



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

DOCUMENT No. TB-368-316-001 **Rev** 00 Prepared Checked Approved

CUSTOMER Doc. No.		NAME	RiS	SK/SKS	RS
TYPE OF DOC.	TECHNICAL SPECIFICATION	SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
TITLE	400/220/132 kV Circuit Breaker	DATE	30.05.14		30/5/14
		GROUP	TBEM		
		W.O. No	83012		

CUSTOMER MADHYA PRADESH POWER TRANSMISSION LTD.

PROJECT Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no. 1) Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

<u>List of Contents</u>	<u>No. of Pages</u>
Cover Sheet	01
Section 1 Scope, Specific technical requirements & Quantities	7
Section 2 General Equipment Specification	33
Section 3 General Technical Requirement	13
Title Block	1
Section 4 Guaranteed Technical Particulars	14
Section 5 Check List	6

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Distribution				CUSTOMER	TBMM O/C

SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES

1. SCOPE:-

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400kV, 220kV & 132kV Circuit Breaker.

This section covers the scope and quantities of 400kV, 220kV & 132kV Circuit Breaker. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification. For environmental conditions, refer Section-3 carefully.

The specification comprise of following sections:

Section-1: Scope, specific technical requirements & Bill of Quantities.

Section-2: Equipment specifications

Section-3: General technical requirements for all equipments under the project.

Section-4: Guaranteed Technical Particulars

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

The equipment is required for the following projects:

Name of the Customer : Madhya Pradesh Power Transmission Company Ltd.

Name of the Project : Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no.- 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

The term 'Owner' appearing in this specification shall refer to MPPTCL, the term 'Purchaser/Employer' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

2. SPECIFIC TECHNICAL REQUIREMENTS:-

As per Appendix A1 of Section-2.

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay**work on total turnkey basis** (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-1

Rev-00

3. BILL OF QUANTITIES:-**3.1 MAIN QUANTITY**

Sl. no.	Description	Unit	Quantity.					Total
			Balaghat	Badnawar	Bhopal	Chhegaon	Nagda	
1.	400KV SF6 gas Circuit breaker with PIR (400 kV, 2500 A, 40 kA for 3 Sec, Three phase SF6 Circuit Breaker with pre insertion resistor ,operating mechanism, Insulators , base frame, HV terminal Plates, control cabinet, support structure, fixing foundation bolts, cable glands , gas leak detector and adapter for gas filling and other accessories complete in all respects)	Nos.	3	5	0	0	0	8
2.	400KV SF6 gas Circuit breaker without PIR (400 kV, 2500 A, 40 kA for 3 Sec, Three phase SF6 Circuit Breaker without pre insertion resistor ,operating mechanism, Insulators , base frame, HV terminal Plates, control cabinet, support structure, fixing foundation bolts, cable glands , gas leak detector and adapter for gas filling and other accessories complete in all respects)	Nos.	3	4	2	1	2	12
3.	220KV Circuit breaker (220kV, 2000 A, 40 kA for 3 Sec, Three phase SF6 Circuit Breaker ,operating mechanism, Insulators , base frame, HV terminal Plates, control cabinet, support structure, fixing foundation bolts, cable glands , gas leak detector and adapter for gas filling and other accessories complete in all respects)	Nos.	0	8	1	1	0	10

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay**work on total turnkey basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda**

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-1

Rev-00

4.	132KV Circuit breaker (132kV, 2000 A, 40 kA for 3 Sec, Three phase SF6 Circuit Breaker ,operating mechanism, Insulators , base frame, HV terminal Plates, control cabinet, support structure, fixing foundation bolts, cable glands , gas leak detector and adapter for gas filling and other accessories complete in all respects)	Nos.	8	0	0	0	0	8
5.	Lumpsum supervision charges for erection, testing and commissioning of one No. 400kV breakers	Nos.	6	9	2	1	2	20
6.	Lumpsum supervision charges for erection, testing and commissioning of one No. 220kV breakers	Nos.	0	8	1	1	0	10
7.	Lumpsum supervision charges for erection, testing and commissioning of one No. 132kV breakers	Nos.	8	0	0	0	0	8
8.	SF6 gas(additional 20 % of the SF6 gas requirements for each 400kV breaker to be supplied in separate cylinders)	Lot	6	9	2	1	2	20
9	SF6 gas(additional 20 % of the SF6 gas requirements for each 200kV breaker to be supplied in separate cylinders)	Lot	0	8	1	1	0	10
10	SF6 gas(additional 20 % of the SF6 gas requirements for each 132kV breaker to be supplied in separate cylinders)	Lot	8	0	0	0	0	8

Note-1 – Portable /hand held SF6 gas leakage detector and SF6 gas filling adapter shall be supplied along with each SF6 breaker.

Note -2 - It may be noted that, BHEL will provide following special tools and test instruments for erection, testing and commissioning of breaker at site.

- i) Operational analyzer along with transducer
- ii) DCRM kit along with Transducer
- iii) SF-6 gas filling & evacuating trolley
- iv) Megger
- v) Multimeter
- vi) Dew Point Meter

Any other Tool/Testing Equipment like timing kit shall be included in bidder's scope.

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay

work on total turnkey basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-1

Rev-00

Note -3- Fitting and accessories of Circuit breaker shall be supplied as per cl. No. 16 of section -2.

Note -4 – Total quantity may vary upto $\pm 20\%$ at contract stage. However, individual quantities may vary upto any extent.

Note -5- The terminal connector of CB shall be in BHEL scope.

Note -6- Galvanizing of CB structure shall be as per cl. No. 3.8 of section -3 of technical specification.

Note -7- Earthing hardware of circuit breaker shall be in bidder scope.

Note -8- Supervision charges shall be quoted on **lump sum** basis only. Bidder shall estimate required no. of man-days for supervision based on his own experience & shall submit a checklist for input wrt site readiness. It will be the sole responsibility of the bidder to obtain site readiness checklist before deputing any of his personnel at site.

3.2 Mandatory Spares :-

3.2.1 Set of spares for 400kV SF6 Circuit Breaker

Sr. No.	Particulars of spares	Qty in Nos.
i	400 KV SF6 Gas Circuit breaker with PIR with structure (Three phase)	1
ii	400 KV SF6 Gas Circuit breaker without PIR with structure (Three phase)	2
iii	Complete pole with PIR without mechanism	1
iv	Complete pole without PIR without mechanism	1
v	Trip Coil	40
vi	Closing coil	20
vii	SF6 Gas density monitor	12
viii	Spring Charging Motor	7
ix	Limit switch	7
x	SF6 Gas cylinder 40 Kgs	2

3.2.2 Set of spares for 220kV SF6 Circuit Breaker

Sr. No.	Particulars of spares	Qty in Nos.
i	Complete pole without mechanism	2
ii	Trip Coil	20

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay

work on total turnkey basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-1

Rev-00

iii	Closing coil	10
iv	SF6 Gas density monitor	6
v	Spring Charging Motor	3
vi	Limit switch	3

3.2.3 Set of spares for 132kV SF6 Circuit Breaker

Sr. No.	Particulars of spares	Qty in Nos.
i	Complete pole without mechanism	1
ii	Trip Coil	4
iii	Closing coil	4
iv	SF6 Gas density monitor	2
v	Spring Charging Motor	3
vi	Limit switch	3

Note – Exact dispatch destination site of mandatory spares of CB shall be intimated **during ordering stage**.

4. TYPE TESTING:-

The offered equipments should be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested, Bidder shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that specifications of equipments offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered equipments could be verified. While submitting bids the model and type etc., shall be clearly indicated.

Type test reports furnished with the offer should not pertain to the period earlier than five years from the **date of opening of Bid which is 20.11.13**.

In case the type tests were carried out earlier than five years, the manufacturer will have to conduct these tests, without any commercial & delivery implication to BHEL, before commencement of supply. In both the above cases type test certificate must be submitted with the bid. The Bidders have to submit one complete set of Type Test reports for the offered equipments.

All the tests as per relevant IS/IEC shall be carried out.

5. TECHNICAL QUALIFYING REQUIREMENT :-

5.1.The manufacturer for supply of plant and equipment not covered in approved vendor list of customer should have a minimum experience as specified below

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay**work on total turnkey basis** (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-1

Rev-00

for supply of respective item (which must have been type tested) and must be an approved vendor of Electricity Boards/ Power Grid/ Transmission utility or a regular supplier of MPPTCL. The certificate of Electricity Boards/ Power Grid/ Transmission utility towards supply of respective item will have to be submitted by the bidder for obtaining approval of such manufacturer from MPPTCL. The equipment/ material manufactured and supplied should be in operation for a period of **two years** as on the date of Bid opening, **which is 20.11.13**, for which performance report is required to be submitted. The performance report should be issued within last two years from the date of bid opening. The Performance report issued by the Power Utilities or User Agencies clearly indicating the Order No. & Date, Ordered quantity and the quantity for which the performance report has been issued, shall only be acceptable.

S. No.	Equipment/ Material	Minimum experience required
1.	Power Transformers, 400kV Reactor, 400kV & 220kV SF6 Circuit Breakers, CT, CVT, Isolator, LA, C&R Panels, PT, 36kV Capacitor Bank, Transformer oil, Carrier Cabinet, Protection coupler, Wave Trap, Copper Control and Aluminum Power Cable, Station Batteries, Station Transformer, Transformer oil and 132kV SF6 Circuit Breakers	Five Years as on the date of Bid opening
2.	Other equipments and materials for construction of the Facilities	Three Years as on the date of Bid opening
3.	Equipment/ Material covered in the Bid : Manufacturing Capacity	100% quantity of Equipment/ Material covered in the Bid should have been manufactured & supplied in any one year during the past three years by the manufacturer of that Equipment/ Material covered in the Bid, as on the date of Bid opening
4.	To substantiate above requirement indicated in S. No. 1, 2 & 3, Bidder may please note that the design, type, rating & class of equipments/ material must be similar to the design, type, rating & class or higher rating & class, as specified in the Bid. For substantiating requirement at Sr. no 3, CA certificate is acceptable.	

5.2. In the case of a Bidder who offers to supply and install major items of supply under the contract that the Bidder did not manufacture or otherwise produce, the Bidder shall provide the manufacturer's authorization, using the form to be provided by BHEL, showing that the Bidder has been duly authorized by the

manufacturer or producer of the related plant and equipment or component to supply and install that item in India. The Bidder is responsible for ensuring that the manufacturer or producer complies with the requirements of ITB 4 and 5 and meets the minimum criteria listed above for that item.

6. INSPECTION & TESTING:-

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and MPPTCL in accordance with agreed quality plan with 3 weeks advance information.

7. QUALITY PLAN:-

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / MPPTCL approval within 1 week of P.O. placement.

SECTION – II

2.1.1 TECHNICAL SPECIFICATION OF CIRCUIT BREAKERS

1.0 SCOPE:

The scope of this bid covers, design manufacturing and supply of equipment as per Section-I Volume-II. The bidder mentioned in this Section of the Technical Bid means "Original Equipment Manufacturer (OEM)". The purchaser means the 'MPPTCL'. *BHEL*

In case bidder is not OEM, sole responsibility of offering equipments/material of manufacturer as per this bid requirement shall rest on the bidder.

2.0 STANDARDS:

2.1 Applicable Standards for the offered equipments/items shall be as per ~~Section-I Volume-II.~~ *relevant IS/IEC.*

2.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.

2.3 ACCEPTANCE OF OTHER AUTHORITATIVE STANDARDS:

In the preceding paragraph relevant Indian standard /IEC standard bid have been shown. However, the equipment meeting any other authoritative international standard, which ensures equal or better quality than the standards, mentioned shall also be acceptable. Equipment for which Indian Standards are not available, the relevant British standards and IEC recommendations will be applicable. Please attach photocopy of all such standards according to which the equipment has been offered.

2.4 TYPE TESTS:

Circuit Breakers should be suitable to close and open successfully for specified idle line charging current without developing dangerous over voltages. All offered circuit breakers should be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested, Bidders shall invariably furnish type test reports from the reputed and approved national/international laboratory/Government approved test houses to prove that bids of Circuit breakers offered conform to the relevant standard. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered circuit breakers could be verified. While submitting offers the model and type etc., shall be clearly indicated. Type test reports so furnished should not pertain to the period earlier than five years from the date of opening of Bid. Bidders have to submit one complete set of Type Test reports for the offered circuit breakers for the following tests:

S.NO.	TYPE TESTS REPORTS TO BE FURNISHED BY BIDDERS
1	Mechanical Operation Test (Mechanical endurance test)
2	Temperature rise test
3	Dielectric tests(Dielectric properties should be tested with the closing resistor)
	a) Lighting impulse voltage withstand test
	b) Power frequency voltage withstand test
	c) Switching impulse voltage withstand test (wet)(for 400KV CB)
4	Power frequency voltage withstand test.
5	Making and breaking capacity test
6	Basic short circuit test (duties for terminal faults)
7	Critical Current Test
8	Short line fault test
9	Short time current test
10	Evolving Fault Test
11	Out of phase breaking test
12	Idle Line charging current breaking tests:
13	Seismic withstand test:
14	Corona inception and extinction voltage test (for 400 KV Breakers only)
15	Capacitor current switching test
16	Shunt reactor current-switching test
17	IP 55 test on marshalling box

Seismic withstand test on the complete equipment shall be carried out along with the supporting structure etc. Seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment. Seismic test shall be carried out in all possible combination of the equipments.

2.5 DISCREPANCY IN TECHNICAL PARTICULARS:

Regarding discrepancy in technical particulars stipulation under Section-I ~~Volume-II~~ shall be applicable.

3.0 SYSTEM CONDITIONS:

3.1 Applicable climatic conditions shall be as per ~~Section-I~~ ~~Volume-II~~.

SECTION-3

3.2 AUXILIARY POWER SUPPLY:

Auxiliary Power Supply for offered EHV equipments shall be as per ~~Section-I~~ ~~Volume-II~~.

SECTION-3

4.0 DUTY REQUIREMENT

4.1 Circuit breakers shall be totally restrike free under all duty conditions and shall be capable of performing specified duties.

4.2 Circuit breakers shall meet the duty requirements for all type of phase to phase and ground fault, irrespective of fault location. Breakers shall also meet idle line charging and

dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily.

4.3 Circuit breakers shall be capable of following duty requirement as mentioned in Appendix-A1 "Principal Parameters":

- i. Interrupting the steady and transient magnetizing inrush current of power transformer.
- ii. Interrupting line charging current.
- iii. Clearing short line faults (kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
- iv. Breaking inductive currents of upto 10 Amp.
- v. Out of phase breaking capacity.
- vi. Various voltage class circuit breakers should be capable for capacitor switching as per IEC.

4.4 Breakers shall satisfactorily withstand high stresses imposed during fault clearing, load rejection and re-energisation of lines with trapped charges. Breakers shall also withstand the voltage specified in Appendix-A1 "Principal Parameters":

5.0 GENERAL TECHNICAL REQUIREMENTS OF CIRCUIT BREAKERS:

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

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

5.3 Complete circuit breaker with all the necessary items for successful operation shall be supplied.

5.4 Circuit breakers shall be suitable for hot line washing.

5.5 All breakers shall be supplied with 1 set (6 nos.) terminal connectors. Details of terminal connector required with each circuit breaker are given in clause 18.0 hereunder and the Bidders are required to note that the terminal connectors shall form a part of scope of supply.

5.6 Current density adopted for the design of the terminal pads shall in no case exceed the following values:

- i. For copper pads - 1.6 Amp/sq.mm.
- ii. For others - 1.0 Amp/sq.mm.

5.7 Provisions shall be made for attaching operation analyzer after installation at site to record contact travel & speed and for making measurement of operation timings, synchronization of contacts of all poles.

6.0 CONTACTS:

6.1 Main contacts shall have ample area and contact pressure for carrying rated current continuously and also the short time rated current of Breakers without excessive temperature rise, which may cause their pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have a minimum of moveable parts and adjustments to accomplish desired results.

6.2 All external and internal make and break contacts shall be sealed and shall be free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have long life expectancy so that frequent replacement due to excessive burning is minimized. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

6.3 Main contacts shall be first to open and last to close to minimize contact burning and wear.

6.4 Any device provided for voltage grading to damp oscillations or to prevent restrike prior to the complete interruption of Circuit or to limit over voltages on closing shall have a life expectancy compatible to that of Breakers as a whole.

6.5 Breakers shall be so designed that when operated within their specified rating, 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-56 under specified ambient conditions.

7.0 PORCELAIN HOUSING:

7.1 Porcelain housing shall be of single piece construction without any joint or coupling. It shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect high mechanical and dielectric strength and shall be thoroughly vitrified tough and impervious to moisture.

7.2 Glazing of porcelain shall be uniform, brown or dark brown coloured, free from blisters, burns and similar other defects with a smooth surface arranged to shed away rainwater or condensed water particles (fog).

7.3 Housing shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation for the conditions under which they will be used. All housing of identical ratings shall be interchangeable.

7.4 Puncture strength of housing shall be greater than the dry flashover value. When operating at normal rated voltage there shall be no electric discharge between the conductors and housing which would cause corrosion or injury to conductors, insulators or supports by the formation of substance produced by electro-chemical action. These housing when operating at the normal rated voltage shall cause no radio interference/disturbance.

7.5 All iron parts shall be hot dip galvanised and all joints shall be airtight. Surfaces of the joint shall be trued-up by grinding porcelain parts and by machining metal parts. Housing

design shall be such as to ensure a uniform compressive pressure on the joints.

7.6 Interrupter housing insulator and support insulator shall satisfactorily withstand insulation level of circuit breaker specified in Appendix-A1 "Principal Parameters" and shall also be suitable for contaminated and polluted atmosphere as per relevant standard.

8.0 AUXILIARY CONTACTS:

8.1 Auxiliary switches (contacts) required for satisfactory operation of Circuit breaker including automatic reclosing (single shot, single and 3 phases), ON/OFF indicators both in control room and cubical switchyard, semaphore indicators in the mimic diagram in the control room and anti pumping feature shall be provided on each circuit breaker. All these auxiliary switches and required relays with their scheme shall be included in the scope of supply.

8.2 In addition to the auxiliary switches mentioned above, Bidders shall provide as spares twenty auxiliary contact each of the normally open and Normally closed types in case of 400 KV circuit breaker whereas for other categories of Circuit breaker ten auxiliary contacts each of the "normally-open" and "normally-closed" types which shall operate with the closing or opening of all the three poles of circuit breakers and further ten auxiliary contacts each of "normally closed" and "normally open" type which shall operate with each of three individual poles of circuit breakers. These spare contacts shall be utilised for additional safety interlocking and other monitoring devices by the purchaser.

8.3 All auxiliary contacts shall be placed in a weatherproof casing and current rating of the switches shall be mentioned in the Bid. Provision shall be available to convert these spare "normally-open" contacts to "normally-closed" type and vice versa.

8.4 Auxiliary switch of Breakers shall be preferably driven by breaker operating rod. However in case due to some constraint same is not possible then a plug-in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.

8.5 Arrangement proposed for connecting control cables to the auxiliary switches shall be clearly stated. Provision shall be made for suitable cable glands fitted on gland plate for receiving control cables required for inter connecting assemblies and the auxiliary switches of the breaker. Additional Gland plates shall be supplied duly drilled and fitted with cable glands. Gland plate and operating mechanism doors shall be provided with gasket properly. These cable glands shall be suitable for armoured copper control cables. The cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each control cabinet for connecting copper control cables provided by the purchaser.

8.6. Bidders may please note that 1.1 KV grade unarmoured copper control cables shall be used by the purchaser and, therefore, the offered cable glands shall be suitable for the sizes of these cables as specified under Appendix-A1 "Principal Parameters"

8.7. **The position of rotating Aux. switches in mechanism box should be such that there should not be any difficulty in cable connection and tracing particular terminal. All terminals marking should be clearly visible from front/outside the switch.**

9.0 TOTAL BREAK TIME:

9.1 "Total Break Time" as specified in Appendix-A1, "Principal Parameters" shall not exceed under any circumstances for the following duties:

(i) Test duties 1,2,3,4,5 (with TRV) as per IEC-62271-100 /IEC56

(ii) Short line fault L90, L75 (with TRV) as per IEC-62271-100 /IEC56

9.2 Bidders may please note that specified break time of Breakers shall not exceed under any duty conditions, variation of the trip coil voltage, pneumatic/ hydraulic pressure and SF6 gas pressure etc.

10.0 OPERATING MECHANISM AND ASSOCIATED QUIPMENTS:

10.1 GENERAL REQUIREMENTS:

Bidders may please note that both closing and tripping mechanisms for all rating of breakers need necessarily be of spring type. This is mandatory requirement.

10.1.1 Each circuit breaker shall be designed for remote control operations from the control room. In addition, there shall be provision for local tripping & closing operations both by electrical & mechanical control. Mechanical arrangement should be provided to facilitate manual tripping of circuit breaker for emergency trip under emergent conditions e.g. failure of DC supply, trip coil is burnt, trip coil mechanism is defective etc., while arc quenching medium is healthy.

10.1.2 Operating mechanism shall be of spring type only, remotely operated by electrical signal. Mechanism shall be adequately designed & capable of performing satisfactorily all specified tripping and reclosing duty within the specified time. Entire operating mechanism control circuitry including electrical controls & monitoring devices and all other accessories, as required, shall be housed in an outdoor type, hot dip galvanised steel enclosure. This enclosure shall conform to the degree of protection IP-55 of latest version of IS:2147. The enclosure shall be invariably mounted on a separate concrete plinth of 300 mm height. However, in case due to IP-55 protection limitations. **If operating mechanism is mounted below the pole housing. in that case it should be possible for the operating personnel to manually charge closing spring / mechanism from ground level including ON/OFF operation without using any stool or otherwise. However. due to any reason if operating platform is absolutely necessary, the same shall be deemed to be included in scope of supply.**

10.1.3 All working parts in the mechanism shall be made of corrosion resistant material. All bearings which require greasing shall be equipped with pressure grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately pinned or blocked to prevent loosening or changing of adjustment with repeated operation of the breaker.

10.1.4 Design of the operating mechanism shall be such that it shall be practically maintenance free. Guaranteed years of maintenance free operation, the number of full load and full rated short circuit current breaking/operation without requiring any maintenance or overhauling, shall be clearly stated in the Bid. As far as possible the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether, if possible.

10.1.5 The operating mechanism shall be non-pumping and trip free electrically and mechanically. A latch checking switch shall be provided on mechanically trip free mechanism to prevent reclosing before Breakers latches have reset. There shall be no objectionable rebounds in the mechanism and it shall not require any critical adjustments at site. It shall be rigid, positive and fast in operation. Mechanism shall be such that the failure of any auxiliary spring shall not cause false tripping or closing. Operation of the power operated closing device, when Circuit breaker is already closed, shall not cause damage to Circuit breaker or endanger the operator's life. Provision shall be made for attaching an operation analyzer to facilitate speed test after installation of Breakers at site. ON-OFF indicating lamps shall be provided on the mechanism box.

10.1.6 A mechanical indicator shall be provided to show "open" and "close" position of Breakers in addition to facilitate for remote electrical indication. An operation counter shall also be provided in the central control cabinet. Mechanical indicator and operation counter shall be located in a position where it shall be visible to a man standing on the ground level with the mechanism housing closed.

10.1.7 Circuit breaker operating mechanism shall incorporate an electrically achieved positive acting anti-pumping feature to prevent Circuit breaker from reclosing after an automatic opening when the initiating closing device is maintained in the position for closing. Necessary anti-pumping relay shall be included in the scope of supply.

10.1.8 All material for making connection between Circuit breaker and its local control cabinet shall be included in the scope of supply.

10.1.9 All the similar contacts of 3 pole circuit breaker shall be designed to touch or open essentially simultaneously & in any case shall close or open within a period of half a cycle or less. Auxiliary circuit through resistors shall be closed in sufficient time before the main contacts closes to ensure that the over-voltage will be held to guarantee value under most favorable sequence of contact closing.

10.1.10 Bidders shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for Circuit breaker.

10.1.11 The mechanism shall be rated for minimum mechanical operations which is covered under M2 class test with IEC 62271- 100.

10.1.12 The parts of the CBs like operating mechanism, links, operating arm etc. should not be exposed to atmosphere. It means various parts of CBs should be properly covered and should be tested for IP 55 equivalent test.

10.2 MOTOR OPERATED SPRING CHARGING MECHANISM:

10.2.1. Spring operated mechanism shall be complete with motor, opening & closing spring with visual indication for spring charged/ discharged condition and all necessary accessories to make the mechanism a complete operating unit. Each mechanism shall be so designed as to enable a continuous sequence of "opening" and "closing" operations to be obtained as long as power is available to the motor and at least one "opening" and "closing" operation

after failure of power supply to the motor. Breaker operation shall be independent of the motor which shall be used solely for the purpose of compressing the closing spring. Motor rating shall be such that it requires only about 30 seconds for charging the closing spring fully. Closing action of Circuit breaker shall compress the opening spring ready for tripping. Spring charging motor shall be AC motor (Single or 3 phase DC Motors are not acceptable.) Mechanism shall be capable of performing the rated operating duty cycle of 0-0.3 seconds-CO-3 minutes-CO. In the event of failure of power supply to spring charging motor, the mechanism shall be capable of performing one sequence of 0-0.3 seconds -CO duty. The mechanism shall undergo olive green passivation.

10.2.2. For Manual spring charging operation through operating handle, it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that one man standing at ground level is able to manually charge the spring without much effort. The handle shall be either at normal operable height or otherwise a suitable 3ft x 3ft platform nearly 4ft below the manual operating handle with foldable ladder shall be provided to facilitate manual charging of spring. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only. The Bidder should enclose G.A. Drawings with their offer.

10.2.3 The mechanism shall be strong, rigid positive and fast in operation. Provision shall be made for local electrical control and local / remote selection with enough contacts in the cubicle of the breaker. Manual emergency local tripping arrangement shall be provided on the breaker for use in emergency during maintenance. This emergency trip is intended for use, shall a failure of any part of DC control circuits including trip coil takes place preventing remote electrical tripping.

10.3 MOTORS:

10.3.1 Motors shall be of self ventilated type having TEFC (totally enclosed fan cooled) enclosure.

10.3.2 Depending upon the capacity and loading conditions supplier shall design suitable grease lubricated or oil lubricated bearings for above motors. Bearing shall be so constructed that the loss of grease and its creeping along with shaft into motor housing is prevented. It shall also prevent dirt and water from getting into the motor.

10.3.3 Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point & the motor shall not be overloaded at any operating point of driven equipment that will arise in service.

10.3.4 Motors shall be capable of giving rated output without reduction in expected life span when operated continuously in the system having the particulars as given in principle parameters.

10.3.5 All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 75% of the rated voltage.

11.0 CONTROL:

11.1 Close and trip circuits shall be designed to permit use of momentary contact switches and trip/neutral/close switch.

11.2 Each breaker pole shall be provided with two independent trip circuits, valves and coils or two independent trip circuits with trip coils each connected to a different set of protective relays using dedicated main and duplicate DC supplies. At no point mixing of two trip circuit supplies shall be made. Trip coil circuits shall be suitable to trip circuit supervision in pre & post closing conditions. Purchaser would provide the trip circuit supervision relays. Bidders shall provide necessary terminals in the central control cabinet of Circuit breaker for pre & post closing trip circuit supervision.

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

11.4 A conveniently located manual mechanical tripping lever or latch shall also be provided for tripping Breakers and simultaneously opening the reclosing circuit.

11.5 Shunt trip coils shall operate correctly under all operating conditions of Circuit breaker up to the rated breaking capacity of Circuit breaker and at all values of D.C. supply voltage between 70% and 110% of rated voltage. However, at 50% of rated voltage, Breakers shall be able to perform closing and opening operations. If additional elements are introduced in the trip coil circuits, their successful operation and reliability for similar applications shall be ensured.

11.6 For maintenance purposes, a local manual closing device along with a detachable handle shall also be provided. Device should be easily operable by one man standing on the ground. Direction of rotation of handle shall be clearly marked. Suitable arrangement for safe storage of handle shall be provided.

11.7 Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage of closing coil.

12.0 SURFACE FINISH PAINTING & GALVANISING:

12.1 All interiors and exteriors of tanks, mechanism, enclosures, cabinets and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil, as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.

12.2. All ferrous metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner or hot dip galvanized or two packs of aliphatic polyurethane finished paint. All metal parts not accessible for

painting shall be made of corrosion resistant 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. 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 of IS:5 or Polyurethane paint having shade Siemens graph RAL 7032. All ferrous parts & steel structure including all sizes of nuts, bolts, plain and spring washers, support channels, structures, etc. shall be hot dip galvanized or stainless steel or electro-galvanized.

13.0 EARTHING:

Operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing terminals suitable for connection to earth mat of substation switchyard. *Earthing hardware shall be in Bidder scope.*

14.0 NAME AND RATING PLATES:

Circuit breaker and its operating device shall be provided with a rating plate or plates marked with but not limited to following details;

- a) Manufacturer's name & trade mark.
- b) Serial number or type designation making it possible to get all the relevant information from the manufacturer.
- c) Year of manufacture.
- d) Rated nominal/highest voltage.
- e) Rated insulation level.
- f) Rated frequency.
- g) Rated normal current.
- h) Rated capacitive/inductive breaking current
- i) Rated short circuit breaking current.
- j) First pole to clear factor.
- k) Rated duration of short circuit current.
- l) Rated out of phase breaking current.
- m) Rated auxiliary d.c supply voltage of closing and opening devices.
- n) Rated pressure of compressed air / gas for operation and interruption.
- o) Rated AC supply voltage of auxiliary circuits
- p) Mass of circuit breaker.
- q) Purchase's order no. & date

Rating plate shall be visible in position of normal service and installation. The rating plate shall be engraved, weather proof and corrosion proof. Description on the rating plate should be given in "legible English letters".

15.0 TERMINAL CONNECTORS:

~~15.1. Terminal connector shall conform to the latest version of IS:5561 or equivalent International Standard. Standard drawing for terminal connectors is enclosed. Clamps shall be designed adequately to take care of any bimetallic effect. Temperature at the clamp shall~~

not exceed 80 deg C. Corona rings shall be provided at the breaker terminals to control the radio interference. Terminal connectors shall be tested for short circuit current capability, temperature rise, Corona inception etc.

15.2. The design of clamp shall be to our approval. The details of current take off as required by us shall be detailed out in drawing and shall be submitted along with the bid. In respect of the terminal connectors following should be ensured:-

- (a) The terminal connector should be made of A6 Aluminum Alloy and by pressure / gravity die cast only. Sand casted terminal connectors are not acceptable
- (b) All castings shall be free from blow holes, surface blisters, cracks and Cavities. All sharp edges should be rounded off.
- (c) No part of clamp shall be less than 12 mm thick.
- (d) The bimetallic strips / sleeve shall be 2 mm thick.
- (e) All nuts, bolts & washers shall be of Hot Dip Galvanised mild steel.
- (f) The conductor should be tightened by six bolts. Conductor hold length must not be less than 100 mm.
- (g) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal flat spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- (h) The portion of clamp to hold the conductor should be flat and straight and not zig-zag in construction, at both the sides, so that holding of clamp by throttling action of current may be avoided.
- (i) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- (j) All current carrying parts shall be designed and manufactured to have minimum contacts resistance.
- (k) The clamp for Twin Moose ACSR Conductor shall be in three pieces so that each conductor may be tightened separately.
- (l) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware.

15.3 400KV bus shall be of quadruple 'MOOSE' conductor. All circuit breakers shall be provided with flexible terminal connectors, which shall be of expansion type to receive 4 inch IPS tube or Twin Moose ACSR conductor and suitable for horizontal take off.

16.0 FITTINGS AND ACCESSORIES:

16.1 Following is the list of the major fittings and accessories to be included by manufacturers as an integral part of equipment. Number and exact location of these parts shall be indicated in the Bid.

S. No.	Particulars	Type of Circuit Breakers	
		SF6	Vacuum
1	Hollow insulator columns for poles of Circuit Breaker	Yes	Yes
2	Operating mechanism housing in accordance with clause no.10.0 shall		

S. No.	Particulars	Type of Circuit Breakers	
		SF6	Vacuum
	complete with ;		
	a) Pistol grip circuit breaker control switch having trip/ normal/close position.	Yes	Yes
	b) Trip coils/ closing coil	Yes	Yes
	c) Space heater equipped with industrial grade switch	Yes	Yes
	d) Cable glands	Yes	Yes
	e) Industrial grade receptable type 3 pin 15 Amps power plug & socket with switch.	Yes	Yes
	f) Local/remote changeover switch.	Yes	Yes
	g) Manually operated tripping push button/lever (mechanical device convenient located to trip all three phases simultaneously).	Yes	Yes
	h) Padlocks and duplicating keys	Yes	Yes
	i) Terminal Boards.	Yes	Yes
	j) Spring charged discharged indicator.	Yes	Yes
	k) Operation counter.	Yes	Yes
	l) Facility for manual charging of spring.	Yes	Yes
	m) Fuses/MCBs as required for AC & DC supply.	Yes	Yes
	n) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 20% spare terminals for owner's use.	Yes	Yes
	o) Manual charging spring operating handle for maintenance.	Yes	Yes
	p) Auxiliary switch	Yes	Yes
	q) Mechanical ON & OFF Indicator.	Yes	Yes
	r) Cubicle lamp with cage & switch.	Yes	Yes
	s) Antipumping relay.	Yes	Yes
	t) Out-of-Step relay.	Yes	-
	u) Set of 6 nos. terminal connector clamps	Yes NO	Yes
	v) Name & Rating plate in accordance with IEC incorporating year of manufacture.	Yes	Yes
	w) Damping resistors	Yes	-
	x) Pressure Gauge for N2 Pressure	-	Yes
3	Portable/hand held SF6 gas leakage detector.	Yes	-
4	SF6 Gas filling adapter	Yes	-
5	INTER pole cabling of CB in Bidder Scope	Yes	-

17.0 FOUNDATION & SUPPORT STRUCTURES FOR BREAKER STRUCTURES:

17.1 Support Structure: Support structures along with the foundation bolts required for

mounting the breaker shall be within the scope of the bidder and prices for the same shall be quoted inclusive of all the items of structures, hardware and accessories for mounting so as to put circuit breaker in to service. The support structures for circuit breakers shall be designed to maintained minimum ground clearance form the lowest live terminal to breaker structure base plate (to be fix on concrete plinth) as per Appendix-A1 principal parameter of the bid.

17.2. Foundation:- Bidders shall furnish a drawing showing foundation plan for breakers offered by them clearly indicating the i) Dynamic upward and downward loads for which it is designed ii) static load iii) total weight of breaker considered for foundation design & iv) all spacing and dimensional details alongwith details of foundation bolts. MPPTCL have standardized foundation plan drawing for circuit breakers. The bidders shall have to match their breaker structure dimensions strictly with this enclosed drawing for respective rating of circuit breakers. The static and dynamic loading for foundation have been specified under Appendix-A1 of this bid.

18.0 ESSENTIAL SPARE ITEMS:

The bidder may please note that the name of essential items required for operation & maintenance of circuit breakers may please be included while offering the prices for circuit breakers covered under the package.

19.0 TYPE TESTS & TEST REPORTS:

19.1. All the equipment offered, shall be fully type tested as per the relevant standards. In case the equipment of the type and design, offered, has already been type tested, Bidders shall furnish two sets of the type test reports along with the Bid. For any change in the design/type already type tested and the design/type offered against this Bid the purchaser reserves the right to demand repetition of tests without any extra cost on the first or any one unit of any rating included in the Bid. In case the equipment has not been type tested earlier, all the type tests as per relevant standards shall be carried out by the successful Bidder/supplier in the presence of purchaser's representative without any extra cost. The test reports submitted with the offer shall not be older than five years, prior to the date of opening of Bid for various tests indicated in Clause 2.4 of this bid document.

19.2. Bidders shall indicate the manufacturer's standard routine tests. Bidders shall completely assemble and test each breaker to ensure satisfactory working of all components and also assembled breakers as a whole.

19.3. 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.

19.4. Speed curves for each breaker shall be obtained with the help of a suitable operational analyzer to determine Breaker contact movement during opening, closing, auto-reclosing and trip free operation under normal as well as limiting operating conditions (control voltage, pneumatic pressure etc.). 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 break/make operation etc. ~~This test shall also be performed at~~

~~site for which the necessary operation analyzer along with necessary transducers, cables, console, etc. shall be provided if required.~~

19.5. Preliminary copy of the test results shall be supplied for approval before dispatch/shipment of Circuit breakers. 4 copies of complete test results shall be furnished with Circuit breakers. These shall include complete reports and results of the routine test and type tests carried out on circuit breakers of identical design.

19.6. ADDITIONAL TESTS:

Purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier / laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this bid. Bidders may please note that Insulation Resistance test by 5KV or 10KV megger at manufacturer's works shall be invariably carried out on each circuit breaker to record following IR values.

- (a) Insulation resistance between top terminal to earth (for open and closed condition of circuit breaker) in — Mega Ohms.
- (b) Insulation resistance between both top Terminals in open and close condition of circuit breaker in — Mega Ohms.
- (c) Insulation resistance between both top Terminals to earth in open and close Condition of circuit breaker — Mega Ohms

20.0 INSPECTION:

20.1 Purchaser shall have access at all times to the works and all other places of manufacture where Circuit Breaker are being manufactured and Bidders shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker

20.2 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. Successful Bidder shall within 30 days of placement of order, submit it's of bought out accessories and the names of sub-suppliers.

20.3 Bidders shall indicate the inspections and checks carried out at various stages of the manufacture of Circuit Breaker. Complete record of stage inspection would be kept by the supplier and this record should be made available for inspection by the representative of the Purchaser. The supplier should indicate the manufacturing programme and the Purchaser will have a right to depute inspecting officers during the manufacture of the equipment. Purchaser reserves the right to carry out stage inspections at all stages, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer.

20.4 At the time of inspection, the supplier shall identify each and every item/accessories of the particular Circuit Breaker under testing. Unless all the items are identified, the

manufacture will not be treated as complete. Various tests stipulated in IS/IEC shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per IS/IEC stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.

20.5 It is expected that before a Circuit Breaker is finally offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany the letter of inspection call so that the Inspecting Officer at the time of inspection may verify the parameters brought out in the preliminary report. Details of all tests should be clearly brought out.

20.6 In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

20.7 Acceptance of any quantity of circuit breaker & its accessories shall in no way relieve the successful Bidder of his responsibility for meeting all the requirements of this bid and shall not prevent subsequent rejection if such equipments are later found to be defective.

21.0 QUALITY ASSURANCE PROGRAMME:

21.1 Bidders must establish that a proper quality assurance program is being followed by them for manufacture of circuit breakers. In order to ensure this, suitable QAP should form a part of the technical Bid, which will be submitted against this Bid. Quality Assurance Program must have a structure as detailed in the following paragraphs.

21.2 Quality assurance and failure prevention starts with careful study and scrutiny of our technical bids and requirements. Supplier shall carefully study all the technical parameters and other particulars & the supplier shall categorically give his confirmation that these requirements shall be met in a satisfactory manner.

21.3 Supplier shall furnish the checks exercised in design calculations. The salient features of design will have to be made available to the Purchaser.

21.4 Supplier shall indicate the various sources of the items being procured. The type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable after placement of order and list of vendors shall be freeze at the time of placement of order.

22.0 DOCUMENTATION:

22.1 LIST OF DRAWINGS AND DOCUMENTS: *(Total sets shall be provided as per section-3)*

Bidders shall furnish four sets of relevant descriptive and illustrative published

literature pamphlets and the following drawings for preliminary study, along with the Bid.

- (a) General outline drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.
- (b) Sectional views showing the general constructional features of Circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (c) All drawings & data typical and recommended schematic diagram for control Supervision & reclosing shall be annotated in English.
- (d) Schematic diagrams of breaker offered for control supervision and reclosing.
- (e) Structural drawing, design calculations and loading data for support structures.
- (f) Short circuit oscillogram & certificates for similar type tested breakers. General arrangement of foundation and structure mounting plan including weights of varnish components and impact loading data for foundation design.
- (g) Type test reports.

22.2 Successful Bidder shall, within two weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. Purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. Supplier shall, if necessary, modify the drawings and resubmit four 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, within three weeks, submit two prints of approved drawings and two sets of good quality reproducible of the approved drawings for purchaser's use.

22.3 Successful Bidder shall also furnish two sets each of bound manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices alongwith each breaker. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. Similar bound manuals for breakers shall be made available to the office of ED(T&P) on one per breaker basis.

Manufacturing of equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser.

22.4 Approval of drawings/work by the purchaser shall not relieve Bidders 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. 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 purchaser reserves the right to reject any work or materials which, in his judgment, is not in full accordance therewith.

22.5 Additional data to be furnished along with the Bid:

- (a) Drawing, showing contacts in close, arc initiation, full arcing, arc extinction and open position.

- (b) Temperature v/s pressure curves for each setting of density monitor along with details of density monitor.
- (c) Method of checking the healthiness of voltage distribution devices (condensers) provided across the breaks at site.
- (d) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.
- (e) Effect of non-simultaneity between contacts within a pole or between poles and also how it is covered in the guaranteed total break time.
- (f) Sectional view of non return couplings if used for SF6 pipes.
- (g) Details and type of filters used in interrupter assembly and also operating experience with such filters
- (h) Details of SF6 gas:
 - i) Test methods used in controlling the quality of gas used in Circuit breakers particularly purity and moisture content.
 - ii) Proposed tests to assess the conditions of SF6 within a circuit breaker after a period of service particularly with regard to moisture contents in the gas.
 - iii) Precise procedure to be adopted by maintenance personnel for handling equipment who 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.

23.0 PACKING AND FORWARDING:

Equipment shall be packed in suitable crates in such a manner to protect it from damage and withstand handling during transit. Bidders shall be responsible for and make good at his own expense, any or all damage to the equipment during transit. Fragile materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided.

Each consignment shall be accompanied by a detailed packing list containing the following information:

- (a) Name of the consignee.
- (b) Details of consignment.
- (c) Destination.
- (d) Total weight of consignment.
- (e) Sign showing upper/lower side of the crate.
- (f) Handling and unpacking instructions.
- (g) Bill of material indicating contents of each Lot

Supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

24.0. COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidders must furnish the following information along with technical Bid:

24.1 Complete details of all the accessories which will be supplied with Circuit breaker

should be furnished. While furnishing these details, items which will be manufactured by Bidders and balance items, which will be procured from sub-suppliers should be clearly identified and indicated in the Bid.

24.2 It is obligatory on the part of Bidder to ensure that supply of all accessories along with Main equipment are simultaneously delivered to avoid any holdup in erection and commissioning. The responsibility for obtaining timely supplies of bought out items will rest on Bidders and only on this basis, delivery period will be offered in the Bid.

24.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest with the Bidder. In case for attending to defects in any accessory or inspection/ replacement of the accessory, which may be bought out item for the Bidder; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by Bidder at his cost.

25.0 SPECIFIC TECHNICAL REQUIREMENTS OF SF6 CIRCUIT BREAKERS:

25.1 Offered circuit breakers shall be of sulphur hexafluoride (SF6) gas filled.

25.2 Circuit breakers shall comprise of three identical single pole units. The duty of circuit breakers for various KV class has been indicated in the "Principle parameters and other requirement for circuit breakers" Appendix-A1 of bid document". Circuit Breakers shall be operated by spring charged mechanism for both opening and closing. The mechanism shall be housed in a dust proof and weather proof control cabinet.

25.3 Breaker assemblies with base, support structure for circuit breaker as well as for control cabinet, central control cabinet and foundation bolts for main structure as well as control cabinet and central control cabinet (except concrete foundations), Breaker terminals and operating mechanisms. Support structures shall be hot dip galvanized.

25.4 Compressed SF6 gas, in each pole with provision of density monitor.

25.5 One central control cabinet and one control box for each pole with all the required electrical devices mounted therein and the necessary terminal blocks for termination of inter pole wiring. Necessary inter pole cables shall be in the scope of supply and the purchaser based on the schematic, wiring diagram and termination schedule to be supplied by the Bidder, shall do cabling at site.

25.6 Instruments, gauges for SF6 gas pressure with suitable number of NO/NC contacts of required quantity for interlocking and other formalities as per schematics.

25.7 All necessary parts to provide a complete and ready to use circuit breaker installation such as main equipment, terminal connectors, control parts, cable connector, pipe lines and other devices, whether specifically called for herein or not.

25.8 Circuit breakers shall be single pressure type, the design and construction of Circuit

beaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surface of circuit breaker.

25.9 All gasketed surfaces shall be smooth, straight and reinforced to minimize distortion and to make a tight seal. Operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals, single "O" ring seals without test holes Double "O" ring seals or Double lip seals and test holes for leakage test of the internal seal shall be provided on each static joint. A suitable pressure-monitoring device on each pole may be provided to ensure pressure of insulating media for the entire assembly.

25.10 In the interrupter assembly there shall be an absorbing product box to eliminate mixing of SF6 decomposition products and moisture. Material used in the construction of Circuit breakers shall be fully compatible with SF6 gas.

25.11 Each pole shall form an enclosure filled with SF6 gas independent of two other poles. The SF6 gas density of each pole shall be monitored and regulated by individual density monitors.

25.12 SF6 gas density monitor shall be adequately temperature compensated. Density monitor shall 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 in service so that the flickering of the pressure switch contacts does not take place.
- iii) Gas pressure indicators should be provided for each breaker pole. These pressure indicators shall have uniform graduated dial.

25.13 Suitable arrangement for pressure relief shall be provided in the gas chamber of circuit breaker to avoid the damages or distortion during occurrence of abnormal pressure increase or shock waves generated by internal electric fault arcs. Position of pressure relief devices (e.g. vents, diaphragms, etc.) shall be arranged to minimize danger to operating personals in the event of gas or vapour escaping under pressure.

25.14 Facility shall also be provided to reduce the gas pressure within Breakers 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.

25.15 Sufficient SF6 gas shall be provided to fill all circuit breaker poles after erection. Additional 20% of the total SF6 gas requirement for each breaker shall be supplied in separate cylinders.

25.16 Portable/hand held SF6 gas leakage detector shall also be supplied along with each SF6 breaker.

25.17 Contacts shall be kept permanently under pressure of SF6 gas. Gap between the

open contacts shall be such that it can withstand atleast the rated phase to ground voltage continuously at zero gauge pressure of SF6 gas due to profuse and sudden leakage.

25.18 If multi break interrupters are used, these shall be so designed and augmented, that uniform voltage distribution is developed across breaking contacts. Calculations/test reports in support of this requirement shall be furnished along with the Bid. Thermal and voltage withstand capability of the grading element shall be adequate for the specified duty and service conditions.

25.19 Special contacts for use with the trip coils and single shot reclosing operation, which permit the relative adjustment with respect to the travel of Circuit breaker, shall also be provided.

25.20 Operating mechanism shall be suitable for high speed single/three phase tripping & reclosing as per duty cycle indicated for various class of CBs in "Principle parameters and other requirement for circuit breakers" Appendix-A1.

25.21 Should the settings of the three breaker poles not be the same (e.g. due to failure of an operating or closing coil) all three poles shall trip simultaneously on appropriate electrical command. An out of step relay shall be supplied with each breaker to give a remote trip discrepancy alarm.

25.22 A non return valve should be provided so that in case of substantial pressure loss in a pole the main interrupting chambers remain pressurised and can retain their full insulating capacity for several more hours.

25.23 Motors shall be "squirrel cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for driving equipment.

25.24 If arcing contacts are used they shall be first to close and the last to open. These shall be easily accessible for inspection and replacement. If separate arcing contacts are not mounted, in that case main contacts shall be easily accessible for inspection and replacement. Tips of arcing contacts and main contacts shall either be made of graphite or silver-plated or of tungsten alloy.

25.25 SULPHUR HEXAFLUORIDE GAS (SF6 GAS):

25.25.1 SF6 gas shall comply with latest version of IEC-376, 376A and 376B and shall be suitable in all respects for use in the switchgear under the worst operating conditions.

25.25.2 High pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with latest version of IS:4379 (Identification of the contents of industrial gas cylinders) and IS:7311 (Seamless high carbon steel cylinders for permanent and high pressure liquefiable gases). These gas cylinders shall also meet Indian Boiler regulations.

25.25.3 SF6 gas shall be tested for purity, dew point, break down voltage, water contents as per latest version of IEC-376, 376A and 376B and test certificates shall be furnished for each lot of SF6 gas.

25.26 CONTROL CABINETS:

- a. Control cabinets shall be of the free standing floor mounting type.
- b. Operating mechanism and all accessories shall be enclosed in weather & vermin proof mechanism cabinet of hot dip galvanized sheet steel construction, the thickness of which shall not be less than 3 mm intended for outdoor operation. Control cabinets shall be provided with a hinged door. Door hinges shall be of union joint type for easy access to the mechanism at the front. Sides shall be properly braced to prevent wobbling. Suitable gasket shall be provided to make the mechanism housing waterproof and dust proof. Housing latch shall accommodate padlock requiring a 12mm dia hole. Padlock and duplicate keys are also included in the scope of supply.
- c. Bus bars shall be of tinned copper of adequate cross-section to carry the normal current, without exceeding the permissible temperature rise over an ambient temperature of 50°C outside the cubicle. Buses shall be braced to withstand forces corresponding to short circuit current of 25 kA.
- d. Motors rated 1 kW and above being controlled from the control cabinet would be suitable for operation on a 433 V, 3 phase 50 Hz system. Fractional kW motors would be suitable for operation on a 230 V, 1-phase, 50 Hz supply system.
- e. Isolating switches shall be group operated units (3 pole for use on 3-phase supply system and 2 pole for single phase supply systems) quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Control cabinet door shall be interlocked with the operating handle of the switch so as to prevent opening of the door when the switch is closed. A device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.
- f. Fuses shall be HRC cartridge link type having prospective current rating of not less than 4.6kA (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.
- g. Push button shall be rated for not less than 6 Amps, 433 V A.C. or 2 Amps, 220V DC 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 fusing of lamps.
- h. For motors upto 5 kW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the switching current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor. For motors above 5 kW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2-pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. 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. Dropout voltage of the contactors shall not exceed 70% of the rated voltage.

i. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting alternatively MCB for motor protection. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed. Relays shall be either directly connected or CT operated depending on the rated motor current.

j. Single phasing prevention relay shall be provided for 3 phase motors to provide protection against single phasing.

k. Mini starters shall be provided with no volt coils whenever required.

l. Purchaser's power cables will be of 1100/650 volts grade stranded aluminum conductor. PVC insulated, PVC sheathed single steel wire armoured 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 Bidder's scope of supply. Requisite number of suitable brass cable glands shall be provided for cable entry at the bottom of the operating cabinet to receive purchaser's control cables. These shall be mounted in accessible position and floor level so that the cable joints can be made easily. Cable glands shall be double compression type.

m. Separate terminal blocks shall be provided in the mechanism housing for terminating circuits of various voltage classes. Terminals for DC & AC shall be provided separately and isolated from each other. CT loads shall be terminated on a separate block and shall have provision for short circuiting the CT secondary terminals. Terminals for the control & other circuits shall be suitable for accommodating 3mm stranded conductor cable leads. A minimum of six spare terminals for control wiring shall be provided. Housing shall be complete with all necessary wiring in the housing.

n. Wiring for all control circuits shall be carried out with 1100/650 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 mm. Atleast 20% spare terminal blocks for control wire terminations shall be provided on each panel. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. Terminals shall be rated for adequate capacity which shall not be less than 10 Amps.

o. Control cabinet shall be provided with 230 V, 1-phase 50 Hz, 20 W fluorescent light fixture and a suitably rated 230V, 1 phase, 5 amps, 3 pin socket for hand lamps. Suitably rated power plug with switches shall be provided to enable the control supply to Breakers to be cut off from the mechanism housing.

p. Suitable strip heaters shall be provided inside each cabinet complete with thermostat to prevent moisture condensation. Heaters shall be controlled by suitably rated double-pole miniature Circuit Breakers and by differential thermostat so that the cubicle

temperature is always maintained approximately 10 deg./ above the outside air temperature. On-Off switch and fuse shall be provided. Heater shall be suitable for 230 volts AC supply unless otherwise specified.

q. 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.

r. Electric measuring instruments shall be of moving iron type Ammeters for measuring current up to 30 Amps shall be directly connected while those for measuring above 30 Amps shall be connected through suitable CTs Ammeters shall be provided with selector switches.

s. Voltmeters shall be protected by HRC fuses and provided with selector switches.

t. Items inside the cabinet made of organic material shall be coated with a fungus resistant varnish.

u. All doors, panels removable covers and breaker openings shall be gasketed all around. All louvers shall have screen and filters. Cabinet shall be dust, moisture, and vermin proof.

v. All cabinets/boxes shall be designed for the entry of cables from bottom by means of weatherproof and dust-proof connections. Suitable cable gland plate (at least 150 mm above the base of cabinet/box) of HDG having minimum thickness of 3 mm, with necessary cable glands shall be provided. The cable gland plate shall be re-movable type and shall have provision for additional glands for future. The glands shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall be cadmium plated. The cabinet/box shall be designed generously for clearance so as to avoid interference between the wiring entering from below and any terminal block or accessories mounted within the box or cabinet.

w. Suitable relay for monitoring of DC supply voltage to the control cabinet shall be provided. Pressure switches used for interlock purposes shall have adequate contact ratings to be directly used in the closing and trip circuits. In case the contacts are not adequately rated and multiplying relays are used then the interlock for closing/ opening operation shall be independent of the relay logic i.e. if the DC supply to the interlock circuit fails then operation lockout shall take place.

25.27 SERVICES FOR SUPERVISION OF ERECTION & COMMISSIONING OF CIRCUIT BREAKERS:

25.27.1 SERVICES FOR SUPERVISION OF ERECTION & COMMISSIONING:

It is obligatory on the part of the Bidder to provide "~~free services~~" of their erection & commissioning team to supervise erection & commissioning of each Circuit Breaker.

Although erection works shall be done by us, services of erection engineer will have to be provided for supervision and guidance. It may be clarified that the breaker shall be made ready for commissioning in all respect and services of your engineer will be required for checking and final commissioning of the breaker. Normally MPPTCL has trained staff for erection of breaker based on guidelines, which are to be furnished by the manufacturer. While undertaking erection work the purchaser will require services of supervision engineer for suitable period depending upon design of equipment and these

services for required period will have to be made available ~~on free of cost basis~~. In case any manufacturer feels that their experienced engineer for final supervision of erection and testing will need assistance of any junior grade supervisor also, services of the same should also be provided ~~on free of cost basis~~. In any case ~~free~~ services by way of deputation of required number of personnel for sufficient period will have to be ensured by the bidder ~~on free of cost basis~~. The intention is that the services are made available until supervision of erection & commissioning is completed. These services shall be provided for each unit. It will be obligatory on the part of bidders to depute their erection supervisor and commissioning engineer positively within one week of telephonic intimation from MPPTCL. *BHEL*

26.0 SPECIFIC TECHNICAL REQUIREMENTS OF VACUUM CIRCUIT BREAKERS:

26.1 Circuit breakers shall comprise of three identical pole units linked together mechanically suitable for operation with a centrally located common operating mechanism box i.e. Normal Duty type. Vacuum circuit breakers with all integral parts required for satisfactory operation shall be supplied with all accessories in position and complete internal wiring connected and terminated in the operating mechanism housing. Offered equipment shall be complete in all respect.

26.2 For 33 KV circuit breaker, all contacts shall be of Butt type.

26.3 VACUUM INTERRUPTERS:

26.3.1 Design of vacuum interrupter shall be such that it gives trouble free operation under normal load and fault condition throughout the life of the equipment. As the efficiency of breaker depends on degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service.

26.3.2 Insulating ceramic body of interrupter shall have high mechanical strength and it shall be capable of withstanding high temperature without any significant deterioration in mechanical and electrical properties.

26.3.3 Interrupter design shall ensure rapid deionization of the gap so that normal electrical strength of the gap is restored instantaneously.

26.3.4 Vacuum interrupters which are used shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculation/ test reports in support of the same shall be furnished along with the tender. Thermal and voltage withstand values of the grading elements shall be adequate for the service conditions and duty specified.

26.3.5 Metallic bellow or the other sealing arrangement should be provided at the moving contact and should have long fatigue free life. Manufacturers' catalogue on vacuum bottle, indicating all such details shall essentially be submitted with the tender.

APPENDIX-A1

**PRINCIPAL PARAMETERS AND OTHER REQUIREMENT FOR
CIRCUIT BREAKERS:**

The 400, 220, 132 and 33KV Circuit Breakers shall conform to the specific technical requirements mentioned hereunder:

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
1	Nominal system voltage(KV rms)	400	220	132	33
2	Highest System voltage (KV rms)	420	245	145	36
3	Rated frequency (Hz.)	50	50	50	50
4	Rated normal current (Amperes rms)at 50°C ambient temperature.	2500	2000	2000	1250
5	Type	Outdoor SF6-Gas			Outdoor, Vacuum
6	Duty Requirements	SPR duty	SPR duty	Normal Duty	Normal Duty
6	Mounting Structure Details	Hot dip galvanized lattice steel support structure.			
7	System Neutral earthing.	Effectively earthed.			
8	Number of Poles	3	3	3	3
9	Type of Operation	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for three pole tripping and closing i.e. normal duty	Suitable for three pole tripping and closing i.e. normal duty
10	Minimum clearances – (mm) a) Between phases b) Between live parts and earth c) Centre to Centre distance between phases	6000 3500 7000	-- -- 4500	-- -- 1700	-- -- 430
11	Ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth)	8000	5500	4600	3700
12	Height of concrete plinth provided by purchaser (mm)	300	300	300	300
13	Operating mechanisms	Spring operating mechanism with electrical controls			

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
14	Rated operating sequence	0-0.3 sec-CO-3min-CO ('O' stands for opening and 'C' stands for closing)			
15	"First Pole to clear" factor	1.3	1.3	1.3	1.5
16	Type of tripping	Trip free	Trip free	Trip free	Trip free
17	Maximum closing time not exceeding (milli-seconds)	<160 ms	150 ms	130 ms	80 ms
18	Maximum total break time (milli seconds)	<60 ms	<60 ms	<60 ms	<60 ms
19	Circuit breaker opening time	< 40 ms	< 40 ms	< 40 ms	< 40 ms
20	<u>Insulation level of breaker-</u> a) 1.2 / 50 micro second lightning impulse withstand voltage (kVP)	1425	1050	650	170
	b) 250 / 2500 micro second switching withstand voltage (kVP)	1050	-	-	-
	c) One minute power frequency withstand voltage (kVrms) i. Across earth ii. Between terminals	520 610	460 -	270 -	70 -
21	Maximum radio interference voltage at 266 kV rms line to ground voltage (both in close and open condition) (micro volt)	1000	1000	1000	-
22	Rated breaking current capacity: i. Line charging at rated voltage at 90 deg. Leading power factor (This should be possible with temporary over voltage as high as 1.5 PU without restrike) (Amp)	600	280	250	-
	ii. Rated small inductive current without switching o/v exceeding 2.3 p.u (Amp)	0 to 10	0-10	0-10	-
	iii. Rated Short circuit breaking current (AC component) Kilo Amp	40	40	40	25
	iv. Out of phase breaking current capacity Kilo Amp	10	10	10	6.25
23	Reactor loaded transformer-interrupting capacity.	Bidder may state Limiting values, if applicable.			
24	Rated short circuit making current capacity) (Kilo Amp)	100	100	79	62.5

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
25	Power Xmer duty requirement	315 MVA	315 & 160MVA	160 & 63MVA	63MVA (Max.)
26	Permissible limit of temperature rise	As per table given in Annexure-I			
27	Maximum acceptable difference in the instance of closing/opening of contacts:				
	i. Within a pole (milli-second)	2.5	5	5	5
	ii. Between poles (milli-second)	3.3	10	10	10
28	Total creepage distance of support insulator (mm)	10500	6125	3625	900
29	Short time current carrying capability for three seconds (Kilo Amp)	40 KA	40 KA	40 KA	25 KA
30	Breaking capacity of auxiliary contacts	10 Amp DC with Circuit time constant less than 20 ms	10 Amp DC with Circuit time constant less than 20 ms	10 Amp (With circuit time constant less than 20 ms)	10 Amp DC with circuit time constant less than 20 ms)
31	Maximum Noise level at base and upto 50 meters (dB)	140	140	140	140
32	Rated line charging current breaking capacity (Amps)	400	-	-	-
33	Trip coil and closing coil voltage	220 V DC	220V DC 110VDC	110V DC 220V D.C	110V DC
34	No. of openings circuit breaker is capable of performing without inspection, replacement and maintenance				
	i. at No load				10000
	ii. at 50% of rated current				10000
	iii. at 100% of rated current	-	-	-	10000
	iv. at 50% of breaking current				100
	v. at 100% of breaking capacity				30
35	Rated single shunt capacitor bank, breaking current at 36KV Voltage in line with IEC 62271-100. (1 x 24 MVAR Capacitor Bank)	-		-	400 Amps (rms)
36	Terminal Connector				

S. No.	Items	Requirements			
		400KV	220KV	132KV	33KV
a.	Connection	4 inch IPS tube	Twin Zebra	Twin Zebra	Twin Zebra
b.	Type	Expansion type to receive 4 inch IPS tube	Suitable to receive Twin Zebra ACSR	Suitable to receive Twin Zebra ACSR	Suitable to receive Twin Zebra ACSR
c.	Quantity	6 Nos.	6 Nos.	6 Nos.	6 Nos.
d.	Arrangement	suitable for horizontal take off	both vertical as well as horizontal take off	both vertical as well as horizontal take off	both vertical as well as horizontal take off
37	Control cable for CBs				
a.	4 Core x 2.5sq.mm (15mm dia)	8	8	8	2
b.	8 Core x 2.5sq.mm (19mm dia)	4	4	4	2
c.	12 Core x 2.5sq.mm (22mm dia)	2	2	2	1
d.	19 Core x 2.5sq.mm (25mm dia)	2	2	2	2
38	Auto reclosing	Breaker shall be suitable for single phase and 3 phase high speed auto reclosing		NA	NA
39	Static and dynamic load on foundation	-			
a.	Static load (in Kg)	Bidder may state loading	3000	1500	900
b.	Dynamic load (i) Upward (in Kg) (ii) Down ward (in Kg)		1500 2200	2000 2000	500 500
40.	Drawing Reference				
a.	For Foundation	-	JICA/MPPTCL/TR-101 TO 107/ 220KV CB Foundation	JICA/MPPTCL/ TR-101 TO 107/ 132KV CB Foundation	JICA/MPPTCL/ TR-101 TO 107/ 33KV CB Foundation
b.	For Terminal Connector	-	JICA/MPPTCL/TR-101 TO 107/ Terminal Connector		
41	Rating of pre-insertion resistor	400Ω	-	-	-
42	Minimum pre-insertion time	8ms	-	-	-

APPENDIX-A2

LIMITS OF TEMPERATURE RISE

Temperature rise and maximum temperature attained by on any part of equipment when in service at site under continuous full load conditions and exposed continuously to the direct rays of the sun shall not exceed the maximum temperature rise specified below under conditions specified in test clauses. Permissible temperature rise indicated is for a maximum ambient temperature of 50°C. If maximum ambient temperature rises, permissible values shall be reduced accordingly.

S. No.	Nature of the Part or of the liquid	Maximum Value of	
		Temp.	Rise in temp. at Max. ambient air temp. not exceeding 50deg C
1	Contacts in air, silver-faced copper, copper alloy or aluminum alloy (see notes (i) and(ii))	105	55
	Bare copper or tinned aluminum alloy	75	25
2	Contacts in oil: Silver-faced copper, copper alloy or aluminum alloy(see note ii)	90	40
	Bare copper or tinned aluminum alloy	80	30
3	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii)	105	55
4	Metal parts acting as springs	(See note iv)	
5	Metal parts in contact with insulation of the following classes:		
	a) Class Y : (for non-impregnated materials)	90	40
	b) Class A : (for materials immersed in oil or impregnated)	100	50
	c) Class E: in air in oil	120	70
		100	50
	d) Class B: in air in oil	130	80
		100	50
	e) Class F: in air in oil	155	105
		100	50
	f) Oil base Enamel Synthetic Enamel in air Synthetic Enamel in oil	100	50
120		70	
100		50	
6	Any part of metal or of insulating material in contact with oil, except contacts	100	50
7	Oil	90	40

Notes:

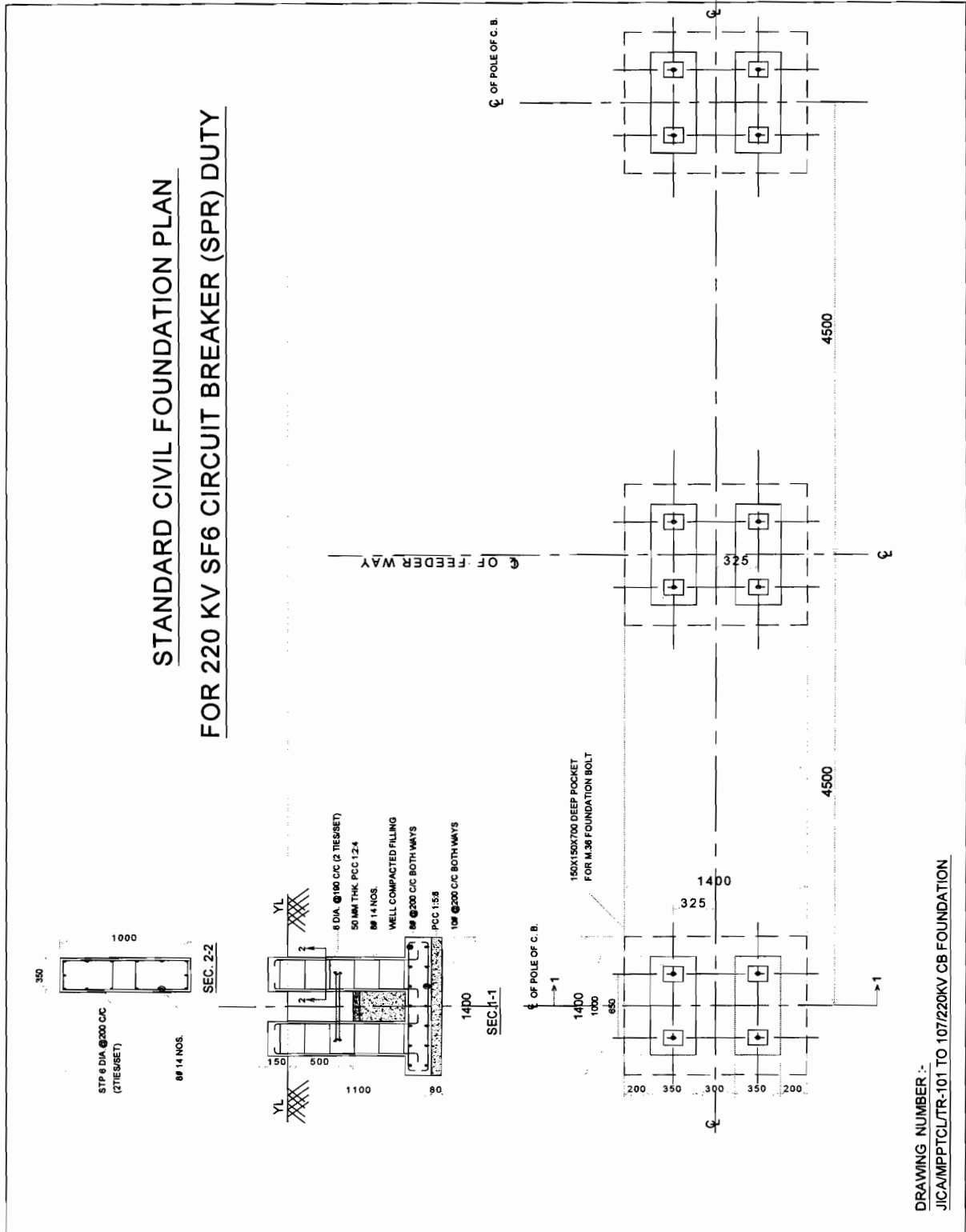
- i) When applying temperature rise of 55°C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.

- ii) Quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, contacts shall be regarded as "bare".
- iii) Values of temperature and temperature rise are valid whether or not conductor connected to the terminals is silver-faced.
- iv) Temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 750°C.

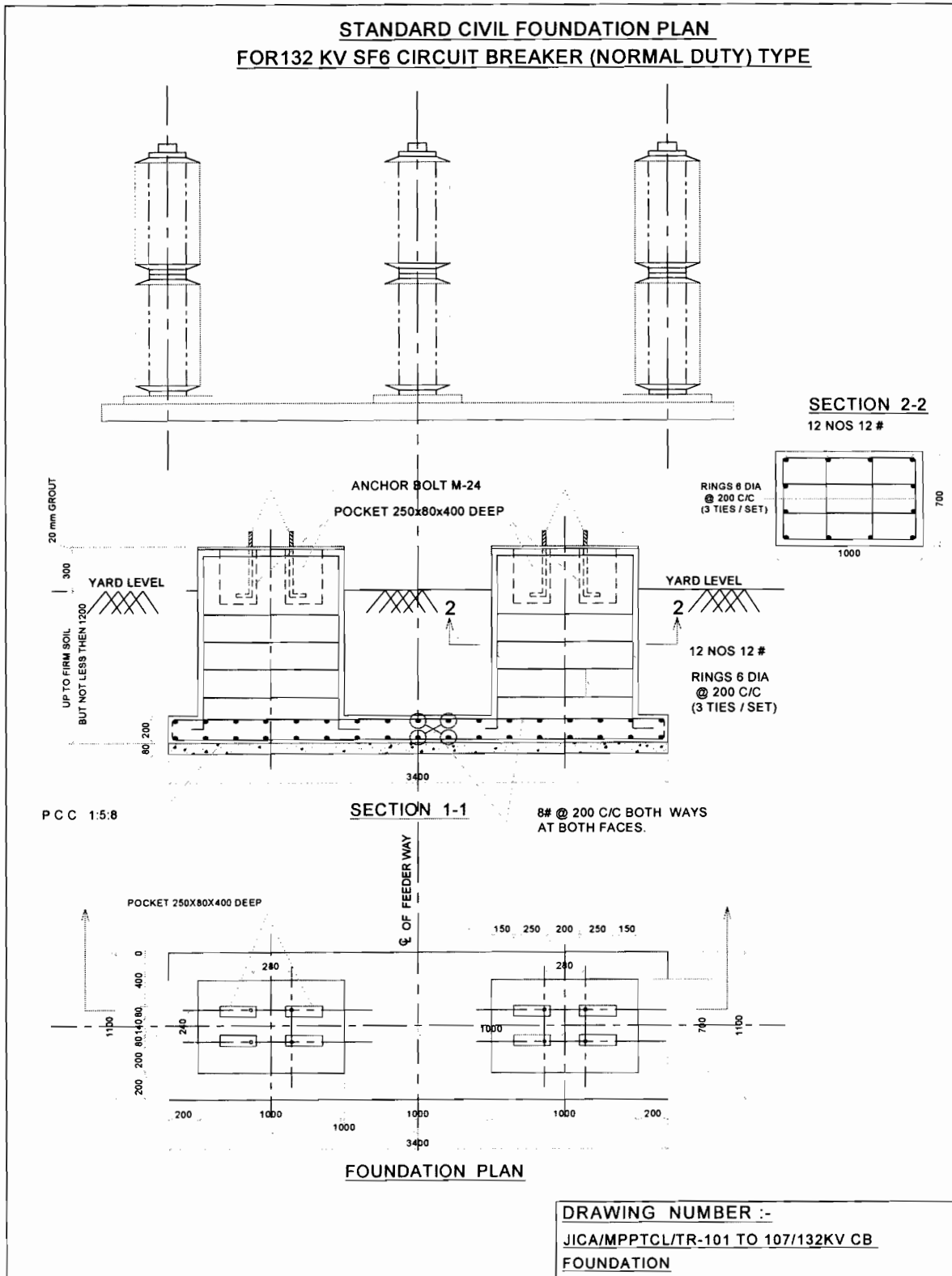
APPENDIX-B
DRAWINGS

S. No.	Drawing No.	Description
1	JICA/MPPTCL/TR-101 TO 107/ 220KV CB FOUNDATION	Foundation Drawing for 220KV SF6 Circuit Breaker
2	JICA/MPPTCL/TR-101 TO 107/ 132KV CB FOUNDATION	Foundation Drawing for 132KV SF6 Circuit Breaker
3	JICA/MPPTCL/TR-101 TO 107/ 33KV CB FOUNDATION	Foundation Drawing for 33KV VCB.
4	JICA/MPPTCL/TR-101 TO 107/ TERMINAL CONNECTOR	Drawing for Terminal connector for 220/132/33 KV CB

**STANDARD CIVIL FOUNDATION PLAN
FOR 220 KV SF6 CIRCUIT BREAKER (SPR) DUTY**



DRAWING NUMBER :-
JICA/MPPTCL/TR-101 TO 107/220KV CB FOUNDATION



Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
 Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Madhya Pradesh power Transmission company Ltd.				
b)	Project Title	Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) – Balaghat , Badnawar, Bhopal, Chhegaon and Nagda substation				
c)	Location	Balaghat	Badnawar	Bhopal	Chhegaon	Nagada
		Balaghat is Located in district of Balaghat of Madhya Pradesh. Distance between Jabalpur to Balaghat is 232 km by Road and 130 km by Rails.	Badnawar is Located in district of Dhar of Madhya Pradesh. Distance between Badnawar to Ujain is 70 km by Road .	Bhopal site is located 20 km away from Bhopal city.	Chhegaon is located in Khandwa district of Madhya Pradesh . Distance between Chhegaon to Khandwa is 15 km by Road.	Nagda is located in Ujjain district of Madhya Pradesh. The road distance between Nagda to Ujjain is 47 km
d)	Transport Facilities	Road/Rail				
e)	Postal Address	To follow				

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
 Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
 on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

SITE CONDITIONS		
a)	Maximum ambient air temperature	50°C
b)	Minimum ambient air temperature	1°C
c)	Average daily ambient temperature	35°C
d)	Maximum Relative humidity	95 % (sometimes approach saturation)
e)	Pollution Severity	Heavily Polluted
f)	Seismic level (horizontal acceleration)	0.3g
g)	Wind zone as per IS 802 (PART 1) - 1995 velocity	4
h)	maximum wind pressure	150kg/sq.mts
i)	Average annual rainfall	1250 mm
j)	Maximum altitude above mean sea level	1000m
k)	Isolceraunic level	90 days per year
l)	Climate	Moderately hot & humid tropical climate , conducive to rust & fungus growth

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V 50 Hz, 3-phase 4 wire, solidly earthed
1 phase A.C power supply	240V ,50 Hz, 1-phase , 2 wire
D.C. power supply	220V , 2-wire ungrounded , for all equipments and panels except PLCC of 400kV /220kV /132kV /33kV substation
D.C. power supply	48V , 2 wire system positively earthed for PLCC

The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltage.

i.	AC supply	Voltage + 10 % to -25% , frequency \pm 4%
ii.	DC supply	Voltage + 10 % to -20%

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
 Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
 on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

SYSTEM PARAMETERS

Description parameters	400kV System	220kV System	132kV System	33kV System
System operating voltage	400 kV	220kV	132kV	33kV
Maximum operating voltage(rms)	420 kV	220kV	145kV	36 kV
Rated frequency	50Hz			
Full wave impulse withstand voltage (1.2/50 micro second)	1425kVP	1050kVP	650kVP	250kVP/ 170kVP
One minute Power frequency dry/wet withstand voltage (rms)	630kV/ 520kV	460kV	275kV	95kV/70kV
Switching Impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kVP	-	-	-
Corona extinction voltage	320kV	156kV	105kV	-
Maximum radio interference voltage for frequency between 0.5MHz and 2 MHz at 320kV rms phase for 400kV system , 156kVrms for 220kV system & 92 kV rms for 132kV system	1000 Micro volt	1000 Micro volt	500 Micro volt	-
Rated short time current	40 kA for three seconds/one second as applicable			25 kA for three seconds/2 6.2kA for two second
Creepage distance @25mm/kV	10500mm	6125mm	3625m m	900mm
System Earthing	Effectively Earthed			

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **five years from the date of bid opening (i.e. 20.11.13)** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

Painting process shall be of powder coating type. All surface shall be cleaned , phosphated and given two coats of rust-resistant primer followed by two coats of finish paints . The interior of all panels cabinets and enclosures shall be finished with gloss white enamel. Two final powder coats of synthetic enamel paint of light grey

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

shade(697 of IS-5) shall be given to exterior surface of all the panels. Sufficient quantities of touch paint shall be furnished for application at site. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two 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 other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 697 of IS:5.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work
on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 & or 4759 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be **610 gm/sq.m** and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

Mandatory spares shall be packed in separate packing with clear identification.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door: IP-55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area IP:52
- d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41
- e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided. All measurements shall be in M.K.S units.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turn key basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda,

marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be **1100 V grade box** –clamp type and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4**, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits : Minimum of 2 nos. of 2.5 sq.mm, copper flexible.

All CT circuits : Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. **At**

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay
work on total turn key basis (Lot no. 1) - Balagaht, Badnawar, Bhopal, Chhegaon and Nagda,

least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of **CRCA** sheet steel of minimum 2.5 mm thickness. The thickness of door s/covers shall not be less than 2.5 mm. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay
work on total turn key basis (Lot no. 1) - Balagaht, Badnawar, Bhopal, Chhegaon and Nagda,

shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant ,the unit designation, contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor’s risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor’s drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Madhya Pradesh power Transmission company Ltd. Bharat Heavy Electricals Ltd.
 Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay
 work on total turn key basis (Lot no. 1) - Balagaht, Badnawar, Bhopal, Chhegaon and Nagda,

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL		FINAL DOCUMENTATION	
			Prints		Prints	CDs
1.	Drawings and Data Sheets	1	6		21	7 nos of all drawings/documents
2.	Drawings "As Built "	-	-		21	
3.	Type Test Reports	1	6		21	
4.	Erection Manuals	-	6		21	
5.	Operation and Maintenance Manuals	-	6		21	
6.	Manufacturing Quality Plan	1	6		21	
7.	Field Quality Plan	1	6		21	
8.	Inspection Test Reports	-	-		21	

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.


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FIRST PAPER PRODUCTION
 09/2018

REV.	DATE	REASON FOR REVISION	DRN	PREPARED BY	CHECKED BY	APPROVED BY

OWNER
MADHYA PRADESH POWER TRANSMISSION
COMPANY LIMITED

PROJECT
 CONSTRUCTION OF NEW 400kV SUB STATION , TRANSMISSION LINES
 AND AUGMENTATION WORK/FEEDER BAY WORK ON TOTAL TURK KEY BASIS
 (LOT NO. -1) -BALAGHAT, BADNANWAR, BHOPAL, CHHIBGAON AND MADDA

DPC PURCHASER
 **BHARAT HEAVY ELECTRICALS LTD**
TRANSMISSION BUSINESS GROUP

DEPT	CODE	NAME	SIGN.	DATE

DATE	SCALE	DATE	DATE	DATE	DATE	DATE	DATE	DATE

TITLE
 SHEET / SUB VERSION DRG NO.
 SHT. NO. REV.

SECTION 4

GUARANTEED AND TECHNICAL PARTICULARS FOR CIRCUIT BREAKER

1. GENERAL

- a) Name of the Manufacturer
- b) Country of Manufacturer
- c) Type of Circuit Breaker
- d) Manufacturer's type designation
- e) Standard Applicable
- f) Rated Voltage (kV rms)
- g) Rated Current
- i. Under normal condition (A)
- ii. Under site condition (A)
- h) Rated frequency (Hz)
- i) Number of poles
- j) Whether 3 pole or single pole unit
- k) Whether All The 3 poles ganged electrically or mechanically
- l) Whether dead tank or live tank design
- m) Type of installation
- n) No. of break per pole
- o) Latching Current

2. GUARANTEED RATINGS

a) Rated short circuit breaking current

i. Symmetrical component at highest system voltage (kA)

ii. DC Component (%)

iii. Asymmetrical breaking current at highest system voltage (kA)

b) Rated Making Capacity

i. At higher rated voltage (kAp)

ii. At lower rated voltage (kAp)

c) (i) Maximum Total break time under any duty condition for any current upto rated breaking current with limiting conditions of voltage and pressure (ms)

ii. Rated break time

d) Closing time (ms)

e) Minimum opening time under any condition with limiting voltage and pressure (ms)

f) Maximum opening time under any condition with limiting voltage and pressure (ms)

g) Maximum close open time under any condition with limiting voltages and pressures (ms)

h) First pole to clear factor

i) Short time current rating (kA) for 1s

- j) Rated operating duty
- k) Maximum braking capacity under kilometric faults
and rated TRV characteristic (kAp)
- l) Maximum breaking capacity under phase
opposition (kAp)
- m) Maximum line charging breaking current with
temporary over voltage upto 1.4 p.u. (A)
- n) Maximum over voltage (p.u.) on switching
transformer on no load and corresponding charging
current
- o) Maximum period between closing of first contact &
last contact in a pole (ms)
- p) Maximum pole discrepancy (ms)
- q) Maximum arc duration and corresponding current
under lockout pressure
- r) Pre-insertion resistor
 - i. Value/ pole (ohms) / with tolerance
 - ii. Minimum and maximum duration of
insertion per pole (ms)
 - iii. Thermal rating for the C-1m-O-CO-2m-
C-1m-O-CO for terminal fault considering
maximum resistance and
 - iv. Thermal rating for the same duty as (iii)
above for reclosing against trapped
charges
- s) Small fault current breaking capacity (kAp)
- t) Maximum temperature rise for main contacts over
design ambient temperature of 50°C
- u) Rated voltage & pick up range for trip coil (V)
- v) Rated voltage & pick up range for closing coil (V)
- w) Rated pressure and limits of pressure of operating
mechanism

- x) Rated pressure and limits of pressure of extinguishing medium
- y) Minimum dead time for
 - i. Three phase reclosing (ms)
 - ii. Single phase reclosing (ms)

3. DIELECTRIC WITHSTAND OF COMPLETE BREAKER

- a) One minute dry & wet power frequency withstand voltage
 - i. Between live terminal and ground (kVrms).....
 - ii. Between terminals with breaker contacts open (kV rms).....
- b) 1.2/50- micro second impulse withstand test voltage
 - i. Between live terminals and ground (kVp).....
 - ii. Between terminals with breaker contacts open (kVp).....
- c) 250/2500 micro second switching surge withstand test voltage
 - i. Between live terminals and ground (kVp).....
 - ii. Between terminals with breaker contacts open (kVp).....
- d) Corona extinction voltage (kV rms)
- e) Maximum radio interference voltage (micro V) at 1.1 Ur/_/3
- f) Total creepage distance
 - i. To ground (mm)
 - ii. Between terminals (mm)

4. OPERATING MECHANISM

- a) Type of operating mechanism for
 - i. Closing
 - ii. Opening

Section-4

Rev-00

- b) Manufacturer's type designation
- c) Normal power consumption (W) at rated voltage of

 - i. Trip coil
 - ii. Closing coil

4.1 Pneumatic operating mechanism

- a) Rated operating pressure (kg/sq.cm)
- b) Range of pressure for (kg/sq.cm)

 - i. Closing
 - ii. Opening

- c) Air Consumption at rated pressure for

 - i. Closing (m3)
 - ii. Opening (m3)
 - iii. Close-open (m3)

- d) Pressure drop/ metre length of piping
- e) Number and Capacity (m3) of breaker local air storage receivers
- f) f) No. of close operations for which sufficient air is available in local receiver
- g) g) Capacity of compressor (m3/hr) and working pressure (kg/cm2)
- h) Maximum time for which compressor can operate continuously (min)
- i) Time to fill

 - i. Air receiver after one CO operation (min)
 - ii. For making up of losses occurring in 4 hours (min)

- j) Pressure at which compressor

 - i. Starts (kg/cm2)
 - ii. Stops (kg/cm2)

- k) Material of compressed air piping

Section-4

Rev-00

- l) Inner & outer dia of main piping (mm)
- m) Whether interpole piping included in scope of supply
- n) Manufacturer's name for
 - i. Compressor
 - ii. Air receiver
 - iii. Pressure reducer
 - iv. Stop valves
 - v. Drain valves
- o) Safety valve
 - i. Low pressure stage Blow off at (kg/cm²)
 - ii. Intermediate stage blow off at (kg/cm²)
 - iii. High pressure stage blow off at (kg/cm²)
- p) Safety valve opens at (kg/cm²)
- q) No. of stored CO operation in breaker air receiver
- r) Alarm switch closes on air receiver at (kg/cm²)
- s) Lockout pressure (kg/ cm²)
 - i. Closing
 - ii.
 - iii.

4.2 Hydraulic operating mechanism

- a) Rated pressure of oil in operating cylinder (kg/cm²)
- b) Limits for pressure (kg/cm²)
- c) Quantity of oil (litre)
- d) Details of arrangements to prevent change of position of breaker of position of breaker in the event of hydraulic
- e) Details of monitoring arrangement for hydraulic pressure
- f) No. of close-open operations possible after loss of AC supply to drive motor
- g) Details of hand pump set provided for emergency operation

- q) Minimum time interval between each make/ break..... operation (ms)

5.2 GENERAL

- a) Whether OGA drawing enclosed
- b) Weight of complete 3 phase breaker for foundation..... design (kg)
- c) Weight of heaviest part of breaker (kg)
- d) Impact loading for foundation design
- e) Seismic level for which breaker is designed
- f) Minimum safety clearance from earthed objects
- g) Noise level in (dB) at base of the breaker
- h) Minimum clearance in air
 - i. Between live parts (mm)
 - ii. Live parts to earth (mm)
 - iii. Live parts to ground level (mm)

6. CONSTRUCTIONAL DETAILS

- a) Whether arcing contacts provided
- b) Type and material of main contacts and arcing..... contacts
- c) Contact pressure on main contacts (kg/cm²)
- d) Contact separation in arcing position (mm)
- e) Contact separation in open position (mm)
 - i. Main contacts
 - ii. PIR contacts
- f) Whether pressure relief device for each of the gas..... chamber of SF6 CB provided
- g) Rate of contact travel
 - i. Opening (m/sec)
 - ii. Closing (m/sec)
- h) Whether the making & breaking contacts are..... hermetically sealed
- i) Type and capacity of device used to obtain uniform..... voltage distribution between breaks

Section-4

Rev-00

- j) Overvoltage withstand capability of grading components (kV/mms)
 - i. Continuous
 - ii. 10 minutes
 - iii. 1 minute
 - iv. 5 seconds
- k) Number of auxiliary contacts per pole provided for Owner's use
- l) Rated voltage of auxiliary contacts (V)
- m) Current rating of auxiliary contacts
 - i. Continuous (A)
 - ii. DC breaking with 20 ms time constant (A)
- n) Whether auxiliary contacts silver plated
- o) Whether support structure included in supply
- p) Height of support structure
- q) Material of support structure
- r) Standard to which the design of support structure conforms
- s) Whether foundation bolts for breakers and cabinets included in scope of supply

7. DETAILED LITERATURE

- i. Type test reports as per IEC-56
- ii. Factory test report & / or filed test report in case of reactor switching duty
- iii. Details of operating mechanism
- iv. Drawing of breaker of support structure
- v. Calculations for compressed
- vi. Details of SF6 gas filling
- vii. Details of SF6 gas leak detector
- viii. Precautions in use of SF6 gas
- ix. Leaflets & literature bringing out salient features of equipment offered

Section-4

Rev-00

- c) Voltage rating
- d) Current rating
- e) Duty class, if applicable
- f) Manufacturers catalogue No.
- g) Total heat load of cabinet
- (for purpose of ventilation requirement)
- 8. Colour of finish paint IS:5
- a) Outside
- b) Inside
- 9. Control Wiring
- (a) Size of conductor
- i. For CT circuits
- ii. For other circuits
- b) Conductor Solid/ Standard
- c) Number of Strands/ conductor
- 10. Terminal Blocks
- (a) Make & type
- b) Current rating
- i) Power terminals (A)
- ii) Other terminals (A)
- 11. Space Heater Rating at 240 V AC
- 12. Control cabinet drawing showing the following
- a) Outline dimensions, floor openings, floor/wall/ pedestal fixing arrangements, weights etc.
- b) Front view, inside view showing the mounting arrangement of various equipment
- 13. Schematic/ Wiring diagram of control cabinet enclosed
- 14. Interconnection drawing showing cable, connections to the control cabinet enclosed
- 15. Type test report to verify design of protection enclosed
- 16. Details of terminal rows:
- i) Whether aranged
- vertical or horizontal

- ii) Clearance from adjacent components
- iii) Distance between rows
- iv) Whether transparent protection cover provided

TERMINAL CLAMPS AND CONNECTORS

1. Manufacturer's Name
2. Applicable Standards
3. Type
4. Material of connector
 - a) Clamp body
 - b) Bolts & Nuts
 - c) Spring washers
5. Rated Current
 - 6.a) Rated terminal load (kg)
 - b) Factor of safety
7. Minimum thickness of any part (mm)
8. Weight of clamp complete with hardware (kg)
9. Type test reports as per IS enclosed
10. OGA drawing enclosed

BUSHING/SUPPORT INSULATOR

1. Manufacturer's Name
2. Type
3. Applicable Standards
 - i) Height
 - ii. Diameter (Top)
 - iii. Diameter (Bottom)
4. Total Creepage distance (mm)
5. Rated voltage (kV)
6. Power frequency withstand voltage for 1 Min. (kVrms) dry and wet
7. 1.2/50 micro sec. Impulse withstand voltage (kVp)
8. 250/2500 micro sec. Switching impulse withstand voltage (kVp) dry and wet

Madhya Pradesh Power Transmission company Ltd.

Bharat Heavy Electricals Limited

Construction of new 400 kV sub stations, transmission lines and Augmentation work/feeder bay work on total turnkey basis (Lot no. 1) - Balaghat, Badnawar, Bhopal, Chhegaon and Nagda

Technical specification for 400/220/132kV Circuit Breakers

Doc. No. TB-368-316-001

Section-4

Rev-00

9. Corona Extinction voltage (kV)

10. Weight (kg)

11. Max. Allowable span (mm)

12. Cantilever Strength (kg)

13. OGA drawing enclosed

SECTION - 5

CHECK LIST FOR 400kV, 220kV & 132 KV CIRCUIT BREAKERS

Put a tick mark (✓) in 'YES/NO' Column if the specified requirement is met, or put a (X) mark, if the specified requirement is not met and give comments in the "Remarks" column.

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
1	Nominal system voltage(KV rms)	400	220	132		
2	Highest System voltage (KV rms)	420	245	145		
3	Rated frequency (Hz.)	50	50	50		
4	Rated normal current (Amperes rms)at 50°C ambient temperature.	2500	2000	2000		
5	Type	Outdoor SF6-Gas				
6	Duty Requirements	SPR duty	SPR duty	Normal Duty		
	Mounting Structure Details	Hot dip galvanized lattice steel support structure.				
7	System Neutral earthing.	Effectively earthed.				
8	Number of Poles	3	3	3		
9	Type of Operation	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for single pole tripping and reclosing i.e. SPR duty	Suitable for three pole tripping and closing normal duty i.e. normal duty		
10	Ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth)	8000	5500	4600		

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
11	Height of concrete plinth provided by purchaser (mm)	300	300	300		
12	Operating mechanisms	Spring operating mechanism with electrical controls				
13	Rated operating sequence	0-0.3 sec-CO-3min-CO ('O' stands for opening and 'C' stands for closing)				
14	"First Pole to clear" factor	1.3	1.3	1.3		
15	Type of tripping	Trip free	Trip free	Trip free		
16	Maximum closing time not exceeding (milli-seconds)	<160 ms	150 ms	130 ms		
17	Maximum total break time (milli seconds)	<60 ms	<60 ms	<60 ms		
18	Circuit breaker opening time	< 40 ms	< 40 ms	< 40 ms		
19	Insulation level of breaker-a) 1.2 / 50 micro second lightning impulse withstand voltage (kVP) b) 250 / 2500 micro second switching withstand voltage (kVP) c) One minute power frequency withstand voltage (kVrms) i. Across earth ii. Between terminals	1425 1050 520 610	1050 - 460 -	650 - 270 -		
20	Maximum radio interference voltage at 266 kV rms line to ground voltage (both in close and open condition) (micro volt)	1000	1000	1000		
21	Rated breaking current capacity:					

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
	i. Line charging at rated voltage at 90 deg. Leading power factor (This should be possible with temporary over voltage as high as 1.5 PU without restrike) (Amp)	600	280	250		
	ii. Rated small inductive current without switching o/v exceeding 2.3 p.u (Amp)	0 to 10	0-10	0-10		
	iii. Rated Short circuit breaking current (AC component) Kilo Amp	40	40	40		
	iv. Out of phase breaking current capacity Kilo Amp	10	10	10		
22	Reactor loaded transformer-interrupting capacity.	Bidder may state Limiting values, if applicable.				
23	Rated short circuit making current capacity) (Kilo Amp)	100	100	79		
24	Power Xmer duty requirement	315 MVA	315 & 160MVA	160 & 63MVA		
25	Permissible limit of temperature rise	As per table given in Annexure-I				
26	Maximum acceptable difference in the instance of closing/opening of contacts: i. Within a pole (milli-second) ii. Between poles (milli-second)	2.5	5	5		
27	Total creepage distance of support insulator (mm)	10500	6125	3625		

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
28	Short time current carrying capability for three seconds (Kilo Amp)	40 KA	40 KA	40 KA		
29	Breaking capacity of auxiliary contacts	10 Amp DC with Circuit time constant less than 20ms	10 Amp DC with Circuit time constant less than 20ms	10 Amp DC with Circuit time constant less than 20ms		
30	Maximum Noise level at base and upto 50 meters (dB)	140	140	140		
31	Rated line charging current breaking capacity (Amps)	400	-	-		
32	Trip coil and closing coil voltage	220 V DC	220 V DC	220 V DC		
33	Auto reclosing	Breaker shall be suitable for single phase and 3 phase high speed auto reclosing		NA		
34	Static and dynamic load on foundation	-				
a.	Static load (in Kg)	Bidder may state loading	3000	1500		
b.	Dynamic load (i) Upward (in Kg) (ii) Down ward (in Kg)		1500 2200	2000 2000		
35	Rating of Pre-Insertion Resistor (ohm)	400	-	-		
36	Minimum Pre-Insertion time (ms)	8	-	-		
37	Drawing Reference					

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
a.	For Foundation (Bidder to match the structure of Breaker with foundation drawing of MPPTCL)	To be given at detailed Engineering Stage	JICA/MPPT CL/TR-101 TO 107/ 220KV CB Foundation	JICA/MPPTCL/ TR-101 TO 107/ 132KV CB Foundation		
38	General					
a)	Whether OGA drawing enclosed					
b)	Whether Interpole cabling included in Bidder's scope alongwith required Glands, Lugs etc. Termination chart shall be submitted alongwith the drawings.					
c)	Whether all Type Test Reports are as per clause No.4 of section-1 and Clause No. 2.4 of section-2.					
d)	GI support structure included in Supply					
e)	Earthing Hardware of circuit breaker shall be in bidder scope					
f)	Whether foundation bolts for breakers and cabinets included in scope of supply					
g)	Mandatory spares included in scope of supply as per clause No. 3.2 of Section-1					
h)	Bidder to confirm all accessories are included in scope as per Clause No. 16.2 of Section-2.					

S. No.	Parameters	400KV	220KV	132KV	Yes/No	Remarks
i)	Whether vendor is meeting the qualifying requirement as per clause No. 5 of Section-1; please attach supporting documents.					
j)	Supervision of Erection, testing and commissioning included in scope and shall be in lump sum basis only.					