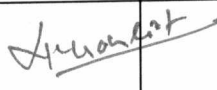




BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
ENGINEERING MANAGEMENT, NOIDA, SECTOR-142

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	Title		420 kV Circuit Breaker		Date	12.06.19 17/4/19																								
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	CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD.																													
	PROJECT: Extension of 765/400kV S/S, Bara TPS (U.P.)																													
	LOI NO: 121/ESD-765kV/13/Bara/Vol-1 dated: 08/03/2019																													
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SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Circuit Breaker complete with accessories as listed under this specification.

This section covers the specific technical requirements of Circuit Breaker. This constitutes minimum technical parameters for the above item as specified by the customer (UPTCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities.
Section-2: Equipment Specification
Section-3: General Technical Requirements

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

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Uttar Pradesh Transmission Corporation Ltd.
Name of the project: Extension of 765/400kV S/S, Bara TPS (U.P.)

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

ITEM	DESCRIPTION	UNITS	REQUIRED
1	Type		SF6, Single pole, electrically gang operated type
2	Rated voltage for equipment (U_r)	kV	420
3	Rated Lightning impulse (U_p) - Phase to earth - Across the isolating distance	kV _p kV _p	1425 1425 (+240)
4	Switching impulse withstand voltage (U_s) - Phase to earth - Across the isolating distance	kV _p kV _p	1050 900 (+345)

5	Power-frequency withstand voltage (U _d) - Phase to earth - Across the isolating distance	kVRMS kVRMS	520 610
6	Rated Frequency	Hz	50
7	Number of poles		03
8	Operation		Single Pole
9	Rated current	A	3150
10	Rated short-time withstand current (1 s)	kA	50
11	Rated Interrupting capacity	kA	50
12	Breaking time	ms	≤ 40
13	Rated peak withstand current	kAP	100
14	Operating sequence		O-0.3s-CO-3m-CO
15	Rated TRV for faults at terminals - TRV crest value - TRV rate of rise - Initial TRV - Time to crest of initial TRV	kV kV/μs kV μsec	624 2 3.7 0.8
16	Rated TRV for short line faults - TRV crest value - TRV rate of rise - Surge impedance	kV kV/μs ohms	480 2 450
17	Rated out-of-phase breaking capability - Rated out-of-phase current - Power frequency recovery voltage	kA kV	10 485
18	Rated TRV out-of-phase breaking - TRV crest value - TRV rate of rise	kV kV/μs	857 1.54
19	Rated line charging breaking capability - Rated line charging breaking current, very low probability of restrike (class 2) - TRV crest value - TRV duration after breaking	A kV s	400 824 0.3
20	Radio Interference Voltage (RIV) - R.I.V. max voltage level (IEC 60694) at 0,5 MHz	μV	500
21	Expected time to perform a complete maintenance inspection (including gas handling)	years	≥ 8
22	Mechanical endurance (mechanism and breaking chamber)	CO	IEC class M2 10000
23	Corona extinction voltage	kV	320
24	Operating Mechanism		
24.1	Type		Spring charged, Pneumatic, Hydraulic or combination of these
24.2	Motor voltage	V _{ac}	240

24.3	Closing and opening coil voltage	Vdc	220
24.4	Number of closing coils		1
24.5	Number of opening coils		2
24.6	Number of auxiliary contacts available for customer use		10 NO 10 NC
24.7	Mechanical OPEN/CLOSE indicators		Yes
24.8	Operation counter		Yes
24.9	Local manual control		Yes
24.10	Test switches (dc)		Yes
24.11	Heater		Yes
24.12	Protection-class enclosure		IP 55
24.13	Hand-charging facilities		Yes
24.14	Mechanical spring charge/discharge		Yes
25	Accessories in the Central Control Panel		
25.1	Anti-pumping relay		Yes
25.2	Local/remote command selector switch		Yes
25.3	Local operation push buttons		Yes
25.4	Minimum pressure lock-out and alarm relay		Yes
25.5	Lighting, heating and service outlet		Yes
25.6	Terminal blocks		Yes
25.7	Test switches (dc)		Yes
25.8	Phase discrepancy timer relay		Yes
25.9	Protection-class enclosure		IP 55
25.10	Nameplate		IEC 62271-100 Table 6
25.11	Emergency trip facility		Located on LCC
25.12	AC power supply (50 Hz)	Vac	240
26	Maximum leakage rate		≤ 1%
27	Standards		IEC 60376 IEC 60427 IEC 60480 IEC 60694 IEC 61233 IEC 62271-100 IEC 62271-203
28	Quality		ISO 9001

1.3 BILL OF QUANTITIES

Sl.	Description	Unit	Quantity
01.	420 kV, 3150 A, 50 kA, 3-ph, SF6 Circuit Breaker along with support structure, foundation bolts, interpole cables, operating mechanism, control cabinet, cable glands and all accessories, complete in all respects.	Nos.	02
02.	Controlled Switching Device (CSD) for above 400kV CB'S along with all accessories suitable for 765/400kV ICT (except special cables) complete in all respect	Nos.	02
03	Special cables* for CSD Length = distance from CB to relay panel	m	1000
04	Supervision of Erection ,Testing & Commissioning of all 420kV Breakers (1 lot = 1 CB)	lot	02
05	Supervision of Erection ,Testing & Commissioning of all CSDs (1 lot = 1 CSD)	lot	02

Note:

- 1) Total qty. of BOQ may vary -30% to +30%.
- 2) * Special cables other than other than 1100V LT power and control cables required for CSD shall be in bidder's scope. Qty. to be estimated by bidder based on layout or site visit.
- 3) All wiring necessary for interface of circuit breakers with CSD is deemed to be included in the scope.
- 4) Supply of terminal connectors for circuit breakers is in BHEL scope.
- 5) The Supervision of testing and commissioning shall be inclusive of the following:
 - i. Testing equipments required for testing.
 - ii. To and Fro fares from Bidder's headquarter to BHEL site.
 - iii. Accommodation and conveyance at site.
 - iv. Any other incidental charges.

No other charges shall be paid by BHEL.

The following instruments/kits shall be brought out at site by Bidder/supplier:

- (a) Time Interval meter (Timing kit)
- (b) SF6 gas leakage Detector
- (c) SF6 gas filling adopter
- (d) Transducer for operational analyzer (if required)

The following instruments/kits shall be made available by BHEL to testing engineer:

- (a) DCRM (operational analyzer kit)
- (b) 1 & 5kV insulation tester
- (c) Single phase variac
- (d) Dew Point Meter
- (e) Capacitance and Tan Delta Kit
- (f) Contact resistance measurement kit

(g) Multimeter

Any other instrument(s), if required for testing/commissioning of circuit breaker shall be arranged by circuit breaker supplier without any price implication to BHEL.

1.4 Pre-qualification Requirement

A. OPERATIONAL EXPERIENCE

Offered equipment should have given three years proven trouble free operational service in tropical climate. However, in case of equipment manufactured in India under valid foreign collaboration, operating experience in tropical climate of offered collaborator's equipment, shall also be acceptable provided copy of valid collaboration agreement for the offered equipment is submitted with the proposal. Further in case of offer of imported equipment, three year operating experience shall be considered in respect of those areas only which are similar to the tropical conditions prevailing in India.

B. MANUFACTURING EXPERIENCE

The indigenous manufacturers or their foreign collaborator must have manufactured at least 20% of the specified quantities of each item of identical or similar equipment as on date of bid opening.

C. TESTING FACILITIES:

The manufacturer must have all necessary facilities at their works for carrying out such routine and acceptance tests as prescribed in the relevant ISS/IEC and any other routine and acceptance test as specified in the specification. Documentary evidence of existence of such facilities will be submitted along with the proposal.

1.5 TYPE TESTS

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years from the date of bid opening of Bara (02.03.2019). The reports should have been conducted on identical or similar equipment/components to those offered. The test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment.

In case type test reports are more than 5 years old (from 02.03.2019) or the reports of type tests are found to be technically unacceptable by BHEL/UPTCL, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.6 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, provided by 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 each item in accordance with the applicable IEC/IS and the material shall be offered for final inspection by BHEL and

UPTCL in accordance with agreed quality plan with 3 weeks advance information. The charges for these shall be deemed to be included in the equipment price.

1.7 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 requirements 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 / customer's approval.

1.8 SPECIAL TOOLS AND TACKLES

Bidder shall supply all special tools and tackle free of cost which are specifically required for the circuit breakers and are proprietary in nature. List of such special tools and tackle should be clearly listed along with the technical offer. Any special tool which is not listed in the list but required during the erection/testing/commissioning of circuit breakers shall also be supplied free of cost by the supplier.

1.9 TITLE BLOCK

The drawings / documents submitted shall be project and product specific and shall incorporate following details:

- a) Project Name : Extension of 765/400kV S/S, Bara TPS (U.P.)
- b) Customer Name : Uttar Pradesh Transmission Corporation Ltd.
- c) Contractor : BHEL
- d) Customer LOI No. : 121/ESD-765kV/13/Bara/Vol-1, Dated: 08.03.2019.

SECTION - 2

EQUIPMENT SPECIFICATION

2.1 General

The 400/765 kV circuit breakers shall be part of the substation of 765/400kV Bara TPS. The circuit breakers shall be outdoor type, comprising three identical single pole units electrically gang operated, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to IEC- 62271-100.

2.2 Codes and Standard

Electrical equipment shall be designed and tested according to the latest IEC Standards including amendments, or complementary standards mentioned in this document, shall be applied, in particular the following IEC publications:

IEC-60376	Specification and acceptance of new sulphur hexafluoride
IEC-60427	Synthetic testing of HV a.c. circuit breakers
IEC-60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60694	Common clauses for high voltage switchgear and controlgear standards
IEC-61233	High-voltage alternating current circuit-breakers – Inductive load switching
IEC-62271-100	High-voltage alternating-current circuit breakers

2.3 Service Conditions

2.3.1 System Parameters

The circuit breakers shall be designed to operate satisfactorily considering the power system parameters and environmental conditions indicated in the general technical requirements.

2.3.2 Auxiliary Services

The circuit breakers shall be designed to operate satisfactorily considering the auxiliary supplies indicated in the general technical requirements.

2.4 Duty Requirements

The circuit breakers shall be totally re-strike free (C-2 class) under all duty conditions. All the circuit breakers shall meet the M2 class of mechanical endurance requirements as per IEC.

The 400kV breakers controlling the interconnecting transformer (ICT) shall be equipped with point on- wave (POW) switching control on an independent pole basis.

Please refer attached single line diagram for the same.

The point-on-wave switching is to be applied to both the trip coils and one closing coil with the facility to by-pass this equipment as per requirement.

The controlling relays shall also record and monitor switching operations and make adjustments to the switching instant to optimise switching behaviour as necessary. They shall provide self -diagnostic facilities, signalling of alarms and enable downloading of data captured from switching events.

The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 400kV effectively grounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily.

The circuit breaker shall be capable for breaking the steady & transient magnetising current corresponding to 1500MVA 765/400kV Inter-Connecting Transformers.

It shall also be capable of breaking line charging currents as per IEC- 62271-100 with a voltage factor of 1.4.

The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC-62271-100.

The circuit breakers shall be reasonably quiet in operation. Noise level in excess of 75 dB measured at 35 meters from the base of the breaker will be unacceptable. Bidder shall indicate the noise level of breaker at distance of 5 to 150 m from base of the breaker.

The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, and arc extinguishing medium pressure, etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.

While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC-62271-100 requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.

The critical current, which gives the longest arc duration at lockout pressure of extinguishing medium and the duration, shall be indicated. All the duty requirements

specified above shall be provided with the support of adequate test reports to be furnished during contract stage.

2.5 Constructional Features

All making and breaking contacts shall be sealed and free from atmospheric effect. In the event of leakage of extinguishing medium to a value, which cannot withstand the dielectric stresses specified in the open position, the contacts shall preferably self-close. In case of circuit breakers with PIR, main contacts shall be last to close and last to open. To Protect main contacts from arcing, main contacts shall be last to close & first to open & vice versa arcing contacts shall be last to open & first to close and shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, then the main contacts shall be easily accessible for inspection and replacement. Main contacts shall have ample area and contact pressure for carrying the rated current under all conditions. The interrupter sectional drawing showing the following conditions shall be furnished during contract stage.

- Close position;
- Arc initiation position;
- Full arcing position;
- Arc extinction position; and
- Open position.

All the three poles of the breaker shall be linked together electrically.

Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay shall also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.

2.6 Sulphur Hexafluoride (SF₆) Gas Circuit Breaker

Circuit breakers shall be single pressure type.

Design and construction of the circuit breaker 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 insulated surfaces of the circuit breaker.

In the interrupter assembly, there shall be absorbing product box to eliminate SF₆ decomposition products and moisture. The details and operating experience with such filters shall be brought out as an additional information to the technical data schedule.

Each pole shall form an enclosure filled with SF₆ gas independent of two other poles. Common monitoring of SF₆ gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall be such that the SF₆ gas from one pole could be removed for maintenance purposes.

Material used in the construction of circuit breakers shall be such as fully compatible with SF₆.

The SF6 gas density monitor shall be adequately temperature compensated to model the density changes due to variations in ambient temperature within the body of circuit breaker as a whole. It shall be possible to dismantle the monitor without removal of gas.

Sufficient SF6 gas shall be supplied to fill all the circuit breakers to be installed plus an additional 20% of the quantity as spare.

2.7 Operating Mechanism

Circuit breaker shall be operated by spring charged mechanism, pneumatic mechanism, hydraulic mechanism or a combination of these. The mechanism shall be housed in a weather proof and dust proof control cabinet.

The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and mechanically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas.

The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices. A mechanical indicator shall be provided to show open and close positions of breaker. It shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing door closed. An operation counter shall also be provided.

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

Working parts of the mechanism shall be of corrosion resisting material. Bearings requiring grease, shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.

Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local /remote' selector switch and close & trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided.

Operating mechanism and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables etc.

Provisions shall be made on breakers for attaching an operation analyser to perform speed tests after installation at site to record contact travel against time and measure opening time.

The bidder shall furnish curve supported by test data indicating the opening time under close-open operation with combined variation of trip coil and operating media during contract stage.

2.7.1 Spring Operated Mechanism

Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. Closing spring shall be supplied with limit switch for automatic charging and other necessary accessories.

As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. After failure of power supply to the motor, one close-open operation shall be possible with the energy contained in the operating mechanism.

Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.

Closing action of the circuit breaker shall charge the opening spring ready for tripping.

When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism

2.7.2 Pneumatically Operated Mechanism

Each-pneumatic operated breaker shall be equipped-with compressed air system in accordance with Clause 2.8.6

The breaker local air receivers shall have sufficient capacity for at least two CO operations of the breaker at the lowest pressure for auto reclosing duty without refilling.

Independently adjustable pressure switches with potential free, ungrounded contacts to actuate a lock out device shall be provided. This lockout device with provision of remote alarm indication shall be incorporated in the circuit breaker to prevent operation whenever the pressure of the operating mechanism is below that required for satisfactory operation of the circuit breaker. The scheme should permit operation of all blocking and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure measurement can be made. Such facilities shall be provided for following conditions:

- Trip lockout pressure 2 Nos.
- Close lockout pressure 1 No.
- Auto reclose lockout pressure 1 No.

- Extreme low pressure 1 No.

The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with the air pressure immediately before operation between 85% and 110% of the rated supply pressure. The make/break time at this supply pressure shall not exceed the specified make/break time within any value of trip coil supply voltage as specified.

2.7.3 Hydraulically Operated Mechanism

Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor.

The hydraulic oil used shall be fully compatible for the specified temperature range.

The oil pressure switch controlling the oil pump and pressure in the high pressure reservoir shall have adequate number of spare contacts to be used for continuous monitoring of low pressure, high pressure etc.

The mechanism shall be suitable for at least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto reclose duty plus pressure drop for one close open operation.

The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The opening time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil supply voltage as specified.

Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of nitrogen shall be provided.

All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.

2.8 Fittings and Accessories

Following is partial list of some of the major fittings and accessories to be furnished as integral part of the breakers. Number and exact location of these parts shall be indicated in the bid.

2.8.1 Control Unit / Central Control Cabinet

Control unit / Central control cabinet complete with:

- Double compression type cable glands, lugs, ferrules, etc.
- Local/remote changeover switch
- Operation counter
- Fuses, as required

- Anti-pumping relay/contactors
- Rating and diagram plate in accordance with IEC including year of manufacture, etc.
- Gauges for SF6 gas pressure
- Gas density monitor with alarm and lockout contacts
- Pole discrepancy relay with each circuit breaker of 3 poles, to detect and trip the circuit breaker
- For pneumatic operated mechanism:
 - Pressure gauges
 - Pump/compressor start counter
 - Unit compressed air system
 - Breaker air receivers
 - Spring loaded safety valve
 - Pressure switch with adjustable contacts
 - Alarm pressure switch
 - Other valves and piping
- For hydraulic operated mechanism:
 - Pressure gauges
 - Pump/compressor start counter
 - Power cylinder
 - Control valves
 - High/low pressure reservoir
 - Alarm pressure switch
 - Hydraulic oil
 - Oil pump
 - Hydraulic joints and piping

2.8.2 Hollow Insulator Columns

The insulators shall conform to requirements stipulated in the insulator specification. All routine tests shall be conducted on the insulators as per relevant IEC. In addition, the following routine tests shall also be conducted on hollow column insulators:

- Ultrasonic test
- Pressure test
- Bending load test in 4 directions at 50% specified bending load
- Bending load test in 4 directions at 100% specified Bending load as a sample test
- Burst pressure test as a sample test

2.8.3 Support Structures

The minimum height of equipment supports shall be 2.55 meters. The structures shall conform to the technical specifications and shall be suitably designed to ensure the minimum clearance to ground. All main and support structures shall be galvanized.

2.8.5 Auxiliary Contacts

The Bidder shall provide the auxiliary contacts based on his final design as per project requirements, subject to approval of the UPTCL.

The auxiliary contacts must be adjustable individually, without affecting the setting of the other contacts. The auxiliary contacts shall have the interrupting capacity to switch the control circuits at the rated voltage (110 Vdc).

2.8.6 Unit Compressed Air System for Pneumatic Operating Mechanism

The unit compressed air system for pneumatic operating mechanism shall meet the following requirements:

The compressed air system shall be provided with suitable anti-vibration pads wherever required and with necessary piping, piping accessories, control valves, safety valves, filters, reducing valves, isolating valves, drain ports, etc.

2.8.6.1 Air Compressor

The compressor shall be of the air cooled type complete with cylinder lubrication and automatically controlled motors. The compressor shall be provided with automatic adjustable unloading device during starting, a time totaliser and a pressure gauge. The compressor shall be mounted within the operating mechanism housing or a separate weather-proof and dust-proof housing. The size of the compressor shall be determined by the bidder. The compressor shall be of sufficient capacity for performing all the operations above mentioned.

The compressor shall be rated for the following duty:

- Total running time of compressor to build up the rated pressure from atmospheric pressure (Not exceeding 80 minutes)
- Normal running air charging considering 10% leakage/day (Not exceeding 15 minutes)
- Air charging time after one close-open operation from rated pressure (Not exceeding 15 minutes)

2.8.6.2 Intercooler and After Cooler (if applicable)

Intercooler between compressor stage and after cooler at discharge if any of H.P. cylinder shall be included in Bidder's scope. They shall be of air cooled type and shall be designed as per ASME Code of IEMA Standards. The design pressure on the air side of cooler shall be 1.25 times the working pressure. A corrosion allowance of 3 mm shall be included for all steel parts.

2.8.6.3 Air Receivers

Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel - Section VIII of BS: 5179. If the air receiver is not fully hot dip galvanised, it shall be coated on the inside face with antirust medium and a corrosion allowance of 3.0 mm shall be provided for shell and dished ends.

Connections for air inlet and outlet, drain and relief valves shall be flanged type or screwed type. Pressure gauge and pressure switch connections shall be screwed type only.

Accessories such as suitable sized safety valve to relieve full compressor discharge at a set pressure equal to 1.1 times the maximum operating pressure, blow off valve, auto

drain tap with isolating and bypass valve, dial type pressure gauge with isolating and drain valve and test connection shall be provided.

Air receiver shall be offered with at least 50% spare capacity, calculated on the basis of total air requirement for 2 CO operations. The air receiver shall have stored energy for 2 CO operations of the breaker at the blocking pressure for auto reclosing duty without refilling. The unit compressor shall be capable of building up required pressure for another 2 CO operations within 30 minutes.

2.8.6.4 Air Quality

Compressed air used shall be dry and free of dust particles and fully compatible with the materials used in the pneumatic operating mechanism. Arrangement for conditioning the compressed air if required shall be provided as an integral part of air compressor system.

If situation warrants, because of the severe ambient conditions, the supplier may offer centralised compressed air system.

2.8.6.5 Control Equipment

The compressor control shall be of automatic start/stop type initiated by pressure switches.

Duplicate incoming supply of 415 V, AC shall be provided by the customer at switchyard bay marshalling box from where the Bidder shall take the feed to the operating mechanism.

All the necessary compressor control equipment shall be housed in a totally enclosed sheet steel cabinet also conforming to requirements of section-3. Pressure gauges and other indicating devices, control switches shall be mounted on the control cabinet.

A glass window shall be provided for viewing the indicating instrument/gauges. The maximum height shall be 2000 mm.

2.8.6.6 Compressed Air Piping, Valves and Fittings:

The flow capacity of all valves shall be at least 20% greater than the total compressor capacity.

The high pressure pipe and air system shall be such that after one 0-0.3 sec-CO-operation the breaker shall be capable of performing one CO operation within 3 minutes.

All compressed air piping shall be bright annealed, seamless phosphorous Deoxidized Non-Arsenical Copper alloy as per BS: 2874 or stainless steel pipe (C - 106 of BS: 2871-1957).

All joints and connections in the piping system shall be brazed or flared as necessary. All compressed air piping shall be carried out in accordance with BS:

Compressed air piping system shall be complete with Saddle clamps to support the piping system at suitable intervals. Necessary bolts, nuts, pipe fixing clamps etc shall be included in the scope of Bidder.

2.9 Tests

The circuit breaker shall be subjected to Type and Routine tests in accordance with the relevant IEC/IS. The Bidder shall provide the list of such tests as per IEC/IS after award of the Contract for UPTCL's approval.

2.9.1 Type Tests

Type tests as per IEC- 62271-100 on the complete breaker / pole along with its own operating mechanism and pole column shall be performed on one circuit breaker if already not performed on indigenously manufactured breakers. The type tests shall include the following as minimum:

- Dielectric tests
- Radio Interference Voltage (RIV) tests
- Measurement of the resistance of the main circuit
- Temperature-rise tests
- Short-time withstand current and peak withstand current tests
- Tightness tests
- Electromagnetic Compatibility (EMC) tests
- Mechanical operation test at ambient temperature
- Short-circuit current making and breaking tests
- Capacitive current switching tests
- Verification of the degree of protection
- Extended mechanical endurance tests on circuit-breakers for special service conditions
- Low and high temperature tests
- Static terminal load tests
- Critical current tests\
- Humidity test
- Out-of-phase making and breaking tests
- Single-phase and double earth fault tests

2.9.2 Routine Tests

Routine tests as per IEC- 62271-100 on the complete breaker / pole along with its own operating mechanism and pole column shall be performed on all circuit breakers. The routine tests shall include the following as minimum:

- Dielectric test on the main circuit
- Dielectric test on auxiliary and control circuits
- Measurement of the resistance of the main circuit
- Tightness test
- Design and visual checks
- Mechanical operating tests

- Operation speed curves test

2.9.3 Site Tests

All routine tests except power frequency voltage dry withstand test on breaker shall be repeated on the completely assembled breaker at site.

SECTION 3 GENERAL TECHNICAL REQUIREMENTS

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) 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 respective equipment sections and are not exclusive. However, in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

It is not the intent to specify completely in technical specifications of equipments/materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. BHEL/UPPCL will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

UPTCL procures all the equipment and materials for substations, keeping into consideration the interchangeability and future extension of substation. All equipment and materials to be supplied shall conform to the UPTCL's current Bid specifications for similar equipment and materials.

2.0 COMPLETENESS OF EQUIPMENTS

2.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

2.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to noncompliance with the requirement stipulated in the Technical Specification and/or IEC/136IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated. The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening (02.03.19). The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

3.0 STANDARDS

3.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.

3.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3 In the event of the Bidder offering equipment conforming to standards other than ISS/ IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.

3.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.

3.5 Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the Purchaser.

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 deg. C
(b)	Minimum ambient air temperature in shade	0 deg. C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	soceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conducive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	800kV, 420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by $\pm 5\%$
(iii)	Number of phases	Three

- (iv) Neutral Effectively Earthed
- (v) **Auxiliary power supply:-**
Auxiliary electrical equipment shall be suitable for operation on the following supply system:
- | | |
|--|--|
| (a) Power device (Like drive motors) | 400V, 3Phase, 4Wire 50Hz
Effectively earthed AC system. |
| (b) Lighting fixtures, space heaters, fractional Horse Power motors and control devices. | 250V, 2wire, 50Hz,
AC supply with one point grounded. |
| (c) DC alarm, Control and Protective | 2wire ungrounded DC supplies |

Devices from sub station batteries as under

- | | |
|------------------------------|-----------|
| (i) 765kV S/S | : 220V DC |
| (ii) 400 kV S/S | : 220V DC |
| (iii) 220/132kV S/S | : 110V DC |
| (iv) Communication equipment | : 48 V DC |

The above supply voltage is subject to variation as follows:

All devices must be suitable for a continuous operation over the entire range of voltage variations :

- | | |
|---------|---|
| (i) AC | Voltage may vary by $\pm 10\%$.
Frequency by $\pm 5\%$
Combined Voltage & frequency by $\pm 10\%$. |
| (ii) DC | a) 220 V may vary between 187 & 242 V
b) 110 V may vary between 93 & 121 V
c) 48 V may vary between 41 & 53 V |

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

Sl. No.	Description of Parameters	765 kV System	400 kV System	33 kV System
1.	Nominal system voltage	765kV	400kV	33kV
2.	Maximum operating voltage of the system(rms)	800kV	420kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated short time current	40/50 kA for 1 Sec	40/50 kA for 1 Sec	25 kA for 3 sec
6.	Dry and wet one minute power frequency withstand voltage	830 kV	680 kV	70 kV
7.	Full wave impulse withstand voltage (1.2/50 microsec.)	2100 kVp	1550 kVp	170 kVp
8.	Corona extinction voltage	508kV	320 kV	--
9.	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 micro-volt at 508 kV rms	1000 micro-volt at 266 kV rms	--

10.	Minimum total creepage 25mm/kV	20000 mm	10500 mm	1300 mm
11.	Min. clearances			
	Phase to phase	7600mm (for Conductor configuration) 9400mm (for rod -Conductor configuration)	4000mm (for Conductor configuration) 4200mm (for rod - Conductor configuration)	320 mm
	Phase to earth	4900mm (for Conductor structure) 6400mm (for rod- structure)	3500 mm	320 mm
	Sectional clearances	10300 mm	6500 mm	3000 mm
12.	System neutral earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site. All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment. The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand. All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing. To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

8.3 Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.

8.4 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.

8.5 All casting shall be free from blow holes, surface blisters cracks and cavities. Sharp edges and corners shall be blurred and rounded off.

8.6 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube

as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

8.7 The clamps/ connectors shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/ connector is designed with respect to specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.

8.8 All current carrying parts shall be designed and manufactured to have minimum contact resistant.

8.9 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 765kV, 400kV, 220kV and 132kV class clamps shall not be less than 508,320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000, 1000 and 500 micro volts for 765kV, 420kV, 220kV and 132Kv system at the test voltage specified.

9.0 SUPPORT STRUCTURES

9.1 The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 765/400/220/132/33kVSubstations.

9.2 All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.

9.3 The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ 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.

All steel structures, plates etc. shall be painted with non-corrosive paint with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5.

11.0 MATERIAL/ WORKMANSHIP

11.1 General Requirement

Where the specification does not contain references 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. 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 the 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 also be interchangeable 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 considered 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 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, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits. Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder 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 Bidder 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 Bidder 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 Bidder. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

11.2 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 favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

12.0 Void

13.0 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on 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 of the varnish.

14.0 void

15.0 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:

b) Installed out door : IP-55

d) Installed indoor in air conditioned area : IP-31

f) Installed in covered area : IP -52

h) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41

j) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

17.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

18.0 PACKAGING AND PROTECTION

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. The Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper

packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration 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 and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 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 otherwise 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. 631 of IS: 5.

20.0 HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 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.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection. After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

23.1 All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.

23.2 Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. 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. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

23.3 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.

23.4 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 the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

23.5 All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation 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.

23.6 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 at least 150 mm above the base of the marshalling kiosk/box 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 plate. Gland plate shall have provision for some future glands to be provided later, if required.

23.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

23.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch. For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

23.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

23.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

23.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

23.12 a) The following routine tests along with the routine tests as per IS: 5039 shall also be conducted.

Check for wiring

Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

23.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS. The following type test reports on auxiliary switches shall be submitted:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

(b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

(c) Heat run test on contacts.

(d) IR/HV test etc.

24.0 TERMINAL BLOCKS AND WIRING

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

24.2 Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These 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 of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

24.3 Terminal blocks 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.

24.4 The terminals shall be such 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.

24.5 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.

24.6 The terminal blocks shall be of extensible design.

24.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

24.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration 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.

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

- a) All circuits except CT circuits Minimum of 2 nos. of 2.5 sq. mm copper flexible
- b) All CT circuits Minimum of 4 nos. of 2.5 sq.mm copper flexible

24.10 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.

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

24.12 There shall be minimum clearance of 250 mm 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.

24.13 The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

24.14 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 Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

25.0 LAMPS AND SOCKETS

25.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

25.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

25.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

25.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/switchfuse units. Selection of the main and Subcircuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite silicon rubber insulator, conforming to IEC- 61462.

26.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

26.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

26.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

26.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

26.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

26.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621.

27.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

27.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

27.2 Operational Features

a) 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 and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system.

27.3 Starting Requirements

a) 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 alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified, shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

27.4 Running Requirements

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests along with list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

- (a) Insulation resistance.
- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

28 DOCUMENTATION

The successful Tenderer or Bidder shall provide the following technical information:

- General outline drawings of all major equipment
- Estimated works programme (Bar Chart)
- Completed technical data schedules
- Type Test Reports
- Quality assurance and quality control programme and organization
- Complete set of catalogues

The following additional information shall be provided before proceeding with the manufacturing, or during the manufacturing period:

- Schedule of engineering documents including drawings
- Assembly drawings, list of materials including spare parts and tools, cabling diagrams, etc.
- Instruction and service manuals
- Paint samples, if requested by UPTCL
- Test reports and certificates
- Shop inspection and testing program
- Packing drawings, if requested by UPTCL
- Marking models, if requested by UPTCL
- List of test required for commissioning
- Detailed procedure for installation
- Detailed procedure for commissioning
- Works programme and schedule (bar-chart)
- Progress report of manufacturing

The Bidder is responsible for any discrepancies, errors or omissions in the submittals whether these have been reviewed by the UPTCL or not, provided that such discrepancies, errors and omissions are not due to inaccurate information or particulars furnished in writing by the UPTCL to the Bidder. All reports or drawings must be provided in the SI unit system.

28.1 Drawings

The successful Tenderer or Bidder shall prepare and submit for review of the UPTCL, the

drawings indicated in this document. The drawings must be A1 format (841 x 594 mm), A3 (420 x 297 mm) or A4 (297 x 210 mm) format and include in the lower right-hand corner, a title block as indicated in section-1.

The successful Tenderer or Bidder shall submit, one (1) Autocad computer file on a CD-ROM Disk and by E-mail, plus four (4) paper copies of each of the drawings to the UPTCL. The copies marked by the UPTCL will be returned to the Bidder, at the latest, 30 days after presentation of these drawings. The corrected drawings will be submitted once more, following the same procedure, if necessary.

An updated Autocad computer file, plus six (6) paper copies of the final version of the drawings, must be submitted by the Bidder, at the latest one (1) month before delivery of the purchased equipment.

28.1.1 Outline and Foundation Drawings

Outline drawings must be provided to scale including dimensions, weight, reaction for design of foundations, centre of gravity for transportation and installation, in plan view, elevation, section and foundation plan including blockouts embedded parts.

Design briefs and detailed drawings must be presented for all metallic structures and supports of the substation equipment. Nameplates, to scale, must indicate test results from the factory, serial number, weight mass, etc. When available, catalogues references and codes must be indicated on the drawings.

28.1.2 Assembly Drawings

A bill of material must be provided with all assembly drawings.

Every device or apparatus must be identified using a numerical or alphanumerical system corresponding to the one used for the respective diagram. The identification will be in accordance with the ANSI C37.2 standards. The terminal blocks must be identified on the drawing as they are on the equipment itself. Every terminal block of a panel or cabinet must be identified with the number indicating the panel or cabinet it belongs to, the terminal strip identification followed by a number starting with 1 for the first terminal and finishing with the number of the last terminal from top to bottom or left to right. The Bidder shall arrange and identify the terminal blocks for exclusive use of Purchaser as show on enclosed drawing specific to each equipment. The Bidder must comply with this requirement.

The UPTCL will not accept any deviation nor will assume any cost resulting from drawing changes or modifications of wiring or cabling resulting from changes caused or originated by the Bidder. Wires originating from a device or terminal block shall be tagged at both ends with identification of remote end device terminal number using the symbols previously mentioned. Every cabinet or panel will be provided with a wiring drawing where all the devices are shown.

28.2 Technical Data Schedules

The Tenderer must fill out completely and attach to his proposal the Technical Data Schedules included in the technical specification of the equipment. The data shall include the values guaranteed by the Bidder. If any data cannot be furnished at tender stage, Bidder shall assign reasons and shall confirm to provide the same at engineering stage for approval. The Bidder shall guarantee that the equipment and the works are in accordance with all the requirements of the present specification including the data from the Technical Data Schedules. The Technical Specifications for equipment represent different types and/or ratings under a single

data schedule. Bidder shall however submit the data schedule for each type and/or rating of the equipment required for the project.

28.3 Instruction Manuals

Service and maintenance manuals including sequence of operation manuals must describe in details, the procedures and the operation instructions for the equipment and the measuring devices. The assembly method, commissioning guide, adjustment, operation and disassembly of every component, system or machine, must be described and illustrated in details. The manuals must include as well a troubleshooting procedure to locate rapidly the defective part. For preventive maintenance purposes, a list of verification point visual marking and measurements will be included. The frequency of inspections and maintenance of every component shall be described in the manuals.

The Bidder shall submit manuals that are clear, fully detailed and easily understood to ensure the appropriate operation and maintenance of the equipment.

The manuals shall include a copy of the "as built" drawings, the list of spare parts and a list of all the pieces of every component or item that makes up the equipment. The latter must include the Bidder identification, the manufacturing codes and the instructions to order the pieces. The manual shall also include an updated copy of the Technical Data Schedules of the equipment, as supplied. The Bidder shall submit the instruction and service manual for UPTCL's review at least one month before shop testing.

The Bidder shall include in every manual a copy of the tests performed on the equipment and all the accessories, and the corresponding results.

The Bidder shall provide for every apparatus, six (6) technical manuals, two (2) of which shall be properly wrapped and placed inside the cabinets, panels or control kiosks at time of delivery. In the case where there is no room for manuals, the two manuals shall be well placed and packed in a wooden crate.

28.4 Language

All technical documents such as: calculation schedules, curves, maintenance and service manuals, quality assurance control program report, plant tests and manufacturing schedule, drawings, nameplates and instructions manuals shall be presented by the Bidder to the UPTCL, shall be in the English language.

29 QUALITY CONTROL PROGRAMME

29.1 Programme

In general terms, the manufacturing quality programme shall be in compliance with ISO 9002 or later standards. The UPTCL reserves the right to verify the document pertaining to the manufacturer's quality assurance programme, as well as the application of the same in the manufacturing plant.

In general, the assembly of all the equipment components shall be carried out in the manufacturer's workshops so that it shall possible to perform inspections, tests, etc. that will ensure a subsequent satisfactory operation. The exceptions to this rule will only be possible upon UPTCL's consent.

The UPTCL's authorized representatives shall have the right of access to the plant and to inspect and verify the quality of materials used in the manufacturing process.

The manufacturer of each major equipment shall submit Quality Assurance Programme (QAP) for the manufacturing and testing of equipment along with the drawings to UPTCL.

29.2 Plant Tests

The materials and all the equipment shall be tested as per the prescriptions of this specification. The tests shall be performed by the Bidder and certified by the authorized representative of the UPTCL.

All the required tests must be performed in order to confirm that the materials and the equipment comply with these specifications, and to allow the UPTCL to detect any material or manufacturing defects.

The results of all the tests shall be marked down in the reports containing all the necessary information to enable verification of compliance with the present specification. The test certificates shall be written in English and shall show the results and real conditions of the tests performed the circuits, oscillogrammes, environmental conditions, nameplate drawings with measured values, graphs, etc.

No later than two (2) weeks after having performed the tests, the Bidder shall submit to the UPTCL, four (4) copies of the report of all tests as a bound document. The test reports shall indicate the tests performed, instruments used, names of test personnel and provide the witness's signature as applicable. The report must also include a description of any failure that occurred while performing the plant tests, even if the test resumed after the failure.

The tests are meant to verify and determine the characteristics of the equipment. Normally, type tests shall be performed on one (1) apparatus of each type and with different technical characteristics. If type tests have been performed on identical apparatus, within a period not exceeding 5 years from 02.03.19, the results may be accepted. The routine tests are intended to reveal any defective material or manufacture non-conformity and shall be performed on all equipment supplied.

The units to be assembled in the plant (panels, cabinets, control cabinets) shall be assembled, wired, adjusted and tested in the plant, as much as possible, under the same service conditions that will prevail at the site of installation, to ensure the accuracy of the wiring and the correct operation of the equipment.

The UPTCL reserves the right to be present at any of the tests.

The equipment to be tested must be totally assembled for an inspection before the tests. The Bidder must submit to the UPTCL a detailed program of tests for review, at least one month before the tests take place. The Bidder shall inform the UPTCL in writing, at least 30 days in advance, of the date of the tests.

29.3 Stage Inspection Programme

UPTCL and/or his representative will conduct routine and/or periodic inspection of the works and material in the manufacturing of the major equipment and construction sites in various stages of the Project. The Bidder shall provide facilities and access to the UPTCL and/or his representative to inspect the workmanship and the quality of the material, manufacturing process and the installation. The Bidder shall advise the UPTCL in writing the schedule of any such routine and/or

periodic inspection. The Bidder shall attach a copy of the completed inspection checklist or final/in-process inspection report by the Bidder's QA/QC UPTCL/inspector on every inspection request submitted to the UPTCL. The Bidder's QA/QC UPTCL/inspector shall ensure that the items for inspection covered by the Bidder's "Inspection Request" are ready prior to inspection by the UPTCL and/or his representative.

30 NAMEPLATES, LABELS AND RATING PLATES

The equipment shall be fitted with nameplates and indication plates, which must be manufactured of non-corrodible stainless steel or aluminium, with a minimum thickness of 1 mm engraved black letters on a light background, and shall be fixed to the apparatus with non-busting screws.

A rating plate shall be attached to each major and auxiliary item of equipment supplied. This plate shall be permanently engraved with the designed full load ratings, serial number, type number, date of manufacture, and other identification deemed necessary. Where required by the UPTCL, diagram plates shall also be supplied.

A nameplate shall be provided to identify the equipment supplied. The identifying inscription shall be approved by the UPTCL or conform to that designated in the appropriate sections of this Specification. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles, etc.

Labels shall be manufactured of non-hygroscopic material with engraving of a contrasting colour or alternatively, for indoor use, of laminated plastic material with lettering engraved. The lettering should be black against white background. The materials used shall be non-fading, non-aging type, suitable for tropical conditions.

All apparatus, motors, control gear and all panels and the apparatus contained therein, shall be labelled, indicating where necessary, their purpose and the "ON" and "OFF" positions.

Upon request by the UPTCL during the approval of Nameplates and Labels, some inscriptions shall be in Hindi language.

ANNEXURE – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 765 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 220 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee

on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or

equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off. For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- k) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 220kV and above) shall be carried out alongwith supporting structure. The Bidder shall arrange to transport the structure from his Bidder's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

SECTION – 4
GUARANTEED TECHNICAL PARTICULARS

1	General	
	Rated Voltage	
	a) Name of the Manufacturer	
	b) Country of Manufacture	
	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	
	Rated Voltage	
	a) Rated short circuit breaking current	
	i. Symmetrical component at 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/3s	
	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 50oC	
	u) Rated voltage & pick up range for trip coil (V)	
	v) Rated voltage & pick up range for closing coil (V)	
	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	
	Rated Voltage	
	a) One minute dry & wet power frequency withstand voltage	
	i. Between live terminal and ground (kV rms)	

	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 $1.1 U_r/_/3$	
	f) Total creepage distance	
	i) To ground (mm)	
	ii) Between terminals (mm)	
4.	Operating Mechanism	
	Rated Voltage	
	a) Type of operating mechanism for	
	i. Closing	
	ii. Opening	
	b) Manufacturer's type designation	
	c) Normal power consumption (W) at rated voltage of	
	i) Trip coil	
	ii. Closing coil	
	Spring charged mechanism	
	Rated Voltage	
	a) Number of close open operations possible after failure of AC supply to motor	
	b) Time required for motor to charge the closing spring (min)	
	c) Whether indication of spring	

	charged condition provided in central control cabinet	
5.	Type of Breakers	
	Rated Voltage	
5.1	SF6 Circuit Breakers	
	a) Quantity of SF6 per pole (m3) at rated pressure	
	b) Guaranteed maximum leakage rate per year	
	c) Rated pressure of SF6 in operating chamber	
	d) Limit of pressure at which breaker operates correctly (kg/ cm2)	
	e) Standard to which SF6 gas complies	
	f) Whether 20% spare SF6 gas stores in unused gas cylinder, included in proposal	
	g) Compacity & filling ration of containers in which SF6 gas would be shipped (m3)	
	h) Whether breakers are dispatched filled with SF6 or required to be filled at site	
	i) Type and make of SF6 pipe coupling used	
	j) Type and make of mandatory maintenance equipment	
	i. SF6 gas filling and evacuation trolley (portable)	
	ii. SF6 gas drying, filling, evacuating equipment and its capacity	
	iii. Operating analyzer type and make	
	iv. SF6 gas leak detector	
	k) Parameters of SF6 gas for initial filling & satisfactory operation	

	i. Density	
	ii. Dielectric strength/ kVmm	
	iii. Acidity (ppm)	
	iv. Water content (ppm)	
	v. Oil content (ppm)	
	vi. Condensation temperature °C)	
	vii. Resistivity (Ohm-cm)	
	l) Whether details of SF6 gas viz test	
	methods, handling etc. enclosed	
	m) Type and material of gasket used	
	to ensure gas tight joints for	
	i. Metal to metal joints	
	ii. Metal to porcelain joints	
	n) Method of housing SF6 gas	
	compressors and equipment	
	i. At circuit breaker	
	ii. In control cubicle	
	o) Type and make of	
	i. Densimeter	
	ii. Pressure gauge	
	p) Densimeter Settings	
	i. Lockout	
	ii. Alarm	
	q) Minimum time interval between	
	each make/ break operation (ms)	
5.2	General	
	Rated Voltage	
	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	
	Rated Voltage	
	a) Whether arcing contacts provided	
	b) Type and material of main contacts and arcing contacts	
	c) Contact pressure on main contacts (kg/ cm ²)	
	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	
	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	
	Rated Voltage	
	a) i. Type test reports as per IEC-62271-100	
	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. Precaution in use of SF6 gas	
	ix. Leaflets & literature bringing out salient features of equipment offered	
	x) Schematic diagrams of switching mechanism for closing resistor showing the duration of insertion	

	alongwith calculation for thermal	
	rating of closing resistors	
	xi. Whether drawings/data	
	data furnished as per cl.12 of	
	chapter switchgear (CB)	
	xii. Method of checking of voltage	
	distribution devices at site	
	enclosed	
	xiii. Details alongwith a complete	
	catalogue of operation analyzer	
	enclosed	
	xiv Data on capabilities of circuit	
	breaker 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	
	xv) Effect of non simultaneity between	
	contact within a pole or between	
	poles and also show how it is	
	covered in the guaranteed rated	
	break time.	
	xvi) Details and type of filters used in	
	interrupter assembly and also	
	the operating experience with	
	such filters	
	xvi) Curves supported by test data	
	indicating the opening time under	
	close open operation with	
	combined variation of trip coil	
	voltage & pneumatic/ hydraulic	
	pressure	
	xvii) All duty requirements specified	
	along with adequate test reports	
CONTROL CABINETS		
	Rated Voltage	
1.	Manufacturer's Name	
2.	Indoor/ Outdoor application	
3.	Design ambient air temperature (deg. C)	
4.	Standards applicable	
5.	Thickness of sheet steel (mm) and	
	whether cold rolled or hot rolled	

6.	Degree of protection provided	
7.	Bill of material for all the equipment mounted on control cabinet giving the following details	
	a) Make and type	
	b) Applicable Standard	
	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 arranged vertical or horizontal	
	ii) Clearance from adjacent components	
	iii) Distance between rows	
	iv) Whether transparent protection cover provided	
BUSHING/SUPPORT INSULATOR		
	Rated Voltage	
1.	Manufacturer's Name	
2.	Type	
3.	Applicable Standards	
4.	i) Height	
	ii. Diameter (Top)	
	iii. Diameter (Bottom)	
5.	Total Creepage distance (mm)	
6.	Rated voltage (kV)	
7.	Power frequency withstand voltage for 1 Min. (kV rms) dry and wet	
8.	1.2/50 micro sec. Impulse withstand voltage (kVp)	
9.	250/2500 micro sec. Switching impulse withstand voltage (kVp) dry and wet	
10.	Corona Extinction voltage (kV)	
11.	Weight (kg)	
12.	Max. Allowable span (mm)	
13.	Cantilever Strength (kg)	
14	OGA drawing enclosed	

SECTION-5

NO DEVIATION CERTIFICATE

It is confirmed that there is no deviation and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and or exceptions. Further it is confirmed that at all drawings/ data sheets/ QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information/ repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL and without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company Seal

SECTION - 6

CHECK LIST FOR 420 KV CIRCUIT BREAKERS

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

Sl. No.	Parameters	420 kV	YES/NO	Remarks
1	Type/class of Circuit Breaker	SF6 / C2M2	YES/NO	
2	Manufacturer's type designation			
3	Standard Applicable	IEC 62271 - 100	YES/NO	
4	Rated Voltage (kV rms)	420	YES/NO	
5	Rated Current	3150 A	YES/NO	
6	Max fault level	50 kA	YES/NO	
7	Phase to phase spacing	7000 mm		
8	Rated frequency (Hz)	50	YES/NO	
9	Number of poles	3	YES/NO	
10	Whether All The 3 poles ganged electrically or mechanically	Electrically	YES/NO	
11	Whether dead tank or live tank design	Live	YES/NO	
12	No. of break per pole		YES/NO	
13	Rated short circuit breaking current			
	i. Symmetrical component at highest system voltage (kA)	50	YES/NO	
	ii. DC Component (%)	As per IEC	YES/NO	
14	Rated short circuit Making Current (kAp)	125	YES/NO	
15	Closing time (ms)	100	YES/NO	
16	First pole to clear factor	1.3	YES/NO	
17	Short time current rating (kA) for 3s	50 kA	YES/NO	
18	Rated operating duty	O-0.3 Sec –CO -3 min – CO	YES/NO	
19	Out of phase breaking current	12.5 kA	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
20	Small fault current breaking capacity (kAp)	As per IEC	YES/NO	
21	Maximum temperature rise for main contacts over design ambient temperature of 50°C	As per IEC	YES/NO	
22	Rated voltage & pick up range for trip coil (V)	220 V DC, Range – 70 % to 120 %	YES/NO	
23	Rated voltage & pick up range for closing coil (V)	220 V DC, Range 85 % to 120 %	YES/NO	
24	Reclosing	Single and three phase high speed auto reclosing	YES/NO	
25	Rated terminal load	As per IEC.	YES/NO	
26	Dielectric withstand of complete Breaker			
a)	One minute dry & wet power frequency withstand voltage			
	i. Between live terminal and ground (kV rms)	520	YES/NO	
	ii. Between terminals with breaker contacts open (kV rms)	610	YES/NO	
b)	1.2/50- micro second impulse withstand test voltage			
	i. Between live terminals and ground (kVp)	±1425	YES/NO	
	ii. Between terminals with breaker contacts open (kVp)	1) ±1425(+240)	YES/NO	
c)	250/2500 micro second switching surge withstand test voltage			
	i. Between live terminals and ground (kVp)	±1050	YES/NO	
	ii. Between terminals with breaker contacts open (kVp)	1) 900(+350)	YES/NO	
d)	Corona extinction voltage (kV rms)	320	YES/NO	
e)	Maximum radio interference voltage for Frequency between 0.5 MHz and 2 MHz	1000 (max) at voltage 266 kV rms.	YES/NO	
f)	Total creepage distance			
	i) To ground (mm)	1) 10500 for 420 kV	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
	ii) Between terminals (mm)	1)10500 mm for 420 kV	YES/NO	
27	Control Switching Device		YES/NO	
28	Operating Mechanism			
	a) Type of operating mechanism for			
	i. Closing		YES/NO	
	ii. Opening		YES/NO	
29	General			
a)	Whether OGA drawing enclosed		YES/NO	
b)	Filled in GTP furnished		YES/NO	
d)	Interpole cabling included in Scope alongwith required Glands, Lugs etc. (FRLS)		YES	
e)	All Type Test Reports & additional type tests as per section 1 & IEC 62271 – 100, not older than 5 years are available with bidder		YES	
f)	All type tests shall be conducted without cost and delivery implication to BHEL if reports are found technically unacceptable by the customer		YES	
g)	Whether GI support structure included in Supply		YES	
h)	Whether foundation bolts for breakers and cabinets included in scope of supply		YES	
i)	Whether documentation schedule as per specification agreed by bidder.		YES	
j)	No. of Aux. contacts per pole for purchaser's usage	10 NO + 10 NC	YES	
k)	Min clearance in Air (mm) as per section-3			
	(i) Between Live Parts		YES/NO	
	(ii) Live Part to Earth		YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
	(iii) Live Part to ground with Support Structure / Stool		YES/NO	
l)	Control Cabinet –			
	Degree of Protection	IP 55 (Min.)	YES/NO	
	Type Tested for IP 55 within last 5 years		YES/NO	
n)	Whether accessories for operating mechanism and cabinets as per specification included in scope of supply		YES/NO	
o)	Supervision of Erection, testing and commissioning included in scope		YES/NO	