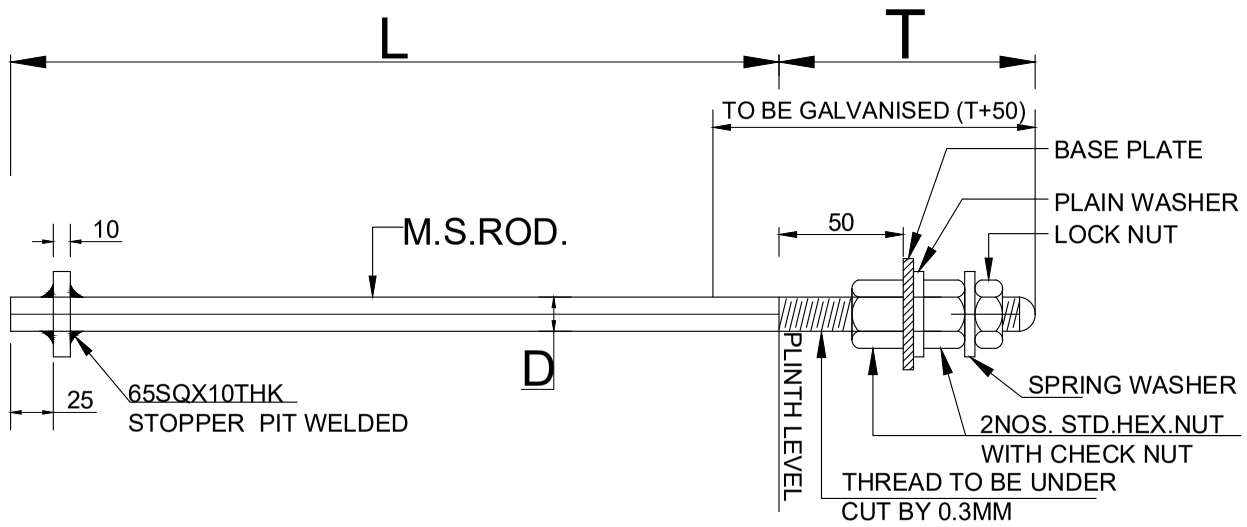
| Sr. No. | Particulars of document | Whether attached the with technical bid |
|---|---|---|
| 1 | Drawings in AutoCAD format | |
| 2 | Drawings hard copies as indicated in specification | |
| 3 | Manual in PDF format | |
| 4 | QAP for manufacturing process in SOFT format | |
| 5 | QAP for manufacturing process in Hard format | |
| 6 | FQP in SOFT format | |
| 7 | FQP in Hard copy | |
| 8 | Type test Reports in hard copies & **soft copies** | |
| a | for breaker | |
| b | for clamps & connectors | |
| **c** | **for hollow insulators** | |
| 9 | Confirmation regarding type tests as per clause no. 1.10(a) page no. 10 – "IMPORTANT NOTE" | |
| 10 | Guaranteed Technical Particulars, completely filled in | |
| 11 | Any other essential documents | |

**SIGNATURE OF BIDDER** **COMPANY'S ROUND SEAL**

**DATE:**
**PLACE:**




## FOUNDATION PLAN




## TYPICAL FOUNDATION BOLTS

| STR. TYPE | D= (Ø) DIA. OF BOLT (MM) | T (MM) | L (MM) | QTY. OF BOLTS PER STR. |
|---|---|---|---|---|
| BREAKER | 24 | 150 | 750 | 8X1=8 |

**GENERAL NOTES:-**

1. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS ARE IN METER.
2. DO NOT SCALE THIS DRAWING ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THE GRADE OF CONCRETE SHALL BE M20 EXCEPT LEAN CONCRETE.
4. THIS DRAWING IS ONLY FOR SUPPORT STRUCTURE DESIGN OF CIRCUIT BREAKER.
5. FOUNDATION DRAWING SHALL BE ISSUED BY CORPORATE ENGG. FOR ABOVE FOUNDATION BASE DEPENDING UPON TYPE OF SOIL.
6. FOUNDATION BOLTS ARE IN THE SCOPE OF GETCO IN CASE OF DIRECT PROCUREMENT TENDER.
7. FOUNDATION BOLTS ARE IN THE SCOPE OF CONTRACTOR IN CASE OF TURNKEY EPC / DEPOSIT WORK.

| FOUNDATION LOAD CONSIDERED | |
|---|---|
| DESCRIPTION | VALUE |
| COMPRESSION (INCLUDING VERTICAL LOAD) | 3047 Kg. |
| TENSION / UPLIFT | 2039 Kg. |
| LONGITUDINAL | 127 Kg. |
| TRANSVERSE | 127 Kg. |

EXECUTION PURPOSE

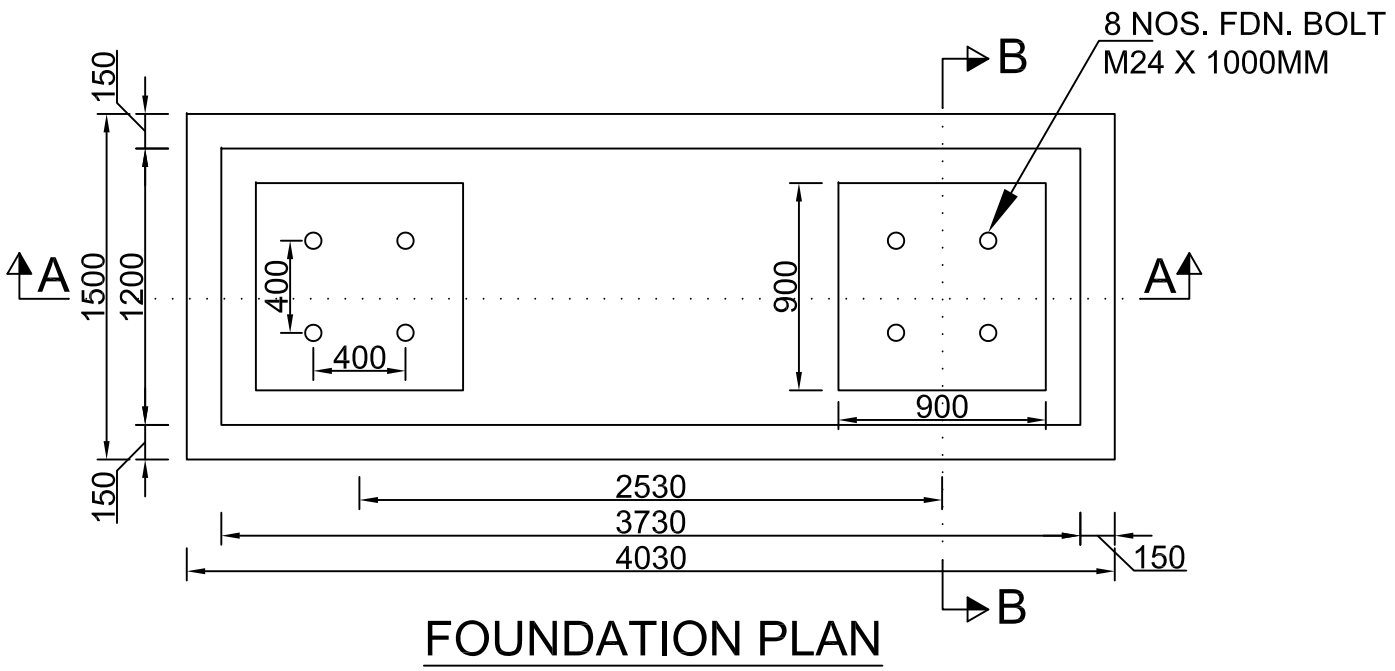
**GUJARAT ENERGY TRANSMISSION CORPN.LTD.**
S.P.VIDYUT BHAVAN, RACE COURSE,
VADODARA - 390 007

**TYPICAL FOUNDATION PLAN FOR 66kV "CIRCUIT BREAKER"**

| SR NO. | REFERENCE | REV: | DESCRIPTION |
|---|---|---|---|
| | | R1 | MODIFICATION IN GENERAL NOTE |
| | | R0 | FIRST PREPARATION 04.03.2015 |

| DRAWN: | CHECKED: | APPD: | SIZE: |
|---|---|---|---|
| JE(CIVIL) | DE(CIVIL) EE(CIVIL) | SE(ENGG.) ACE(ENGG.) | A2 |

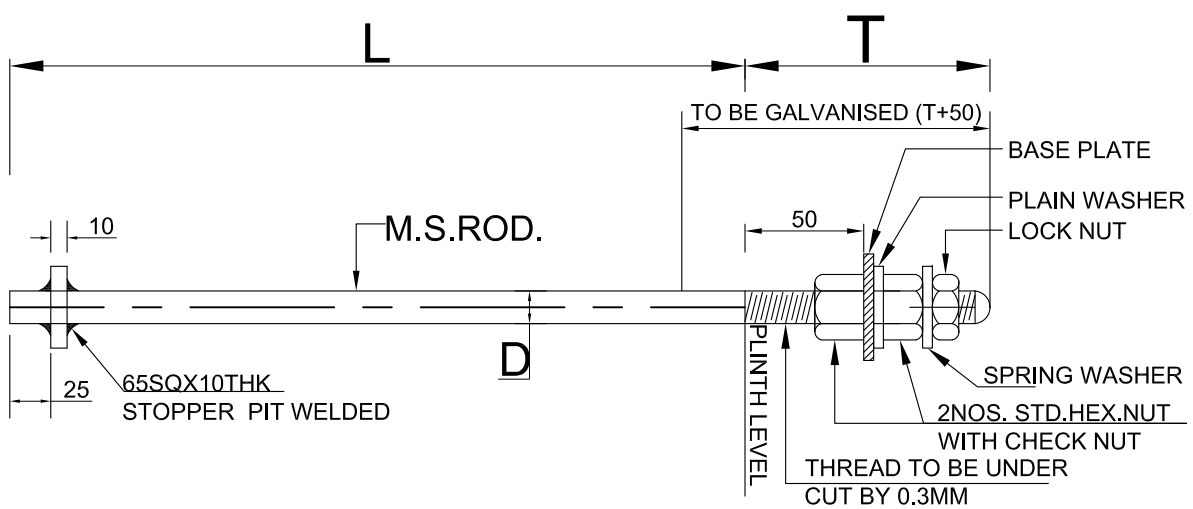
| SCALE: | DATE: | DRG. NO: | SHEET: | REV: |
|---|---|---|---|---|
| N.T.S | 15.05.2022 | GETCO / C / 06S-STD/ CB-BASE-19 | 1 OF 3 | R1 |




FOUNDATION PLAN

**GENERAL NOTES:-**

1. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS ARE IN METER.
2. DO NOT SCALE THIS DRAWING ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THE GRADE OF CONCRETE SHALL BE M20 EXCEPT LEAN CONCRETE.
4. THIS DRAWING IS ONLY FOR SUPPORT STRUCTURE DESIGN OF CIRCUIT BREAKER.
5. FOUNDATION DRAWING SHALL BE ISSUED BY CORPORATE ENGG. FOR ABOVE FOUNDATION BASE DEPENDING UPON TYPE OF SOIL.
6. FOUNDATION BOLTS ARE IN THE SCOPE OF GETCO IN CASE OF DIRECT PROCUREMENT TENDER.
7. FOUNDATION BOLTS ARE IN THE SCOPE OF CONTRACTOR IN CASE OF TURNKEY EPC / DEPOSIT WORK.




**TYPICAL FOUNDATION BOLTS**

| STR. TYPE | D= (Ø) DIA. OF BOLT (MM) | T (MM) | L (MM) | QTY. OF BOLTS PER STR. |
|---|---|---|---|---|
| BREAKER | 24 | 150 | 850 | 8X1=8 |

EXECUTION PURPOSE

**GUJARAT ENERGY TRANSMISSION CORPN.LTD.**
S.P.VIDYUT BHAVAN, RACE COURSE,
VADODARA - 390 007

**TYPICAL FOUNDATION PLAN FOR 132kV "CIRCUIT BREAKER"**

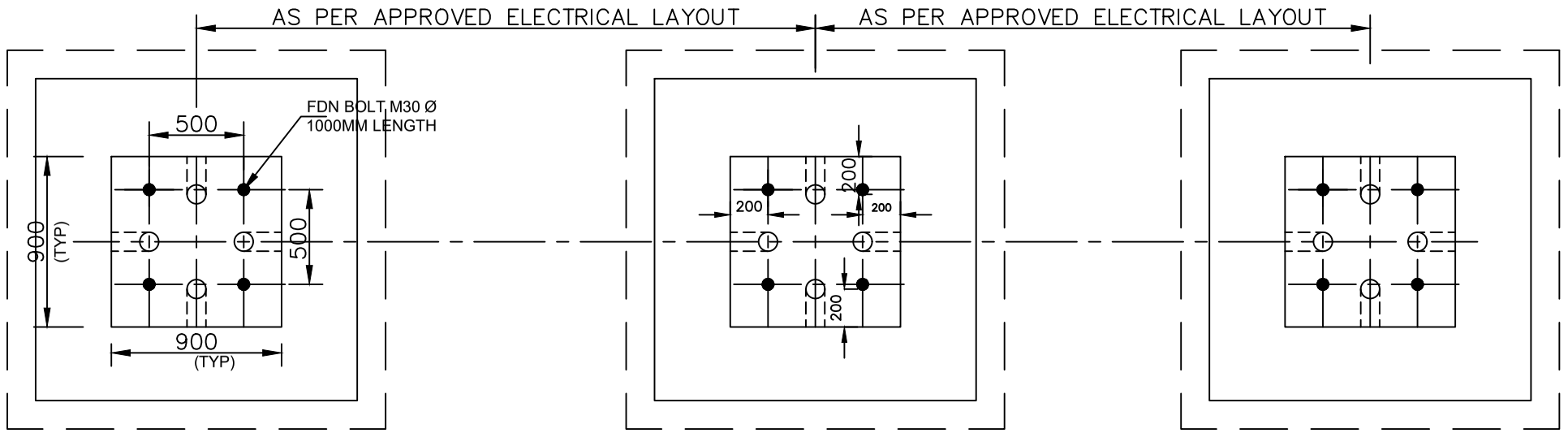
| SR NO. | REFERENCE | REV: | DESCRIPTION |
|---|---|---|---|
| | | R0 | FIRST PREPARATION |

| DRAWN: | CHECKED: | APPD: | SIZE: |
|---|---|---|---|
| JE(CIVIL) | DE(CIVIL) EE(CIVIL) | SE(ENGG.) ACE(ENGG.) | A2 |

| SCALE: | DATE: | DRG. NO: | SHEET: | REV: |
|---|---|---|---|---|
| N.T.S | 10.02.2022 | GETCO / C / 01S-STD/ CB-BASE-19 | 1 OF 1 | R0 |

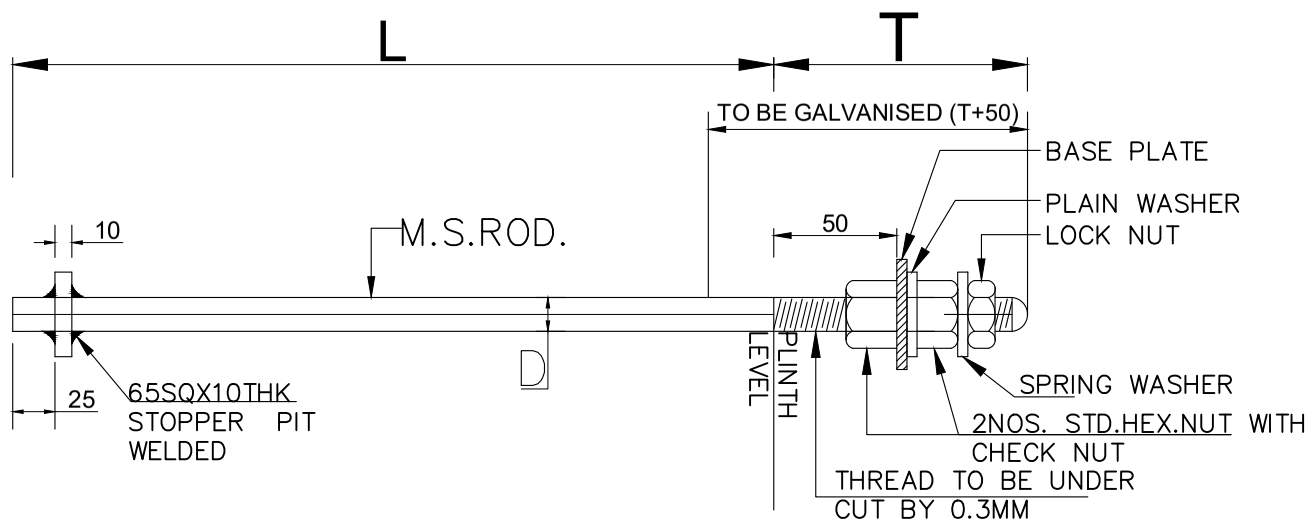
**GENERAL NOTES:-**

1. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS ARE IN METER.
2. DO NOT SCALE THIS DRAWING ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THE GRADE OF CONCRETE SHALL BE M20 EXCEPT LEAN CONCRETE.
4. THIS DRAWING IS ONLY FOR SUPPORT STRUCTURE DESIGN OF CIRCUIT BREAKER.
5. FOUNDATION DRAWING SHALL BE ISSUED BY CORPORATE ENGG. FOR ABOVE FOUNDATION BASE DEPENDING UPON TYPE OF SOIL.
6. FOUNDATION BOLTS ARE IN THE SCOPE OF GETCO IN CASE OF DIRECT PROCUREMENT TENDER.
7. FOUNDATION BOLTS ARE IN THE SCOPE OF CONTRACTOR IN CASE OF TURNKEY EPC / DEPOSIT WORK.




## EXCAVATION PLAN

| STR. TYPE | D= (ø) DIA. OF BOLT (MM) | T (MM) | L (MM) | QTY. OF BOLTS PER STR. |
|---|---|---|---|---|
| BREAKER | 30 | 150 | 850 | 4X1=4 |




## TYPICAL FOUNDATION BOLTS

| FOUNDATION LOAD CONSIDERED | |
|---|---|
| DESCRIPTION | VALUE |
| COMPRESSION (INCLUDING VERTICAL LOAD) | 5098.6 Kg. |
| TENSION / UPLIFT | 2345.36 Kg. |
| LONGITUDINAL | 1019.7 Kg. |
| TRANSVERSE | 1019.7 Kg. |

| SR NO. | REFERENCE | REV: | DESCRIPTION |
|---|---|---|---|
| | | R1 | MODIFICATION IN GENERAL NOTE |
| | | R0 | FIRST PREPARATION 11.03.2015 |

EXECUTION PURPOSE

**GUJARAT ENERGY TRANSMISSION CORPN.LTD.**
S.P.VIDYUT BHAVAN, RACE COURSE,
VADODARA - 390 007

**TYPICAL FOUNDATION PLAN FOR 220KV 'CIRCUIT BREAKER'**

| DRAWN: | CHECKED: | APPD: | SIZE: |
|---|---|---|---|
| JE(CIVIL) | DE(CIVIL) DE(ENGG) EE(ENGG) | SE (CIVIL) ACE (ENGG.) CE (ENGG.) | A3 |

| SCALE: | DATE: | DRG. NO: | SHEET: | REV: |
|---|---|---|---|---|
| N.T.S. | 15.05.2022 | GETCO / C / 2S-STD /CB-BASE-19 | 1 OF 1 | R1 |