BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-371-316-001	Rev. No.	01	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION		SIGN	Satyaki Chadhri		
TITLE			NAME	SC	NK	SKS
245kV & 72.5kV Circuit Breaker			DATE	02/12/23	02/12/23	02/12/23
			GROUP	TBEM	WO No	WO24A02836

CUSTOMER	PUNJAB STATE POWER CORPORATION LTD.
PROJECT	3x33MW Shahpurkandi HEP PH-I and 3x33MW + 1x8MW Shahpurkandi HEP PH-II
OWNER'S CONSULTANT	WAPCOS
NOA NO.	Ref No.:50/SKPP/HD/101/Vol-VII dtd. 29.01.2014
Station	220kV Switchyard at Shahpurkandi HEP PH-I and 220/66kV Switchyard at Shahpurkandi HEP PH-II

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS
00	10/07/23	SC	NK	SKS	220kV & 72.5kV Circuit Breaker BOQ items bifurcated.

Distribution	To	TBEM	TBMM	TBQM	Vendor
	Copies	1	1	1	4

SECTION-1

Scope, Bill of Quantity, Specific Technical Requirements

1.1 Scope

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project sites and supervision of erection, testing & commissioning of 245kV & 72.5kV Circuit Breaker complete in all respect for efficient & trouble free operation mentioned under this specification.

The equipment is required for the following project:

Name of the customer : **PUNJAB STATE POWER CORPORATION LTD.**

Name of the project : **3x33MW Shahpurkandi HEP PH-I and 3x33MW + 1x8MW Shahpurkandi HEP PH-II**

Site : **220kV Switchyard at Shahpurkandi HEP PH-I and 220/66kV Switchyard at Shahpurkandi HEP PH-II**

In case of any conflict among the various sections of this specification, the order of precedence shall be section 1, section 2 & the section 3.

1.2 Bill of Quantities

1.2.1 Main Quantity :

Sl No	Sub-Equipment	UOM	Qty. Shahpurkandi
1	SUPPLY- CIRCUIT BREAKER : 245KV 40KA FOR 1S 25MM/KV CREEPAGE 1600A, 3 PHASE CIRCUIT BREAKER WITHOUT PIR, ALONGWITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT (EXCLUDING FOUNDATION BOLT)	Nos.	12
2	SUPPLY- CIRCUIT BREAKER : 245KV 40KA FOR 1S 25MM/KV CREEPAGE 1600A, 3 PHASE CIRCUIT BREAKER FOR GT BAY WITHOUT PIR, ALONGWITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT (EXCLUDING FOUNDATION BOLT)	Nos.	06
3	SUPPLY- CIRCUIT BREAKER: 72.5KV 31.5KA FOR 1S 25MM/KV CREEPAGE 800A, 3 PHASE CIRCUIT BREAKER WITHOUT PIR, ALONGWITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT (EXCLUDING FOUNDATION BOLT)	Nos.	02

4	SUPPLY- CIRCUIT BREAKER: 72.5KV 31.5KA FOR 1S 25MM/KV CREEPAGE 800A, 3 PHASE CIRCUIT BREAKER FOR GT BAY WITHOUT PIR, ALONGWITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT (EXCLUDING FOUNDATION BOLT)	Nos.	01
5	SUPPLY- CIRCUIT BREAKER: 220KV, FOUNDATION BOLTS FOR CIRCUIT BREAKER, PLATFORM AND LADDER	Lot	01
6	SUPPLY- CIRCUIT BREAKER: 220KV, FOUNDATION BOLTS CIRCUIT BREAKER, PLATFORM AND LADDER OF GT BAY	Lot	01
7	SUPPLY- CIRCUIT BREAKER: 72.5KV, FOUNDATION BOLTS FOR CIRCUIT BREAKER, PLATFORM AND LADDER	Lot	01
8	SUPPLY- CIRCUIT BREAKER: 72.5KV, FOUNDATION BOLTS FOR CIRCUIT BREAKER, PLATFORM AND LADDER OF GT BAY	Lot	01
9	SERVICES- CIRCUIT BREAKER: 245KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF 3 PHASE CIRCUIT BREAKER	Nos.	12
10	SERVICES- CIRCUIT BREAKER: 245KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF 3 PHASE CIRCUIT BREAKER FOR GT BAY	Nos.	06
11	SERVICES- CIRCUIT BREAKER: 72.5KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF 3 PHASE CIRCUIT BREAKER	Nos.	02
12	SERVICES- CIRCUIT BREAKER: 72.5KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF 3 PHASE CIRCUIT BREAKER FOR GT BAY	Nos.	01

1.2.2 Mandatory Spares Quantity:

Sl No	Sub-Equipment	UOM	Qty. Shahpurkandi
1	SPARES- CIRCUIT BREAKER: 245KV 40KA FOR 1S 25MM/KV CREEPAGE 1600A, Complete limb of circuit breakers without operating mechanism	Nos.	1
2	SPARES- CIRCUIT BREAKER: 245KV, Closing coils	Nos.	2
3	SPARES- CIRCUIT BREAKER: 245KV, Tripping coils	Nos.	4
4	SPARES- CIRCUIT BREAKER: 245KV, Fixed arcing contacts	Sets	2
5	SPARES- CIRCUIT BREAKER: 245KV, Moving arcing contacts	Sets	2
6	SPARES- CIRCUIT BREAKER: 245KV 40KA FOR 1S 25MM/KV CREEPAGE 1600A, FOR GT BAY - Complete limb of circuit breakers without operating mechanism	Nos.	1
7	SPARES- CIRCUIT BREAKER: FOR GT BAY - 245KV, Closing coils	Nos.	2
8	SPARES- CIRCUIT BREAKER: FOR GT BAY - 245KV, Tripping coils	Nos.	4
9	SPARES- CIRCUIT BREAKER: FOR GT BAY - 245KV, Fixed arcing contacts	Sets	2
10	SPARES- CIRCUIT BREAKER: FOR GT BAY - 245KV, Moving arcing contacts	Sets	2

11	SPARES- CIRCUIT BREAKER: 72.5KV 31.5KA FOR 1S 25MM/KV CREEPAGE 800A, Complete limb of circuit breakers without operating mechanism	Nos.	1
12	SPARES- CIRCUIT BREAKER: 72.5KV, Closing coils	Nos.	2
13	SPARES- CIRCUIT BREAKER: 72.5KV, Tripping coils	Nos.	4
14	SPARES- CIRCUIT BREAKER: 72.5KV, Fixed arcing contacts	Sets	2
15	SPARES- CIRCUIT BREAKER: 72.5KV, Moving arcing contacts	Sets	2

6 nos. of 220kV Circuit Breaker at Sl. No. 02 of BOQ and 1no. of 72.5kV Circuit Breaker at Sl. No. 04 shall be used for Generator Synchronization.
There is no Generator Circuit Breaker in LV side of Generator Transformer. Synchronization is envisaged on HV side (245kV & 72.5kV).

Mandatory Spares at Sl. No. 11-15 shall be provided for the GT Bay Breaker.

Notes –

1. The above quantities may vary ± 10%.
2. Prices for all applicable accessories of Circuit Breakers shall be included in the equipment prices.
3. For item at Sl. No. 5,6,7,8 of Main Quantity, each lot is defined as the total quantity required for successful completion of 220/66kV Circuit Breakers under supply.
4. For items at Mandatory Spares Quantity Sl. No. 4-5, 9-10, 14-15, 1 (one) Set is defined as quantity required for 1 (one) pole of Circuit Breaker.
5. Supply of terminal connectors for circuit breakers is in BHEL scope.
6. Foundation Bolts for Circuit Breaker are included in Sl. No. 5,6,7,8.
7. i) The supplied GT Bay Circuit Breaker should fit in allocated space in attached layout with phase to phase spacing of 4.5 mtr. for 220kV Circuit Breaker.
   ii) Centerline distance between 220kV Circuit Breaker and 220kV HDB Isolator is 5mtr.
   iii) Centerline distance between 220kV Circuit Breaker and 220kV Tandem Isolator is 6.5mtr.
   iv) Centerline distance between 220kV Circuit Breaker and 3.75mtr. wide road is 5mtr.
   If same does not fit in layout, then the offer of Circuit Breaker manufacturer shall be rejected.
8. a. The scope of Supervision of Erection, testing and commissioning of Circuit Breakers shall be duly inclusive of the following:

   i. Testing equipments required for testing.
   ii. Accommodation and conveyance at site.
   iii. Any other incidental charges.
   iv. Visit charges (To & Fro charges)

b. The following instruments/kits shall be brought out at site by Bidder and shall be taken back after successful completion of testing and commissioning.
(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.

The respective dates of commencement of erection, testing and commissioning activities by BHEL will be intimated to the equipment supplier from time to time, so that arrangements for supervising the activity can be made accordingly by the manufacturer.

1.3 Specific Technical Requirements

1.3.1 Technical Parameters –

Sl. no.	Parameter	220kV system	66 kV system
1.	Rated voltage (Umax) kV (rms)	245	72.5
2.	Rated frequency (Hz)	50	50
3.	No. of poles	3	3
4.	Type of circuit breaker	SF6 gas insulated	SF6 gas insulated
5.	Rated continuous current (A) at an ambient temperature of 50^0C	1600	800
6.	Rated short circuit capacity with percentage of DC component as per IEC62271-100 corresponding to minimum opening time under operating conditions specified.	40 kA	31.5kA
7.	Symmetrical interrupting capability kA (rms)	40	31.5
8.	Rated short circuit making current kAp	100	78.75

9.	Short time current carrying capability kA (rms)	40 for one second	31.5 for one second
10.	Rated durations of short circuit	1 (one) second	1 (one) second
11.	Out of phase breaking current carrying capability kA (rms)	As per IEC	As per IEC
12.	First pole to clear factor	1.3	1.5
13.	Temperature rise over an ambient temperature of 50°C	As per IEC: 62271-100	As per IEC: 62271-100
14.	Total break time (ms) for any current up to rated breaking current	Less than 60ms.	Not more than 60ms.
15.	Operating mechanism or a combination of these	Spring	Spring
16.	Rated operating duty cycle	1. As per CEA technical standards, 220kV & 66kV Line CB should be auto reclosing type with operating cycle of O-0.3sec-CO-3 min-CO. 2. The 220kV & 66kV Machine Circuit Breakers and Bus Couplers should be non-auto reclosing type with operating cycle of O-0.3sec-CO-3 min-CO. * (Where O: opening C: closing)	
17.	Reclosing	Single phase & Three phase auto reclosing.	-
18.	Rated line charging breaking current	Not less than 125A (Corresponding switching over voltage values on line side to be intimated by the bidder.)	Not less than 10A. (Corresponding switching over voltage values on line side to be intimated by the bidder.)
19.	Rated transient recovery voltage for terminal faults		
a)	Corresponding to rated short circuit breaking current (Symmetrical & Asymmetrical)	As per IEC-62271 or relevant IS.	As per IEC-56 (latest edition)
b)	Corresponding to currents below the rated short circuit	As per IEC-62271 or relevant IS.	As per IEC-56 (latest edition)
20.	Difference in the instant of closing & opening of contacts a) within a pole b) Between poles	 Not more than 5 ms Not more than 10 ms	 Not more than 3.33 ms Not more than 5 ms
21.	Small inductive current interrupting capacity	Any value up to 10A without switching over voltage exceeding 2.0 pu	Any value up to 10A without switching over voltage exceeding 2.0 pu
22.	Number of trip coils per pole	Two	Two
23.	Specification of Sulphur Hexa Flouride gas	As per IEC-376 or relevant IS.	
24.	Amplitude factor	Not less than 1.5	-

25.	Whether breaker suitable for single pole operation or gang operation of three poles	-	Gang operation of three poles through mechanical
26.	Phase to phase spacing in layout	4500mm	2000mm
27.	**Rated insulation levels**		
i)	Full wave impulse withstand (1.2 /50 µs) between line terminals and ground	±1050 kVp	±325 kVp
ii)	Full wave impulse withstand (1.2 /50 µs) between terminals with circuit breaker open	±1050 kVp	±325 kVp
iii)	Rated switching impulse withstand voltage (250/2500 µs) Dry & wet between line terminals and ground	NA	NA
iv)	Rated switching impulse withstand voltage (250/2500 µs) Dry &wet Between terminals with circuit breaker open	NA	NA
v)	One minute power frequency dry withstand voltage between line terminals and ground	460 kV rms.	140 kV rms
vi)	One minute power frequency dry withstand voltage between terminals with circuit breaker open	460 kV rms.	160 kV rms
28.	Minimum corona extinction voltage with CB in all positions	156 kV rms	NA
29.	Radio interference level	Not more than 2500 µV	NA
30.	Minimum Creepage distance		
i)	Phase to ground (25mm/kV)	6125mm	1813mm
ii)	Between CB terminals	6125mm	1813mm
31.	Seismic level	0.3g horizontal	

* Machine Circuit Breakers – Circuit Breaker for GT Bays. Please refer the enclosed SLD.

The parameters of Circuit Breaker shall be as per relevant IS/IEC standards.

1.3.2 Type Tests

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out after 17.06.2008. The tests should have been conducted on identical or similar equipment/components to those offered. In case type test reports are earlier than 17.06.2008 or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.3.3 Special Tools and Tackles

Bidder shall supply all special tools & tackle (other than maintenance tools/spares mentioned in BOQ) free of cost which are specifically required for 220kV & 66kV circuit breaker and are proprietary in nature. List of such special tools and tackles shall be clearly listed along with the technical offer. Any special tool which is not listed in the list but are required during the erection/commissioning of circuit breakers shall also be supplied free of cost by the supplier.

Operational analyzer, SF6 gas filling and evaluation equipment with necessary piping, couplings, flexible tubes and valves, SF6 gas monitoring device / SF6 Gas Leakage Detector, Spare SF6 Gas & SF6 Gas cylinders as mentioned in Section-02 are not part of special tools and tackles and same are not to be supplied.

In case, special tools & tackles which is proprietary in nature is not required for erection/ testing/commissioning or for smooth operation of circuit breaker, supplier has to submit a certificate mentioning that no special tools & tackles is required for circuit breaker.

1.3.4 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the bidder's 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 PSPCL 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.

1.3.5 Quality Plan

Bidder to follow BHEL/customer approved quality plan at contract stage.

1.3.6 Title Block

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

a) Project Name: 3x33MW Shahpurkandi HEP PH-I and
3x33MW + 1x8MW Shahpurkandi HEP PH-II
b) Customer Name : Punjab State Power Corporation Ltd. , Patiala
c) Consultant Name : WAPCOS Gurgaon
d) Contractor : BHEL
e) Customer LOA no.: Ref No.:50/SKPP/HD/101/Vol-VII dtd. 29.01.2014.

1.3.7 Approval of Drawings & Engineering Documents

The drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block of the customer as detailed in Section 1, 2 & 3.

Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings. The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance and furthermore, these shall be used for delay analysis, if any from the bidder.

1) General Arrangement
2) Scheme drawings
3) Bill of Materials
4) Wiring diagram
5) Mechanism Housing assembly
6) Marshalling box details
7) Interrupter insulator
8) Support insulator
9) Support structure & ladder
10) Foundation bolt drawing
11) Type test reports
12) GTP for CB

The following documents are to be submitted for Circuit Breaker Accessories and Mandatory Spares.

1) Catalogues/data sheet for Circuit breaker accessories
2) Mandatory spare list

The schedule for submission and resubmission shall be in line with details provided in Section-3.

The successful bidder shall have to extend all possible supports like timely submission/re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval. The bidder shall submit the GTP of circuit breakers in the format provided in this technical specification Section-04.

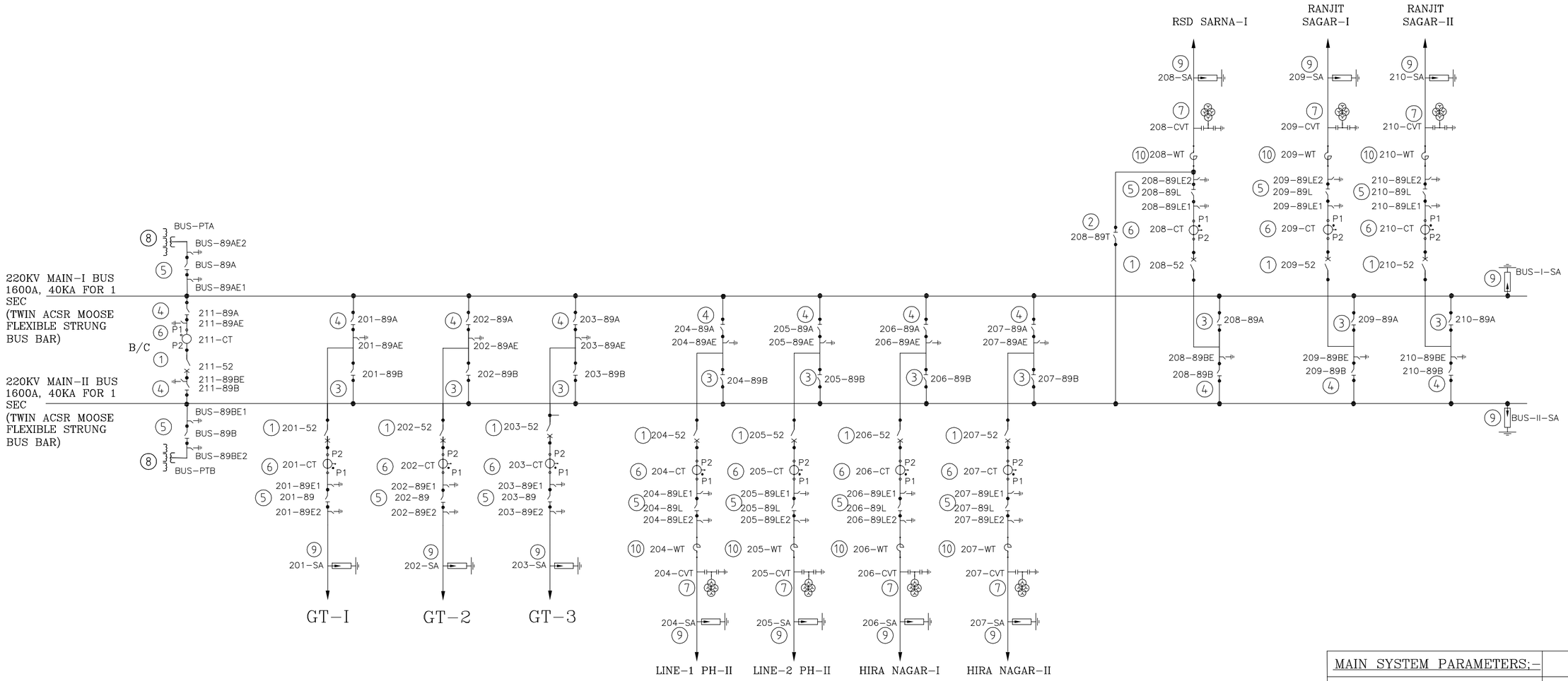
1.3.8 Deviations

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-371-510-01

COMPUTER DRG. PARTY NAME :



S.NO.	DESCRIPTION	SYMBOL	QTY.	EQUIPMENT DESIGNATION
1.	220KV, 1600A, 40KA/1SEC, SPRING OPERATED SF6 CIRCUIT BREAKER WITH OPERATING CYCLE O– 0.3 SEC– CO– 3 MIN.		11	201–52, 202–52, 203–52, 204–52, 205–52, 206–52, 207–52, 208–52, 209–52, 210–52, 211–52
2.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB, MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITHOUT EARTH SWITCH		01	208–89T
3.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB, MECHANICALLY GANGED MOTOR OPERATED TANDEM ISOLATOR WITHOUT EARTH SWITCH		10	201–89B, 202–89B, 203–89B, 204–89B, 205–89B, 206–89B, 207–89B, 208–89A, 209–89A, 210–89A
4.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH ONE EARTH SWITCH		12	201–89A, 201–89AE, 202–89A, 202–89AE, 203–89A, 203–89AE, 204–89A, 204–89AE, 205–89A, 205–89AE, 206–89A, 206–89AE, 207–89A, 207–89AE, 208–89B, 208–89BE, 209–89B, 209–89BE, 210–89B, 210–89BE 211–89A, 211–89AE, 211–59B, 211–89BE
5.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH TWO EARTH SWITCH		12	201–89, 201–89E1, 201–89E2, 202–89, 202–89E1, 202–89E2, 203–89, 203–89E1, 203–89E2, 204–89L, 204–89LE1, 204–89LE2, 205–89L, 205–89LE1, 205–89LE2, 206–89L, 206–89LE1, 206–89LE2, 207–89L, 207–89LE1, 207–89LE2, 208–89L, 208–89LE1, 208–89LE2, 209–89L, 209–89LE1, 209–89LE2, 210–89L, 210–89LE1, 210–89LE2, BUS–89A, BUS–89AE1, BUS–89AE2, BUS–89B, BUS–89BE1, BUS–89BE2
6.	220KV, 40KA/1SEC, SINGLE PHASE CT (1600–800–200/1A)		33	201–CT, 202–CT, 203–CT, 204–CT, 205–CT, 206–CT, 207–CT, 208–CT, 209–CT, 210–CT, 211–CT
7.	220KV, $\frac{220kV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/110V$, SINGLE PHASE CVT		21	204–CVT, 205–CVT, 206–CVT, 207–CVT, 208–CVT, 209–CVT, 210–CVT
8.	220KV, $\frac{220kV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$, SINGLE PHASE PT		06	BUS–PTA, BUS–PTB
9.	198KV, 10KA, CLASS III, LIGHTNING ARRESTER (SINGLE PHASE)		36	201–SA, 202–SA, 203–SA, 204–SA, 205–SA, 206–SA, 207–SA, 208–SA, 209–SA, 210–SA, BUS–1–SA, BUS–2–SA
10.	220KV, 0.5mH, 630A, 40KA/1SEC WAVE TRAP		14	204–WT, 205–WT, 206–WT, 207–WT, 208–WT, 209–WT, 210–WT

MAIN SYSTEM PARAMETERS:–	
NOMINAL VOLTAGE	220 kV
HIGHEST SYSTEM VOLTAGE	245 kV
NO. OF PHASES	3
BIL	1050 kV_{PEAK}
1 MIN POWER FREQUENCY W/S VOLTAGE	460 kV_{RMS}
CREEPAGE DISTANCE	25mm/kV
SHORT CIRCUIT CAPABILITY	40 kA/1s
FREQUENCY	50 Hz
MINIMUM CORONA EXTINCTION VOLTAGE	156 kV
SEISMIC ACCELERATION	0.3 g

NOTES:–

1. 220KV WAVE TRAPS SHALL PREFERABLY BE MOUNTED ON R & B PHASES OF RESPECTIVE FEEDERS.

REV.	DATE		ZONE	
		ALTERED		
		CHECKED		
		APPROVED		
07	16.12.2022	ALTERED NK / CHECKED NK / APPROVED SKS	ZONE	REVISED AS PER MOM DATED 13.12.2022 HELD AT SITE OF SKPP PH–1 & PH–2
06	30.08.2022	ALTERED MSP / CHECKED MSP / APPROVED SKS	ZONE	REVISED AS PER CUSTOMER COMMENTS DURING VISIT TO SITE DTD 12.07.2022 and email dtd. 25.08.2022 (WAPCOS comm. dtd 18.08.2022) Wave Trap have been added for all lines. (subject to price implication). Line orientation changed, bus coupler position changed,
05	30.05.2022	ALTERED SY / CHECKED MSP / APPROVED SKS	ZONE	REVISED AS PER CUSTOMER COMMENTS VIDE PSPCLs comments received vide Email dated 19–04–2022 and WAPCOS?s comments vide Ref: WAP/E&M/SKPP/2021/391 dated 22–12–2021
04	07.02.2020	ALTERED PK / CHECKED NK / APPROVED SKS	ZONE	REVISED AS PER CUSTOMER COMMENTS VIDE MEMO NO. 220/24 DTD. 06.02.2020.
03	07.01.2020	ALTERED PK / CHECKED NK / APPROVED SKS	ZONE	REVISED TO MATCH WITH ELECTRICAL LAYOUT REV 02.
02	16.12.19	ALTERED / CHECKED / APPROVED	ZONE	REVISED AS PER CUSTOMER COMMENTS VIDE MEMO NO. 1334/39 DTD. 04.10.19 & CUSTOMER MEETING DTD. 09.12.19 AT PSPCL PATIALA.
01	29.08.19	ALTERED / CHECKED / APPROVED	ZONE	

NK
NK
SKS

NAME OF CUSTOMER	PUNJAB STATE POWER CORPORATION LTD.
NAME OF CONSULTANT	WAPCOS LIMITED
ADDITIONAL INFORMATION	परियोजना का नाम
W.O.No. 83003	NAME OF PROJECT
STATUS OF DRAWING	PROJECT: 3X33MW SHAHPURKANDI PH–I
DISTRIBUTION OF PRINTS	

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
पारेषण परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	NK		12.12.19
जाँचा CHECKED	SKS		
स्वीकृत APPROVED	RS		

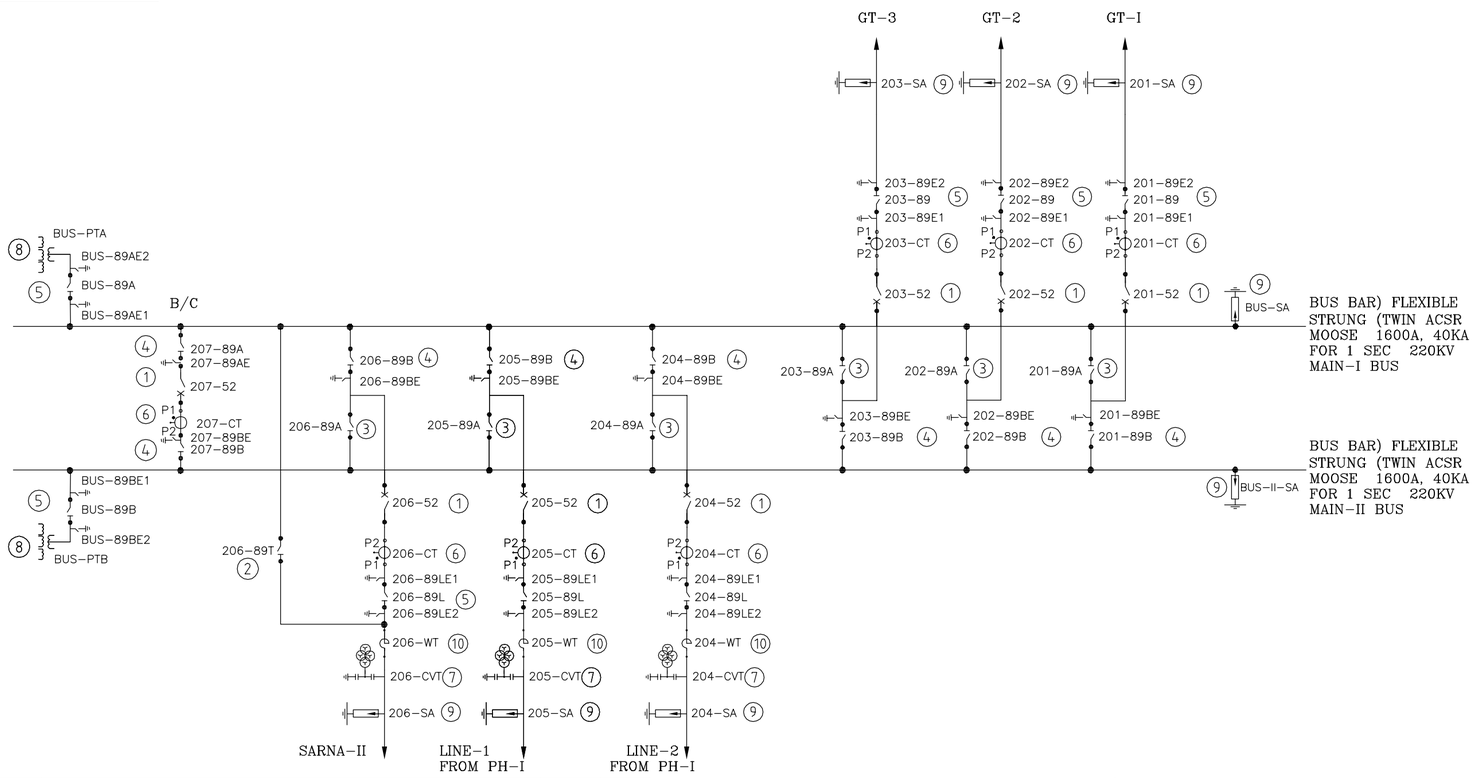
विभाग DEPT. / कोड CODE | उनुपात / SCALE NTS | कार्ड कोड CARD CODE

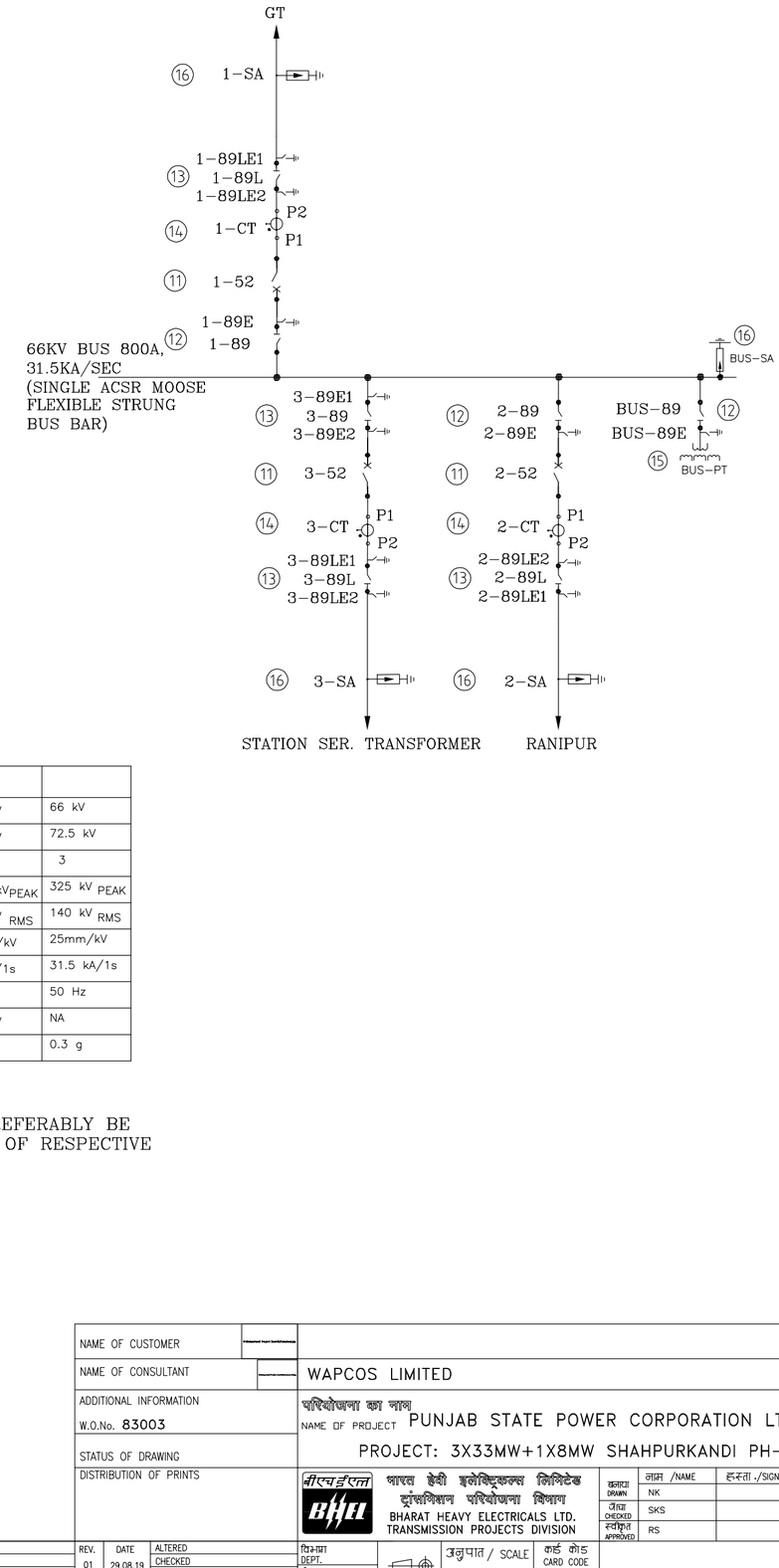
शीर्षक/TITLE
SINGLE LINE DIAGRAM FOR 220KV SWITCHYARD FOR PH–I

ड्राईंग क्र./DRAWING NO. TB–3–371–510–01

पृष्ठ क्र./SHEET No. 01 / अगला पृष्ठ/NEXT SHEET ––

पुनः/REV. 07





S.NO.	220KV EQUIPMENTS DESCRIPTION	SYMBOL	QTY.	EQUIPMENT DESIGNATION
1.	220KV, 1600A, 40KA/1SEC, SPRING OPERATED SF6 CIRCUIT BREAKER WITH OPERATING CYCLE O– 0.3 SEC– CO– 3 MIN.		07	201–52, 202–52, 203–52, 204–52, 205–52, 206–52, 207–52
2.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB, MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITHOUT EARTH SWITCH		01	206–89T
3.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB, MECHANICALLY GANGED MOTOR OPERATED TANDEM ISOLATOR WITHOUT EARTH SWITCH		06	201–89A, 202–89A, 203–89A, 204–89A, 205–89A, 206–89A
4.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH ONE EARTH SWITCH		08	201–89B, 201–89BE, 202–89B, 202–89BE, 203–89B, 203–89BE, 204–89B, 204–89BE, 205–89B, 205–89BE, 206–89B, 206–89BE 207–89A, 207–89AE, 207–89B, 207–89BE
5.	220KV, 1250A, 40KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH TWO EARTH SWITCH		08	201–89, 201–89E1, 201–89E2, 202–89, 202–89E1, 202–89E2, 203–89, 203–89E1, 203–89E2, 204–89L, 204–89LE1, 204–89LE2, 205–89L, 205–89LE1, 205–89LE2, 206–89L, 206–89LE1, 206–89LE2, BUS–89A, BUS–89AE1, BUS–89AE2, BUS–89B, BUS–89BE1, BUS–89BE2
6.	220KV, 40KA/1SEC, SINGLE PHASE CT (1600–800–200/1A)		21	201–CT, 202–CT, 203–CT, 204–CT, 205–CT, 206–CT, 207–CT
7.	220KV, $\frac{220kV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$, SINGLE PHASE CVT		09	204–CVT, 205–CVT, 206–CVT
8.	220KV, $\frac{220kV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$, SINGLE PHASE VT		06	BUS–PTA, BUS–PTB
9.	198KV, 10KA, CLASS III, LIGHTNING ARRESTER (SINGLE PHASE)		24	201–SA, 202–SA, 203–SA, 204–SA, 205–SA, 206–SA, BUS–1–SA, BUS–2–SA
10.	220KV, 0.5mH, 630A, 40KA/1SEC WAVE TRAP		06	204–WT, 205–WT, 206–WT

S.NO.	66KV EQUIPMENTS DESCRIPTION	SYMBOL	QTY.	EQUIPMENT DESIGNATION
11.	66KV, 800A, 31.5KA/1SEC, SPRING OPERATED SF6 CIRCUIT BREAKER		03	1–52, 2–52, 3–52
12.	66KV, 800A, 31.5KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH ONE EARTH SWITCH		03	1–89, 1–89E, 2–89, 2–89E BUS–89, BUS–89E
13.	66KV, 800A, 31.5KA/1SEC, 3 POLE HDB MECHANICALLY GANGED MOTOR OPERATED ISOLATOR WITH TWO EARTH SWITCH		04	1–89L, 1–89LE1, 1–89LE2, 2–89L, 2–89LE1, 2–89LE2, 3–89, 3–89E1, 3–89E2, 3–89L, 3–89LE1, 3–89LE2
14.	66KV, 31.5KA/1SEC, SINGLE PHASE CT (800–400–200/1A)		09	1–CT, 2–CT, 3–CT
15.	66KV, $\frac{66kV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$, SINGLE PHASE PT		03	BUS–PT
16.	60KV, 10KA, CLASS III, LIGHTNING ARRESTER (SINGLE PHASE)		12	1–SA, 2–SA, 3–SA, BUS–SA

MAIN SYSTEM PARAMETERS:–		
NOMINAL VOLTAGE	220 kV	66 kV
HIGHEST SYSTEM VOLTAGE	245 kV	72.5 kV
NO. OF PHASES	3	3
BIL	1050 kV_{PEAK}	325 kV PEAK
1 MIN POWER FREQUENCY W/S VOLTAGE	460 kV_{RMS}	140 kV RMS
CREEPAGE DISTANCE	25mm/kV	25mm/kV
SHORT CIRCUIT CAPABILITY	40 kA/1s	31.5 kA/1s
FREQUENCY	50 Hz	50 Hz
MINIMUM CORONA EXTINCTION VOLTAGE	156 kV	NA
SEISMIC ACCELERATION	0.3 g	0.3 g

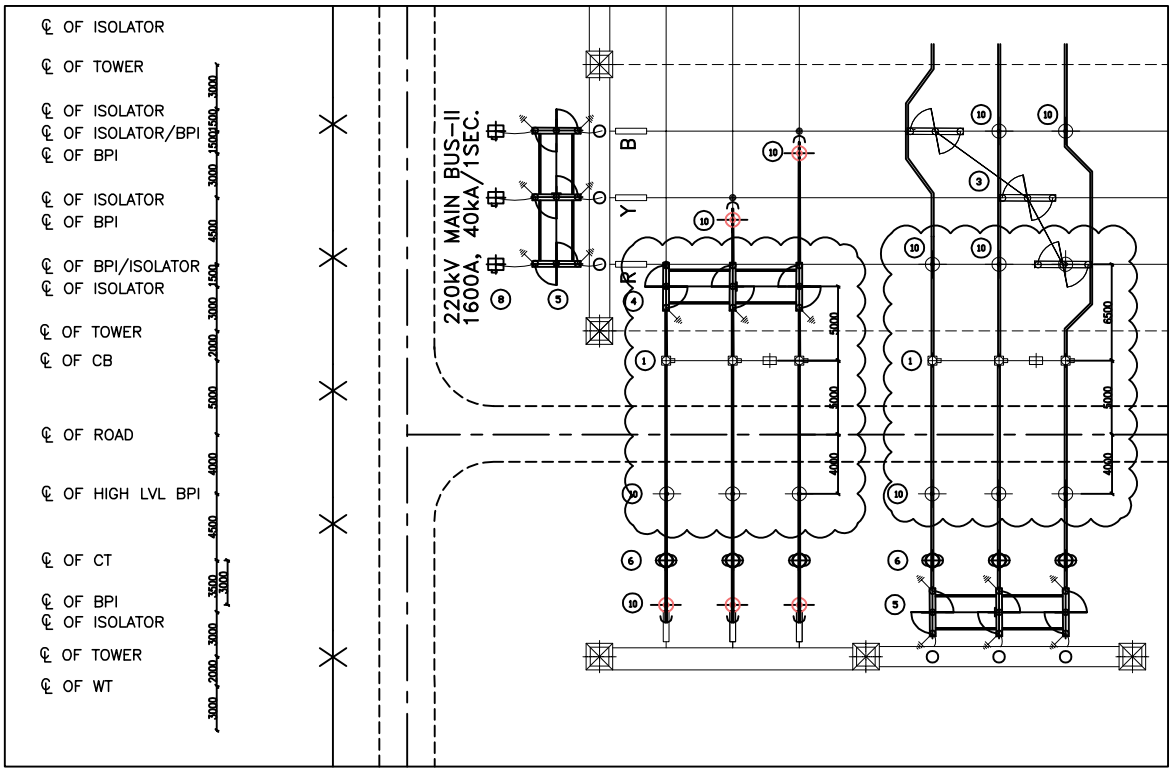
NOTES:–

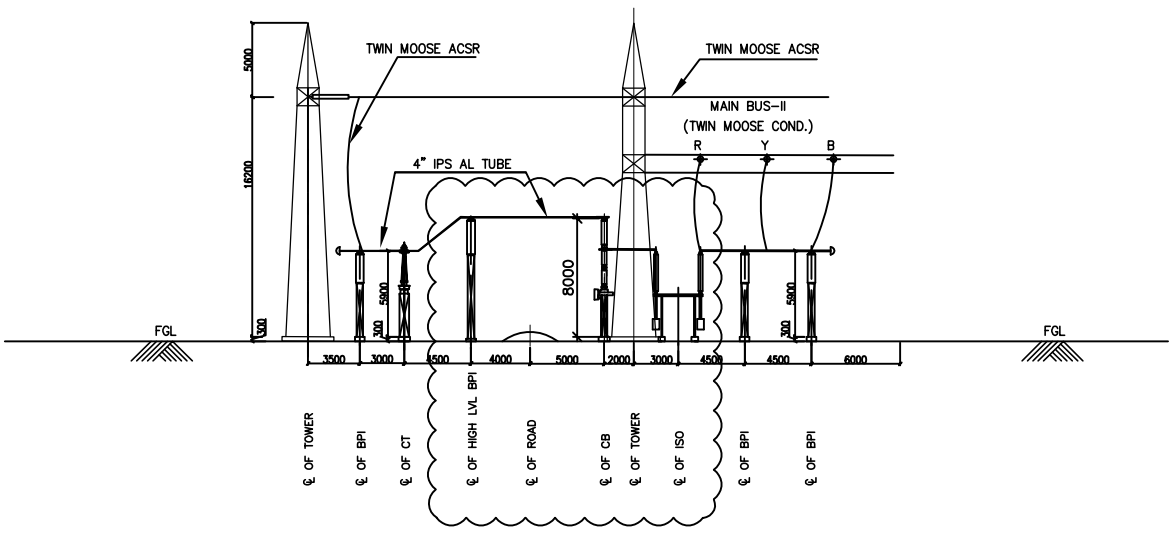
1. 220KV WAVE TRAPS SHALL PREFERABLY BE MOUNTED ON R & B PHASES OF RESPECTIVE FEEDERS.

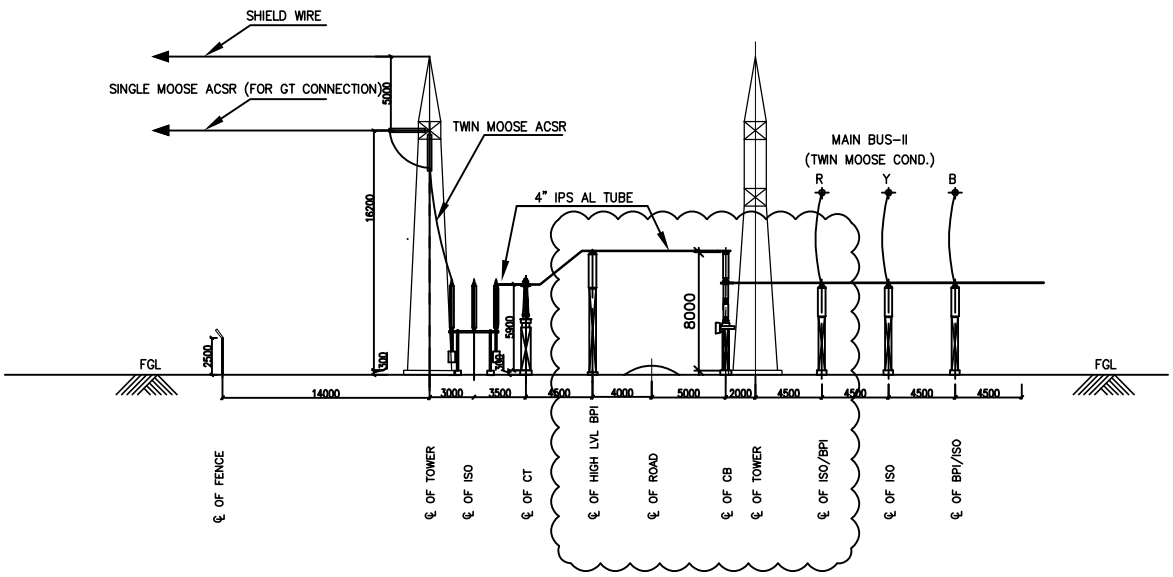
REV.	DATE	ALTERED	REVISED AS PER MOM DATED 13.12.2022 HELD AT SITE OF SKPP PH-1 & PH-2
08	16.12.2022	NK / CHECKED NK / APPROVED SKS	
07	10.08.2022	MSP / MSP / SKS	REVISED AS PER CUSTOMER COMMENTS DURING VISIT TO SITE DTD 12.07.2022 and email dtd. 25.08.2022 (WAPCOS comm. dtd 18.08.2022) Wave Trap have been added for all lines. (subject to price implication).
06	30.05.2022	SY / MSP / SKS	REVISED AS PER CUSTOMER COMMENTS VIDE PSPCLs comments received vide Email dated 19-04-2022 and WAPCOS?s comments vide Ref: WAP/E&M/SKPP/2021/391 dated 22-12-2021
05	08.11.2021	PK / NK / SKS	NO COMMENTS/APPROVAL ON REV.04 HAS BEEN RECEIVED FROM PSPCL. HOWEVER, SLD HAS BEEN REVISED IN ADVANCE DUE TO CUSTOMER COMMENTS FOR CHANGE IN ORIENTATION OF LINES COMMUNICATED DURING DURING VARIOUS MEETINGS WITH PSPCL
04	07.02.2020	PK / NK / SKS	REVISED AS PER CUSTOMER COMMENTS VIDE MEMO NO. 220/24 DTD. 06.02.2020.
03	07.01.2020	PK / NK / SKS	REVISED TO MATCH WITH ELECTRICAL LAYOUT REV 02.
02	16.12.19	NK / NK / SKS	REVISED AS PER CUSTOMER COMMENTS VIDE MEMO NO. 1334/39 DTD. 04.10.19 & CUSTOMER MEETING DTD. 09.12.19 AT PSPCL PATIALA.
01	29.08.19	ALTERED / CHECKED / APPROVED	

NAME OF CUSTOMER	
NAME OF CONSULTANT	WAPCOS LIMITED
ADDITIONAL INFORMATION	
W.O.No. 83003	
STATUS OF DRAWING	
DISTRIBUTION OF PRINTS	
NAME OF PROJECT	PUNJAB STATE POWER CORPORATION LTD. PROJECT: 3X33MW+1X8MW SHAHPURKANDI PH-II
BHEL	BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS DIVISION
DRAWN / CHECKED / APPROVED	NK / SKS / RS — DATE 12.12.19
DEPT. CODE	SCALE NTS
CARD CODE	
TITLE	SINGLE LINE DIAGRAM FOR 220KV & 66KV SWITCHYARD FOR PH-II
DRAWING NO.	TB-3-371-510-02
REV.	08
SHEET No.	01
NEXT SHEET	—

COMPUTER DISC PATH NAME :
REF. DRG. No.
SIGN. & DATE
INVENTORY No.


℄ OF ISOLATOR
℄ OF TOWER
℄ OF ISOLATOR
℄ OF ISOLATOR/BPI
℄ OF BPI
℄ OF ISOLATOR
℄ OF BPI
℄ OF BPI/ISOLATOR
℄ OF ISOLATOR
℄ OF TOWER
℄ OF CB
℄ OF ROAD
℄ OF HIGH LVL BPI
℄ OF CT
℄ OF BPI
℄ OF ISOLATOR
℄ OF TOWER
℄ OF WT
220kV MAIN BUS-II
1600A, 40kA/1SEC.
R
Y
B


TWIN MOOSE ACSR
TWIN MOOSE ACSR
MAIN BUS-II
(TWIN MOOSE COND.)
R
Y
B
4" IPS AL TUBE
8000
FGL
FGL
℄ OF TOWER
℄ OF BPI
℄ OF CT
℄ OF HIGH LVL BPI
℄ OF ROAD
℄ OF CB
℄ OF TOWER
℄ OF ISO
℄ OF BPI
℄ OF BPI


SHIELD WIRE
SINGLE MOOSE ACSR (FOR GT CONNECTION)
TWIN MOOSE ACSR
MAIN BUS-II
(TWIN MOOSE COND.)
R
Y
B
4" IPS AL TUBE
8000
FGL
FGL
℄ OF FENCE
℄ OF TOWER
℄ OF ISO
℄ OF CT
℄ OF HIGH LVL BPI
℄ OF ROAD
℄ OF CB
℄ OF TOWER
℄ OF ISO/BPI
℄ OF ISO
℄ OF BPI/ISO

SECTION-2

TECHNICAL SPECIFICATION FOR 220KV SF6 CIRCUIT BREAKERS

1.0 PARTICULARS OF THE SYSTEM:

The equipment shall be suitable for use on 50 Hz,3 phase solidly grounded system. The circuit breaker, besides providing a control of lines/transformers shall protect the system equipment against damage from faults. The system voltage may vary from 80% to 110%.

2.0 SCOPE:

The following items are included in the scope of this Specification:

i) Design, fabrication, wiring & testing at Manufacturer's works, supply, delivery and commissioning of SF6 gas filled circuit breakers, complete with control block along with, unitized air compressor, air receiver etc. for pneumatic control, spring control or with hydro control system along with gas monitoring instruments, operating mechanism, terminal connectors, hot dip galvanized steel supporting structures with foundation bolts/copper piping/connectors/valves and cable glands etc. The necessary cabling between circuit breaker and apparatus Box shall also be included in the bidder's scope of supply. All hardware should be hot dip galvanized.

ii) The equipment offered by the bidders shall be complete in all respects and any equipment of auxiliary nature not specifically mentioned but essentially required for proper design, co-ordination, operation and maintenance should be considered included under the scope of the Specification without any extra cost to the purchaser. The offer for the equipment shall also include foundation frame and anchor bolts etc.

3.0 STANDARDS:

All the material and equipment shall comply in every respect with the latest IEC-62271-100 and IEC-60694, Indian Standard Specification no. 13118 or any other equivalent recognized International/National Standards. The bidder shall state the standard Spec. to which the equipment confirms.

4.0 TYPE & RATING:

The circuit breakers to be offered shall be SF_6 Gas filled type, and shall be restrike free high speed suitable for outdoor installation under the specified climatic conditions.

The breakers shall be furnished as complete unit with all the auxiliary equipment and all internal wiring installed and terminated in the apparatus box/switch cubicle for ready installation at site on receipt at destination. All apparatus connections and

cabling shall be designed and arranged so as to minimize the risk for fire and any damage that may be caused in the event of fire.

The circuit breakers shall provide rapid and smooth interruption of current under all conditions completely suppressing undesirable phenomenon even under the most severe short circuit conditions and when interrupting small conditions including leading or lagging reactive currents.

The rate of rise of re-striking voltage applicable to the ratings offered shall be clearly stated. Actual rupturing capacity of circuit breakers offered shall also be indicated.

5.0 SF_6 GAS FILLED CIRCUIT BREAKERS:

SF_6 circuit breakers shall consist of three identical single pole units using SF_6 gas at single pressure and puffer type interrupting arrangement. The interrupting chambers of poles shall be pneumatically/electrically/hydraulically/spring charge connected with independent operating device. SF_6 gas confirming to IEC-376 or relevant IS shall be used in the interrupting units at such a pressure that the breaker does not require any complex auxiliary circuit for pressure and temperature control, special heating system and special compressors etc. Suitable gas filling and pressure/density (temperature compensated) monitoring arrangements along with safety plug if any, shall be provided for each interrupting unit.

Insulation to earth of the circuit breaker shall be independent of SF_6 pressure. Suitable measures shall be adopted in the individual interrupting units to achieve requisite degree of dryness of SF_6 gas and to absorb its decomposition products. SF_6 gas filling should not develop dangerous over pressure inside the interrupting unit within the temperature rise limits to be encountered in service. SF_6 gas filled in the interrupting units should work in the closed circuit without causing any exhaust to the open air in service and during opening or closing operations. Time period in terms of number of operations on fault, number of years of normal service after which SF_6 filling needs replacement shall be stated. SF_6 gas for first filling of each circuit breaker shall be included in the scope of supply and the complete specification of the SF_6 gas proposed to be utilized shall be provided. Spare SF_6 gas cylinders duly filled, adequate for filling gas atleast in four breakers and equipment for filling and detecting leakage of SF_6 gas recommended by the bidder for proper maintenance of circuit breaker shall be quoted in the schedule of requirement.

In case purging of breakers, before filling with SF_6 gas is desirable then the required equipment shall also be furnished as a part of the maintenance equipment. The equipment shall be complete with necessary piping, couplings, flexible tubes and valves for connecting to the circuit breakers.

6.0 CIRCUIT BREAKER OPERATIONS:

Each circuit breaker shall be remote controlled from the control room but provision shall be made for local electrical spring charged & pneumatic control also. For remote and local electrical operation 220 volts D.C. supply shall be available and the power operating coils viz. closing and shunt tripping shall be so designed that they operate the breaker satisfactorily within a control voltage variation of 70% to 110% of the normal for normal trip coils and 85% to 110% of the normal for closing coils. Breakers with pneumatic, hydraulic and spring charged mechanism shall be considered. However, spring closing and spring tripping operating mechanism shall be preferred._SF_6 type breaker, equipped with electro/pneumatic/hydraulic/spring charged mechanism shall be offered along with unitized air compressor & Air receiver, copper piping, valves, accessories, pressure switches etc. SF_6 Breakers offered with hydraulic & spring charged operating mechanism shall also be capable of performing all specified duty cycles satisfactorily. The circuit breakers with pneumatic mechanism shall be so designed as to require the minimum quantity of compressed air/oil etc. for their closing and opening operations as well as for continuous scavenging. Each circuit breaker with pneumatic control shall be equipped with its own air receiver which shall have adequate capacity to permit at least two complete close-open operations at full rating, starting from normal working pressure without any replenishment of air. The control kiosk shall be equipped with a non-return valve and adjustable pressure switches, which will open/close its contacts when the pressure falls below pre-set values. The pressure switch shall have the required number of contacts for interlocking and alarm/indication purpose under low air pressure conditions. Arrangements shall be made to prevent the closing of the breaker due to leakage of air passing through the closing valve without a positive impulse from the closing coil. A drain valve shall also be provided on each individual receiver if considered necessary by the manufacturer. Adjustable pressure switches with potential free contacts to actuate devices for trip lock out/close lock-out, auto-reclose lock-out and low pressure alarm shall be provided in the pneumatic operating mechanism to prevent the operation of breaker whenever the pressure of the operating medium is below that required for satisfactory operations. The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions, with air pressure immediately before operation between 85% and 105% of 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.

In SF_6 C.B. with electro-hydraulic operating mechanism each pole of the breaker shall be provided with independent electro-hydraulic operating mechanism. The operating mechanism shall be enclosed in weather proof/vermin proof sheet steel enclosure. The electro hydraulic operating mechanism shall be complete and self-contained unit without requiring any external source of energy except electric

supply. The hydraulic system shall consist mainly of operating unit with cylinders a set of actuating valves, Nitrogen gas accumulators (to supply the energy instantaneously), Oil pump (to change the controls for performing various operations) and motor etc.

The electro-hydraulic mechanism shall meet the following requirements:

a) In case of failure of supply, the energy stored in the accumulator shall be sufficient for a Co-operation with initial pressure equal to lowest pressure of auto re-close duty plus pressure drop for one close duty plus pressure drop for one close operation of the breaker.

b) The energy stored shall be sufficient for the duty cycles specified (O-t-CO-t-CO) & the accumulator charging time for restoring pressure shall be so short so as to meet the further operating sequence as per IEC.

c) Hydraulic mechanism shall be provided with suitable safeguards of lock-out arrangement to prevent operations below the specified minimum operating pressure. The closing lock-out pressure shall be such that opening operations is possible after the breaker is closed. Oil pressure controlling the oil pump & pressure cylinder shall be continuously monitored at purchasers control board.

d) The hydraulic oil used in the mechanism shall be capable of pertaining its properties, so that operation of the breaker is throughout the specified temperature range.

e) The mechanism shall have a comprehensive pressure monitoring & control system to regulate the operating pressure at all time automatically & give electrical indication in local as well as remote control board in case of hydraulic pressure, loss of N2 gas in accumulator etc.

f) SF_6 gas pressure monitoring unit shall consist of a manometer a temp. Compensated pressure switch (density monitor) & a connection point with a valve for SF_6 filling sampling.

g) The mechanism shall be so designed that in the event of pressure loss in the hydraulic system the breaker contacts remain in the particular position.

h) The hydraulic mechanism shall also be provided with the handle for an emergency operation of the breaker.

Two independent trip coils shall be provided on each C.B from reliability point of view. It is intended to have continuous type of pre-closing and post-closing trip circuit supervision through auxiliary relays and suitable resistors to be connected in series with each trip coil for the purpose. All the trip coils shall, therefore, be designed keeping in view the above requirements.

It shall be possible to lock out the circuit breaker operating apparatus box/switch cubicle in the open as well as in the close position of the breaker. The operating mechanism shall be trip free as per IEC-62271 or relevant IS and shall have anti-hunting feature.

A mechanical position indicator for ON/OFF condition of the circuit breaker shall also be provided on each breaker/pole or switch cubicle/apparatus box in addition to electrical or pneumatic type of indications.

In case any of the poles do not obey opening or closing command causing pole discrepancy, then the common switch cubicle should ensure automatic tripping of all the three poles by pneumatic or some other mechanical action (independent of electrical tripping Ckt.& pole discrepancy relays etc.)

The 220KV C.B. shall be suitable for single phase as well as 3 phase auto reclosing duty.

7.0 APPARATUS CUBICLE/SWITCH CUBICLE:

All the control equipment immediately connected with the operation of the circuit breaker shall be installed in an outdoor type, weather/vermin proof and splash proof strong cubicle having suitable number of hinged doors so as to afford easy access for all equipments mounted inside. Apparatus Box shall be fabricated from heavy gauge M.S. sheet at least 2mm thick have locking arrangement with locks(s) shall be provided on the front door to check un-authorized operation. The cubicle shall be hot dip galvanized construction so as to be suitable for use under tropical conditions at site. The cabinet shall contain the following equipments in addition to any other equipments required for satisfactory operation of the circuit breaker: -

i) Control selector switch for local/remote electrical operation with a neutral position.

ii) Control switch for local electrical operation.

iii) Control knob for local pneumatic operation in the absence of DC supply.

iv) Pressure switches with alarm contacts for signaling high/low pressure

v) Relief & drain cock

vi) Non-return and stop valves.

vii) Pressure switches for blocking circuit breaker opening, closing and reclosing under low pressure.

viii) Anti hunting device (Electrically operated).

ix) Trip coils and closing coils.

x) Indicating lamps for various operations.

xi) A heating element complete with a rotary switch.

xii) Safety valves.

xiii) Switches & fuses for controlling AC&DC supplies.

xiv) A power plug with switch.

xv) A light point with door switch.

xvi) Small wiring of 2.5mm2 for the cabinet.

xvii) Air filter.

xviii) A terminal board with suitable number of numbered terminals.

xix) Air piping and auxiliaries for the cabinet.

xx) Cable glands for various power and control cables.

xxi) Operation counter.

xxii) Rating and diagram plate incorporating the year of manufacture, specification no. P.O. No. & date etc.

xxiii) Electro-pneumatic valves for opening, closing and reclosing operations.

xxiv) Circuit breaker mechanical ON/OFF position indicator.

xxv) Any other item to complete the job.

All fixtures, nuts & bolts etc. for mounting the apparatus be either on the circuit breaker supporting structure or on a nearby plinth shall be supplied by the bidder. Apparatus shall be equipped with requisite number of cable glands for receiving PVC insulated power and control cables necessary for control of circuit breakers.

8.0 AUXILIARY SWITCHES:

Each circuit breaker shall be provided with necessary number of auxiliary switches both on the normally open and normally closed types for ON/OFF indication lamps on both local control panel and semaphore indicators on the remote control panel. Provision shall also be made for various interlocking, auto-reclosing schemes and remote position indication etc. In addition, 8Nos. normally open, 8 Nos. normally closed contacts shall also be provided with each circuit breaker as spare and the same should be wired up to the marshalling box but they should not be used. It shall be possible to change any number of normally closed contacts into normally open contacts and vice-versa. The total no of auxiliary switches thus provided and the rating of each contact shall be clearly stated. There shall be a provision to add more auxiliary contacts at a later stage. The leads from auxiliary switch contacts shall be brought to a terminal board installed inside the auxiliary switch housing and suitable cable glands shall be provided for terminating PVC insulated control cables.

The bidder shall clearly state in the tender whether the 'NO/NC' contacts are of normal design or of make before break and vice versa type.

9. MOUNTINGS:

The circuit breakers shall be self-supporting type. However, if necessary, for the purpose of minimum ground clearance the circuit breakers shall be mounted on raised steel structures which shall be included in the scope of supply. The bidder shall supply the following information and data for design of foundations: -

1. Dead weight per pole and of complete circuit breaker.
2. Static bending moments about the foot of each pole and for complete circuit Breaker.
3. Static shear force at the spot of each pole and for complete circuit breaker.

4. Impact loading, if any, during operation of breaker. The above data shall represent static reactions for the worst windings or operation conditions.

Necessary connecting materials such as lamps, bolts, nuts, washers etc. and fixing bolts for mounting the equipment on the supporting structures, wherever required, shall also be supplied by the bidders.

10. CONTACT SYSTEMS:

The design of contact system of the circuit breakers shall be such as to provide easy access to the contact system while under-taking maintenance and replacement jobs.

Auxiliary arcing contacts may be provided to protect the main contacts from damage during circuit breaker operation. It shall be clearly stated whether the main contacts are silver plated or not and the thickness of silver plating shall be stated if the same has been provided.

In the event of leakage of extinguishing medium to a value which cannot withstand dielectric stresses specified in the open condition, it may be clearly stated whether the contacts will remain in the open condition or self-close.

Main contacts shall have ample area and contact pressure for carrying the rated current and short time rated current without excessive temperature rise which may cause pitting or welding.

Main contacts shall be the first to open and last to close so that contact burning and wear & tear are the least.

11. TEMPERATURE RISE:

The maximum **temperature** and temperature rise attained by various parts of circuit breaker, when in service under continuous full load conditions and exposed continuously to the direct rays of the sun and air shall not exceed the permissible limits specified in the IEC/ISS.

12. RECOVERY VOLTAGE & POWER FACTOR:

The circuit breaker shall be capable of interrupting rated power with recovery voltage equal to the rated maximum line to line service voltage at rated frequency and at a power factor not exceeding 0.15.

13. ASYNCHRONOUS SWITCHING:

The breaker shall be capable of satisfactory operation even under conditions of phase opposition that may arise due to faulty synchronizing. The maximum capacity/ power which the breakers can satisfactorily interrupt under phase opposition shall be provided.

14. RESTRIKING VOLTAGE:

Capability of the breakers for interrupting at different frequencies shall be provided. The complete data for the frequency, amplitude factor etc, for the rate of rise of restriking voltage shall be furnished as required as per latest edition of IEC-62271.

The measures adopted for ensuring proper operation at high rate of rise of restriking voltage and for limiting the actual voltage values across the breaker poles shall be provided. The type, characteristics and rating of the resistor used, if any, to shunt the break contacts and of the auxiliary switching devices used for interrupting the resistor current shall be clearly stated.

15. LINE CHARGING CURRENTS INTERRUPTING, CABLE CHARGING CURRENT BREAKING & SHUNT CAPACITOR BANK SWITCHING CAPACITY:

The circuit breaker shall be designed so as to be capable of interrupting line charging, cable charging & shunt capacitor bank switching currents without undue rise in the voltage on the supply side and without any restrike and without showing signs of undue strains. The guaranteed over voltages which will not be exceeded while interrupting the specified current shall be provided.

The expected over voltage caused while interrupting the above charging current shall be provided.

The results of the test along with copies of the oscillograms conducted to prove the ability of the breakers to interrupt these and low line charging current value shall be provided..

16. TRANSFORMER CHARGING CURRENT BREAKING CAPACITY:

The breakers shall be capable of interrupting inductive currents such as those occurring while switching off unloaded transformers, without giving rise to undue over voltage and without restrikes. The maximum over voltage value which will not be exceeded under such conditions shall be provided.

17. BREAKING CAPACITY FOR KILOMETRIC FAULT:

The interrupting capacity of the breaker for kilometric faults(short line faults)shall be provided. The details of test conducted for proving the

capabilities of the breaker under kilometric faults conditions shall also be provided.

18. AUTOMATIC RAPID RECLOSING:

The circuit breaker shall be suitable for three phase rapid reclosing duties. The operating duty of the circuit breaker shall be **O-D-CO** in which 'D' represents the dead time of the circuit breaker.

19. INSULATING SUPPORTS:

The basic insulation level of the external insulator support shall be as per IEC/IS given under para relating to type and rating shall be suitable for installation in contaminated atmospheres. The porcelain used shall be homogeneous and free from cavities or other flaws. These shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. All bushings of identical ratings shall be inter changeable. The puncture strength of the bushings shall be greater than the flash over value. The bushings shall be entirely free from rapid disturbances when operating at a voltage up to 10% above rated voltage and shall also be free from external & internal corona. The test certificates of support porcelain insulator & interrupting chamber shall be supplied along with tender as per relevant IEC/ISS.

20. CONTROL CONNECTIONS AND WIRING:

All connectors and wiring shall be suitable for tropical atmosphere. Apparatus box connections shall be insulated and shall be neatly and securely fixed to the panel. All box wiring shall be of a suitable self extinguishing type and shall run in porcelain of non-rusting metal cleats. Where 415 volts connections are taken through junction boxes or marshaling boxes, they shall be adequately screened and ' 415 volts DANGER' notices must be affixed on to the outside of the junction boxes or marshaling boxes.

All box wiring shall be in accordance with relevant IS or BS. All wires on apparatus box and all multi core cables shall have Ferrules which shall bear the same number on both ends. Ferrules shall be of white insulating material and shall be provided with glossy finish to prevent adhesion. They shall be clearly and durably marked in black and shall not be affected by damp or sun. Ferrule numbering shall be in accordance with relevant IS or BS. The same ferrule number shall not be used on wires in different circuits or the same apparatus box. Wiring shall generally be accommodated on the sides of the box and the wires for each circuit shall be separately grouped. The function of each circuit shall be marked on the associated terminal block.

Where apparatus is mounted in/on switch cubicle box, the metal cases shall be separately earthed by means of copper wires or strips having adequate cross-section.

Multi core cable tails shall be bounded such that each wire may be traced without difficulty to its cable.

All terminal boards shall be suitably mounted to give easy access to terminations and to enable ferrule number to be read without difficulty. Terminal block rows shall be spaced adequately and not less then 100mm. apart to permit convenient access to wire termination.

Terminal boards shall have pairs of terminals for incoming and outgoing wires. Insulating barriers shall be provided between adjacent terminals/connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. 20% spare terminals shall be provided in each row. All fuses shall be of cartridge type. Fuses and links shall be labeled.

21. INTERLOCKS:

Necessary interlocks to prevent the closing or opening of the breaker under low air & gas pressure and devices for initiating alarm shall be provided. Provision shall also be made to enable (Mechanical and Electrical) interlocking with the Isolator when the breaker is closed etc.

22. CONTACT TRAVEL:

The contact travel i.e length of break in each pole should be indicated. It may be clearly stated whether this contact travel is sufficient to withstand the rated voltage of the breaker in the event of leakage of SF_6 gas from the poles. It may be indicated whether the breaker is safe from damage in open as well as closed position even if the SF_6 gas leaks from the poles.

23. RANGE OF SF_6 GAS PRESSURE:

The range of normal working pressure of SF_6 gas for satisfactory operation of breaker should be specified. It may be indicated whether this working pressure varies with the altitude of station at which the breakers are installed.

24. TESTS:

Each circuit breaker shall comply with the type test and shall be subjected to routine tests prescribed in latest edition of IEC-62271/IEC-694/IS13118.

Reports of all type tests as stipulated in IEC-62271, IEC-694 or IS-13118 and line charging current and cable charging current and transformer

charging & shunt capacitor switching current tests etc. carried out on similar design and rated breaker by internationally recognized test laboratories shall be furnished.

In case some type tests are conducted at supplier's own works, instead of at Govt. approved laboratory, the type test reports for same shall be accepted only if bidder undertakes to conduct this type test free of charges in presence of Boards' representative at time of inspection.

Routine tests as per IEC-62271/IEC-694 or IS-13118 shall be carried out on each breaker in the presence of purchaser's representative if so desired by the purchaser. All test reports shall be submitted and be got approved from the purchaser before the dispatch of the equipment.

25. GUARANTEED AND TECHNICAL PARTICULARS:

Guaranteed technical particulars (GTP) as specified in Annexure-A attached shall be furnished along with the tender. The particulars which are subject to guarantee shall be clearly marked. Guaranteed technical particulars must be authenticated with the requisite test reports. GTP should be self-explanatory and required information/values/data as asked for in section 04 shall be incorporated in GTPs and words like "as per enclosed type test report" should be avoided.

26. MATERIAL & WORKMANSHIP:

All material used in the construction of equipment shall be of the best quality available of their respective kinds and whole of the work should be of approved design and make.

27. INTERCHANGEABILITY:

Corresponding parts of similar items should be interchangeable in every respect.

28. INSTRUCTION PLATES AND MARKINGS:

All name plates, instruction plates, warning signs and any marking whatsoever on the equipment and its parts and accessories should be in English Language.

Terminal block diagram indicating function of each lead with self speaking remarks may be affixed on the inside door of switch/control cubicle.

All name plates shall be riveted. One main name plate shall also be riveted inside the Apparatus/Switch Cubicle P.O. No.& date & the name of purchaser shall also be mentioned on the name plate.

In order to facilitate sorting and erection at site, every part of the plant and equipment shall be suitably marked. These markings shall be in conformity with those given on the assembly drawings

29. PACKINGS:

All material shall be suitably packed for transport, direct to site and supplier shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the suppliers.

30. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification. All foundation bolts shall be included in the scope of supply. Earthquake dampers, if necessary, shall also be provided on the equipment without any extra cost.

31. DEVIATIONS:

Any deviations from this specification shall be clearly brought out in technical deviation sheet, otherwise it will be presumed that equipment offered strictly conforms to purchaser's specification. All such deviations shall be listed giving reference to the particular clauses of the specification which are so affected.

TECHNICAL SPECIFICATION FOR 72.5 KV SF6 GAS FILLED CIRCUIT BREAKERS

PARTICULARS OF THE SYSTEM

The 72.5 kV equipment shall be suitable for use on 72.5 kV three phase solidly earthed neutral system of 50 c/s. Suitability of circuit breakers for the systems and installation should be ensured and ratified. The circuit breakers to be procured are to be installed at 66 kV substation of Shahpurkandi Hydro-Electric power project of PSPCL.

TYPE & RATING

The 72.5 KV SF -6 circuit breakers shall be triple pole, outdoor type, suitable for rapid three phase re-strike free and suitable for outdoor installation/ operation under the climatic conditions specified above, without any protection from sun & rain. These circuit breakers are required for the control of transmission lines, transformers and bus coupler. Each circuit breaker shall comprise of three identical poles linked together mechanically to ensure simultaneous gang operation of 3 poles. The circuit breaker shall be of established design & of robust construction so as to require minimum of maintenance to provide long trouble free service.

The rate of rise of re-striking voltage applicable to the ratings offered shall be provided. Actual rupturing capacity of circuit breakers shall also be indicated.

TYPE OF BREAKERS

The circuit breakers to be offered shall be SF-6 gas filled type suitable for-outdoor installation under the specified climatic conditions.

The breakers shall be furnished as complete units with all the auxiliary equipment and all internal wiring installed and terminated in the apparatus box/switch cubicle for ready installation at site on receipt at destination. All apparatus connections and cabling shall be designed and arranged so as to minimize the risk of fire and any damage that may be caused in the event of fire.

The circuit breakers shall ensure rapid and smooth interruption of current under all conditions completely suppressing undesirable phenomena even under the most severe and persistent short circuit conditions or when interrupting small currents including leading or lagging reactive currents.

SF6 CIRCUIT BREAKERS

SF6 circuit breakers shall consist of three identical single pole units each using SF6 gas at single pressure and puffer type interrupting arrangement. Circuit breaker shall have a common operating device for three poles. SF6 gas

conforming to IEC 376 shall be used in the interrupting units at such a pressure that the breaker does not require any complex auxiliary circuit for pressure & temperature control, special heating system and special compressors etc. Suitable gas filling and pressure monitoring arrangements (preferably independent pole wise) shall be provided.

Insulation to earth of the circuit breaker shall be independent of SF6 pressure. Suitable measures shall be adopted in the individual interrupting units to achieve requisite degree of dryness for SF6 gas and to absorb its decomposition products. SF6 gas filling should not develop dangerous over pressures inside the interrupting units within the temperature rise limits to be encountered in service. SF6 gas filling in the interrupting units should work in the closed circuit without causing any exhaust to the open air after performing opening or closing operations. Time period in terms of number of operations on fault, number of years of normal service after which SF6 gas filling needs replacement shall be stated.

There should be no leakage of SF6 gas from the joints and sealing points. The gaskets used between the support insulators of the breakers should be such that these should not fail.

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

SF6 gas for first filling of each circuit breaker plus 20% extra (to be supplied in non-returnable gas cylinders) shall be included in the scope of supply and complete specification of the SF6 gas proposed to be utilized shall be stated. Prices of SF6 gas with cylinder filling device, and trolley indicating the net weight of the gas in it must also be quoted separately.

The high pressure cylinders in which the SF6 gas shall be supplied and stored at site shall comply with the requirements of following standards and regulations:

i. IS- 4379 : Identification of the contents of industrial Gas cylinders.
i IS-7311: Seamless High carbon steel cylinders for permanent and high pressure liquefiable gases
ii. Indian Boiler Regulations

Equipment for filling, evacuation and detecting leakage of SF6 gas recommended by the bidder for proper maintenance of circuit breaker shall be offered. Prices for the same shall also be taken into consideration for bid

evaluation. In case purging of breaker before filling with SF6 gas is desirable then the required equipment shall also be furnished as a part of the maintenance equipment. The plant shall be complete with necessary pipes, couplings, flexible tubes and valves for coupling to the circuit breakers.

CIRCUIT BREAKER OPERATION

Each circuit breaker shall be remote controlled from the control room but provision shall be made for local electrical/spring control operation also. For remote and local electrical operation, 110 volts D.C. Supply shall be available and the power operating coils viz. Closing and Tripping coils shall be so designed that they operate the circuit breaker satisfactorily within a control voltage varying between 70% to 110% of the normal voltage for trip coils and 80% - 110% of the normal voltage for closing coils.

Each circuit breaker shall be offered along with unit spring charging equipment comprising of A.C motor unit, spring, accessories, limit switches etc. Along with auto recharging of the spring after each tripping. Manual arrangement for charging the spring shall be provided.
Each circuit breaker shall be equipped with its own spring charging system. Suitable provisions shall be made for lockout, alarm/ indicating etc. under low SF6 gas pressure conditions.

Two independent trip coils shall be provided for each breaker from reliability view point. It is intended to have continuous type of pre-closing and post - closing trip circuit supervision through auxiliary relays and suitable resistors to be connected in series with each trip coil for the purpose.

All the trip coils shall therefore be designed keeping in view the above requirement.

It shall be possible to lock out the circuit breaker operating apparatus box/ switch cubicle in the open as well as closed position of the breaker.

The operating mechanism shall be trip free as per IEC-56 and shall have anti-hunting feature. A mechanical position indicator for ON/ OFF condition of the circuit breaker shall also be provided on each breaker /switch cubicle/ apparatus box in addition to electrical or pneumatic type of indications.

Mechanical indicator provided to show open and close position and operation counter shall be located in a position -not more than 1.5 m. from the ground where it will be visible to a man standing on the ground level with mechanism housing closed.

APPARATUS BOX

All the control equipment immediately connected with the operation of the circuit breaker shall be installed in an outdoor type, weather, vermin and splash proof strong cubicles having suitable number of hinged doors so as to afford easy access for all equipment's mounted inside. Apparatus box shall be fabricated from heavy gauge M.S. Sheet of at least 3mm thickness. Positive locking arrangement with lock(s) shall be provided on the front door to check unauthorized operation. The cubicles shall be either hot dip galvanized or of other approved design and construction so as to be suitable for use under tropical conditions at site. The cabinet shall contain the following equipment in addition to any other equipment required for satisfactory operation of the circuit breakers:

1. Control selector switch for local /remote electrical operation with a- neutral position.

2. Control switch for local electrical operation.

3. Control Manual switch for local operation in the absence of DC supply.

4. Separate pressure switches with alarm contacts for signaling high / low pressure of SF6 gas limit switches shall also be proved for start and stop of the motors on complete spring releasing or charging.

5. Suitable pressure gauge (s) (Density Monitors) for showing SF6 gas pressure of each limb and pressure switches for giving low gas pressure alarm and blocking of closing/ tripping. The contacts should be provided ided and wired upto terminal block for getting annunciation in the control room.

6. Circuit breaker mechanical ON/OFF position indicator and spring charged indication.

7. Anti hunting device (Electrically operated).

8. Trip coils and Closing coils.

9. Indicating lamps for various operations.

10. A heating element complete with a rotary switch.

11. Safety valves.

12. Switches and fuses for controlling AC & DC supplies.

13. A power plug with switch.

14. A light point with door switch.

15. Complete wiring for the cabinet should be fire resistant and having stranded copper conductor of cross-sectional area 2.5 mm^2.or more according to current requirements.

16. A terminal board with suitable number of numbered terminals including 20% spare terminals.

17. Cable glands for various power and control cables.

18. Emergency trip device.

19. Operation counter.

20. Rating and diagram plate in accordance with IEC incorporating the year of manufacture and purchaser's order reference.

21. Earthing terminals and lugs for the earthing of marshalling/ apparatus box.

22. Any other item to complete the job

All fixtures, nuts , bolts etc. for mounting the apparatus box either on the circuit breaker supporting structure or on a nearby - plinth shall be supplied by the bidder. Apparatus box shall be equipped with requisites number of cable glands for receiving PVC insulated power and control cables necessary for the control and operation of circuit breakers.

AUXILIARY SWITCHES

Each circuit breaker shall be provided with necessary number of auxiliary switches both of the normally open and normally closed type for satisfactory operation of the breaker and for operating ON/OFF indication lamps locally and semaphore indicators on the control panel. In addition 10 nos; normally open and 10 nos. normally closed contacts shall also be provided with each circuit breaker as spare for various interlocking, schemes and remote position indications. It shall be possible to change any number of normally closed contacts into normally open contacts and vice versa. The total number of auxiliary switches thus provided and the rating of each contact shall be clearly

stated. There shall be a provision to add more auxiliary switches at a later stage. The leads from auxiliary switch contacts shall be brought to a terminal board installed inside the auxiliary switch housing and suitable cable glands shall be provided for terminating PVC insulated control cables.

The bidder shall clearly state in the tender whether the NO/NC contacts are of normal design or of make before break and vice versa type.

MOUNTINGS

The circuit breakers shall be self-supporting type. However, if necessary for the purpose of minimum ground clearance the circuit breakers shall be mounted on raised steel structures which shall be included in the scope of supply. The successful bidder shall supply the following information and data for design of foundations after the award of the contract.

1. Dead weight per pole for complete circuit breaker.

2. Static bending moments about the feet of each pole and for complete circuit breaker.

3. Static shear force at the foot of each pole and for complete circuit breaker.

4. Maximum height of the steel supporting structure.

5. Maximum diameter of the pole.

6. Maximum horizontal force acting at upper terminal of each pole due to impact of closing/opening of the circuit breaker.

7. Max. impact loading in terms of equivalent static load both compression. and upward due to opening/closing of the breakers. It shall be clearly stated whether these forces shall act simultaneously or at different timing.

8. No. of steel supporting columns provided for mounting the equipment.

The above data shall represent static reactions for the worst windage or operation conditions. Circuit breakers whether of self supporting type or on raised steel structure shall ensure minimum sectional clearance as per relevant IEC/IS.

Necessary connecting materials such as clamps, bolts, nuts, washers etc. and fixing bolts for mounting the equipment on the supporting structures wherever required shall also be supplied by the bidder.

DESIGN FEATURES

Contact System

The design of contact system of the circuit breakers shall be such as will provide easy access to the contact system while undertaking maintenance and replacement jobs.

Auxiliary arcing contacts may be provided to protect the main contacts from damage during circuit breaker operation.

It shall be clearly stated whether the main contacts are silver plated or not and the thickness of silver plating shall be stated if the same has been provided, Material of main & arcing contacts shall also be stated.

It may clearly be stated whether the contact travel is sufficient to withstand the rated voltage of the breaker in the event of leakage of SF6 gas from the poles.

In the event of leakage of extinguishing medium to a value which cannot withstand dielectric stresses specified in the open condition, it may be clearly stated whether the contacts will remain in the open condition or self close.

Main contacts shall have an ample area and contact pressure for carrying the rated current and short time rated current without excessive temperature rise which may cause pitting or welding. Material and cross section area of the main contacts shall clearly be stated.

Main contacts shall be the-first to open and last to close so that contact burning and wear are the least.

Temperature Rise

The maximum temperature and temperature rise attained by various parts of the circuit breaker when in service at site under continuous full load conditions and exposed continuously to the air and direct rays of the sun shall not exceed the permissible limits specified in IEC-56 (latest edition) or relevant IS.

Recovery Voltage And Power Factor

Each circuit breaker shall be capable of interrupting without opening resistors rated power with recovery voltage corresponding to the rated maximum line to line service voltage at rated frequency and at a power factor not exceeding 0.15. The breakers shall also be capable of interrupting faults currents of magnitude 2 to 10% of rated breaking current without causing any re-strike or non permissible over voltage in the system critical current which gives the longest

arc duration at lock out pressure of extinguishing medium and arc duration shall be indicated.

Faulty Synchronizing

Each circuit breaker shall be capable of satisfactory operation even under conditions of phase opposition which may arise due to faulty synchronism as per IEC-56 requirements. The maximum current which the circuit breaker can satisfactorily interrupt at twice the maximum phase to ground applied voltage under phase opposition conditions shall be stated.

Transformer Charging Current Breaking Capacity

The circuit breakers shall be capable of interrupting small inductive currents such as those occurring while switching off unloaded transformer banks and reactor/ capacitor loaded transformers without giving rise to undue over voltage and without re-strikes. The minimum transformer charging current which can be interrupted by the breaker and corresponding over voltage value under such conditions shall be stated.

Re-striking Voltage

The circuit breakers offered shall be re-striking free. The rated transient recovery voltage for terminal faults shall be as per TS. Measures adopted for ensuring proper operation at high rate of rise of re-striking voltage and for limiting actual voltage across the circuit voltages breaker shall be described. The details of any device incorporated to limit or control the rate of rise of re-striking voltages across the circuit breaker contacts shall also be stated. The circuit breaker shall be capable of with -standing higher peak voltage and RR of TRV expected during clearance of short circuit immediately after the power transformers in the vicinity of centre of generation and at the end of long lines.

Overhead Line Charging Current Interrupting Capacity

Each circuit breaker shall be designed so as to interrupt without restriking the assigned line changing current as per IEC publication No. 56 (latest edition) , if any, corresponding assigned maximum over voltages both on the line and supply side of the circuit breaker shall be clearly stated.

Breaking Capacity for Kilometeric Faults

The interrupting capacity of the circuit breaker for kilometeric faults under supply side and line side characteristics shall be as per IEC -56. The details of test conducted from providing the capabilities of the breakers under kilometeric fault conditions shall also be provided.

Insulating Supports

The porcelain used for bushing/support insulators shall be homogenous, free from cavities and other flaws. The bushings shall be securely cemented with the pole base such that its failure to base due to shear is minimum. The insulators shall be designed to have ample insulation. Mechanical strength and rigidity for satisfactory operation under the conditions indicated in this specification. All insulators / bushings of identical ratings shall be interchangeable. The puncture strength of insulators/bushings shall be greater than the flash -over value. The insulators/bushings shall be entirely free from ratio disturbance when operating at voltage 10% above rated voltage and shall also be free from external and internal corona. Total phase to earth creepage distance and that between top and bottom terminals shall not be less than the values specified under this specification without re-strike. The minimum transformer charging current which can be interrupted by the breaker and corresponding over voltage value under such conditions shall be stated by the bidder.

Noise Level

The circuit breakers shall be reasonably quiet in operation. Noise level at the base of the breaker should be less than 140db. Breakers shall be provided with sound muffles to reduce the noise level, if required. Bidders shall indicate the noise level of breaker at distance of 50, 100 and 150 m from itself.

Interlocks

Necessary interlocks shall be provided to prevent manual/auto closing or opening -of the breaker under low gas pressure. Devices for initiating the necessary alarms and indications shall also be provided.

Control Connections and Wiring

All connections and wiring shall be suitable for tropical atmosphere.

Apparatus box connections shall be insulated and shall be neatly and securely fixed to the panel. All box wiring shall be of self-extinguishing type and shall run in porcelain or non-rusting metal cleats of the limited compression type.

The cable/wiring used shall be of fire resistant type. Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts of the run shall be external to the boxes. All conduit-runs shall be adequately drained and ventilated, conduits shall not be run at or below ground level.

Where 415 Volts connections are taken through junction boxes or marshalling boxes they shall be adequately screened and 415 Volts Danger" notice must be affixed to the outside of the junction boxes or marshalling boxes.

All box wiring shall be with stranded copper conductor having size 2.5 mm^2 or more as per current requirement and in accordance with relevant IS.

All wires on apparatus box and all multi-core cables shall have ferrules which shall bear the same number on both ends.

Ferrules shall be of white insulating material and shall be provided with glossy finish. These shall be clearly and durably marked in black and shall not be affected by dampness or oil.

Ferrule numbering shall be in accordance with relevant IS. The same ferrule number shall not be used in wires in different circuits on the same apparatus box. Stranded wires shall be terminated with tinned (not soldered) insulated crimped lugs of copper or other suitable claw washers, separate washers being used for each wire. The size of the washers shall be suitable for the size of wire terminated. Wiring shall in general be accommodated on the sides of the box and the wires for each circuit shall be separately grouped.

Wires shall not be joined or tied between terminal points. Wherever practicable all circuits in which the voltage exceeds 125 volts shall be kept physically separate from the remaining wiring. The function of each circuit shall be marked on the associated terminals boards.

Where apparatus is mounted on the box all metal cases shall be separately earthed by means of copper wire or strip having adequate cross section.

Multi-core cable tails shall be so bound that each wire may be traced without difficulty to its cable.

All terminal boards shall be suitably mounted to give easy access to terminations and to enable ferrule numbers to be read without difficulty.

Terminal board rows shall be adequately spaced and not less than 100mm apart to permit convenient access to wire terminations. Terminal boards shall be so placed with respect to the cable clutch (at a minimum distance of 200 mm) as to permit satisfactory arrangement of multi-core cable tails.

Insulating covers of self-extinguishing material, preferably transparent, shall be provided on terminal boards on which connections for circuit with a voltage greater than 125 volts are terminated.

Cables shall be provided on the front portions of the terminal board. No live metal shall be exposed at the back of the terminal boards. All fuses shall be of the cartridge type

Fuses and links shall be labelled (circuit wise). MCBs shall be provided wherever necessary and feasible.

Grounding

Two grounding terminals shall also be provided on each equipment / apparatus for proper grounding connection with the station ground-mat.

Metal Parts

All ferrous parts of equipment shall be heavily hot dip galvanized. Bolts, nuts, screws, pins, washers etc. used in these equipment shall also be galvanized. The galvanizing should conform to IS -2629 - latest edition.

All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points, edges and sharp faces.

TESTS

a) Type tests

The circuit breaker along with its operating mechanism shall conform to the requirement of type tests as per latest edition of, IEC publication No. 56 /IEC - 694 /IS -13118.Complete set of type test reports with necessary oscillograms, drawings pertaining to the offered circuit breakers shall be submitted during detailed engineering.

b) Routine tests

The routine tests as per latest edition of IEC publication No. 56-/ IEC -694 or IS -13118 covering up to the data amendments shall be carried out in the presence of purchaser's representative, if so desired by the purchaser. In addition to above speed curve for each breaker shall be obtained with the help of a suitable operation analyzer to determine breaker contacts movement during opening, closing, under normal as well as limiting operating conditions (control voltage and SF6 gas pressure etc). The curves shall show speed of contacts at various stages of operation travel of contacts , opening time, closing time shortest time between separation and meeting of contacts at break/ make operation etc. Operation analyzer to perform this test shall be included in the list of tools and equipment for initial erection and subsequent maintenance.

c) Routine test certificates of associated equipment such as motors, support insulators, hollow insulators gas cylinders and SF6 gas etc as per relevant IS/IEC shall also be supplied for reference and record of the purchaser.

d) **Field Tests of Breakers**

Each circuit breaker shall be liable to undergo field testing before its initial operation. During the field testing, each circuit breaker must satisfactorily perform and satisfy the requirements of the specification. Special tests, if any, arranged by the purchaser at site to prove any of the requirement of the breaker shall be carried out in the presence of supplier's Engineers who shall fully associate with the testing.
Details of the pre-commissioning tests to be carried out on the breakers at site shall be submitted during contract stage for reference of the purchaser.

Special tools and tackles required, if any, for the pre-commissioning tests shall also be clearly indicated in the details of the pre-commissioning tests. All test reports for routine tests shall be submitted and got approved from the purchaser before dispatch of the equipment.

GUARANTEED TECHNICAL PARTICULARS

Guaranteed technical particulars as per GTP attached with specification shall be submitted during contract stage.

ERECTION / COMMISSIONING

All equipment with associated items covered in the specification are intended to be erected and commissioned in the presence of bidder commissioning Engineer. While commissioning the circuit breakers it shall be obligatory on the part of the supplier to comply with the following precautions / conditions:

i) A copy of pre-commissioning tests/ reports and commissioning schedule/checking shall be supplied by the bidder's Engineer at the time of commissioning the circuit breaker for reference and record of the purchaser.

ii) Proper pressure of SF6 gas in the arc-chambers of all the three phases shall be ensured before commissioning the circuit breaker.

iii) Bidder's commissioning Engineer shall be required to be present at the time of commissioning and also at the time of loading the system being controlled by the particular circuit breaker. Necessary intimation regarding the date and time of

commissioning /loading shall be given to the supplier by the purchaser.

iv) It shall be ensured that there is no possibility of operation by mistake at the time of commissioning.

DRAWINGS LITERATURE AND MANUALS

In addition to any other drawings which the bidder may like to submit during contract stage, the following drawings shall be supplied.

i. Drawing showing the general outline /dimensions of circuit breaker and the supporting structures indicating the bill of material, foundation plan and all other relevant information.
ii. Drawing showing details of breaking unit.
iii. Drawings showing details of electrical connections between the breaker poles and the control equipment.
iv. Drawing showing details of apparatus box.
v. Drawing showing schematic and wiring diagram for 3 pole closing and tripping. Illustrative and descriptive literature of circuit breaker shall also be submitted.

The supplier shall supply 15 (fifteen) sets of final drawings along with one set of reproducible thereof and fifteen sets of operating and maintenance instructions manual for the equipment before the actual dispatch of equipment.

PAST PERFORMANCE

The bidder shall invariably supply list of orders received / already executed by him along with the tender. The bidder shall also enclose with his tender, the performance certificates from the users/State Electricity Boards for the offered type of circuit breakers

MATERIAL AND WORKMANSHIP

All material used in the construction of equipment shall be of the best quality available of their respective kinds and whole of the work should be of approved design and make.

INTERCHANGEABILITY

Corresponding parts of similar items should be interchangeable in every respect.

INSTRUCTION PLATES AND MARKINGS

All name plates, instruction plates, wiring signs and any marking on the equipment and its parts and accessories should be in English language. In order to facilitate sorting and erection at site, every part of the plant and equipment shall be suitably marked. These markings shall be in conformity with those given on the assembly drawings. All name plates shall be riveted one. The main nameplate shall also be riveted inside the apparatus/ switch cubicle. P.O. No. & name of purchaser shall be mentioned on the name plate drawings.

PACKING

All material shall be suitably packed for transport direct to site and contractor shall be responsible for all damages/ losses due to improper packing. All boxes shall be marked with the signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the bidder.

COMPLETENESS OF EQUIPMENT

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment shall be deemed to have been included in this specification. All foundation bolts shall be included in the scope of supply. Earthquakes dampers if necessary shall also be provided on the equipment without any extra cost.

DEVIATIONS

Any deviations from this specification shall be clearly brought out in technical deviation sheet, otherwise it will be presumed that equipment offered strictly conforms to purchaser's specification. All such deviations shall be listed giving reference to the particular clauses of the specification which are so affected.

BILL OF MATERIAL

The drawings for the bill of material of the breaker must be submitted during contract stage. It will consist of separate drawings with elevations, plans, top views and cross sections of all main parts of the breaker. The parts / items to be sent loose shall also be shown/ mentioned in the bill of material drawing. On receipt of equipment at site, the consignee shall compare it with the bill of material mentioned/ shown on the bill of material drawings in order to find out the material / items supplied short /damaged by the supplier with a particular consignment. In case some items other than those mentioned in the bill of material drawings are found short /defective at the time of commissioning of breaker, the same shall be considered to have been supplied short/defective at the time of receipt of material. As such the supplier must mention/shown all the

main items of the breaker on the bill of material drawing, which are liable to be dispatched and must be checked by the consignee at the time of receipt of equipment at site.

SECTION-3

Refer document

General Technical Requirements: TB-371-316-000 Rev 00.

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-371-316-000	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN	Satyaki Chadha 24/03/23	27.03.23	27-03-2023
TITLE	GENERAL TECHNICAL REQUIREMENTS-SECTION 3			NAME	SC	NK	SKS
				DATE	27.03.23	27.03.23	27.03.23
				GROUP	TBEM	W.O.	Awaited

CUSTOMER	**PUNJAB STATE POWER CORPORATION LTD.**
PROJECT	**3x33MW Shahpurkandi HEP PH-I and 3x33MW + 1x8MW Shahpurkandi HEP PH-II**
OWNER'S CONSULTANT	**WAPCOS**
Station	**220kV Switchyard at Shahpurkandi HEP PH-I and 220/66kV Switchyard at Shahpurkandi HEP PH-II**

RevNo.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	To	TBEM	TBMM	TBQM	Supplier
	Copies	1	1	1	4

GENERAL TECHNICAL REQUIREMENTS-SECTION 3

Site Information

S.No.	Particular	Details
a)	Owner	*Punjab State Power Corporation Ltd (PSPCL)*
b)	Customer	*Punjab State Power Corporation Ltd (PSPCL)*
c)	Project Title	*3X33MW Shahpurkandi HEP-I & 3X33MW+1X8MW Shahpurkandi HEP-II*
d)	Location	*Near Shahpurkandi in District Pathankot (Pb.).*
e)	Transport Facilities	*Nearest Rail Head: Pathankot (Approx. distance from site: 15Kms)* *Nearest Highway: Delhi-Pathankot-Jammu* *Nearest Airport : Amritsar*
SITE CONDITIONS		
a)	Max. ambient air temp.	*50 ℃*
b)	Min. ambient air temp.	*0 ℃*
c)	Max. design ambient temp.	*50 ℃*
d)	Design reference temp.	*50 ℃*
e)	Average Humidity	*Max. 85%*
f)	Special corrosion condition	*No*
g)	Atmospheric UV radiation	*Very High*
h)	Altitude above sea level	*Less than 1000 meter above mean sea level (MSL)*
i)	Pollution Severity	*High Pollution level*
j)	Seismic Zone	*Zone-IV as per IS 1893* *Seismic acceleration 0.3g*
WIND DATA		
	Wind Zone	*39m/sec*
Main Electrical Parameters:		
	Fault Levels:	*220kV: 40kA for 1 sec.* *66kV : 31.5kA for 1 sec.*
	Creepage Distance	*25mm/kV for All Equipment and string insulators i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT etc.*

SYSTEM PARAMETERS:

Sl.No.	Parameters	220 kV	66 kV
1	Highest system voltage	245 kV	72.5 kV
2	Lightning Impulse voltage		
	Phase to earth and between phases	1050kVp	325kVp
3	Switching impulse voltage	--	--
4	Power frequency withstand for 1 min (rms)		
	Phase to earth and between phases	460 kV(rms)	140 kV(rms)
5	Max. fault level (1 sec.)	40kA	31.5kA
6	Minimum creepage distance	6125mm	1813mm
7	Radio Interference Voltage	Not more than 1000μV at 156kVrms	--

CLEARANCES:

Sl.No.	Nominal Voltage	Phase to Phase (mm)	Phase to Earth (mm)	Section Clearance (mm)	Ground Clearance (mm)
1	220kV	2100	2100	5000	2550
2	66kV	750	630	3100	2550

The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level
220kV	5900mm	11700mm	16200mm/21200mm
66kV	4600mm	8000mm	16200mm/21200mm

1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipment's and services covered under other sections of tender documents and are not exclusive.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

The following words and expressions shall have the meanings hereby assigned to them throughout this document.

"Employer/Owner" means Punjab State Power Corporation Ltd (PSPCL).

"Purchaser" means Bharat Heavy Electricals Limited.

"Supplier/Manufacturer/Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

PSPCL is setting up a Hydro Electric Project, named Shahpurkandi HEP of capacity 206 MW 3x33 MW + (3x33+8) MW. The installed capacity of Power House I is 3x33 MW and Power House II is 3x33+8 MW. The equipments are required for the 220kV and 66kV switchyard for the same.

2.0 GENERAL REQUIREMENT

2.1 The Supplier/Manufacturer shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 It is recognised that the Bidder may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.

2.3 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories 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 unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification, which are necessary for commissioning and satisfactory operation of the switchyard/ 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 inter-changeable with one another.

3.0 STANDARDS

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.2 The equipment offered by the Bidder shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standard, provisions of IS shall prevail. The Bidder shall also note that the list of standards presented in Annexure-A & B is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable International standard (IEC/Equivalent), as per the specification, shall be accepted.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

3.4 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.

3.5 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-A & B / individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-A & B / individual sections for various equipments shall be subject to Employer's approval.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

4.1 All equipments shall perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

4.2 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.

4.3 The Bidder shall design terminal connectors of the equipment taking into account various forces as above at Sl.No.4.2 that are required to withstand.

4.4 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

5.0 ENGINEERING DATA AND DRAWINGS

All drawings submitted by the Bidder shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

Drawings submitted by the Bidder shall be as per title block of the project provided in this specification.

The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

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

Four sets of hard copies of the, drawings shall be submitted to the Employer for comments / approval. The comments shall be marked on one set of hard copy and returned to Bidder for necessary correction in original drawings. Corrected drawings replacing previously submitted drawings should be marked accordingly. The final approved drawings shall be submitted on CD with eight sets of hard copies in product wise folders.

Foundation Drawings

If a piece of Works requires its own foundation or needs a special area for installation, the Bidder shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, and details of conduits, slopes and the arrangement of any supporting structure, i.e. base frames or other steel constructions for permanent fixing or erection purposes. All arrangement and layout drawings shall be drawn to scale.

5.1 Approval Procedure

The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ by Employer on initial submission	15 days
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission
iv)	Furnishing of distribution copies (4 hard copies to each power house and one scanned copy (pdf format)	Within 3 (three) weeks of receipt of resubmission
v)	Furnishing of distribution copies of test reports	
	a) Type test reports (one scanned softcopy in pdf format & 4 hard copies to each power house)	2 weeks from the date of final approval
	b) Routine Test Reports (one copy for each power house)	-do-
vi)	Furnishing of instruction/ operation manuals (4 copies per power house and one softcopy (pdf format) per power house)	On completion of Engineering
vii)	As built (4 copies per power house and one softcopy (pdf format) per power house)	On completion of entire works

NOTE :

(1) The bidder may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(3) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Bidder to the Employer.

(4) The Bidder shall furnish to the Employer catalogues of spare parts.

6.0 MATERIAL/ WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential 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.

6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.

6.1.3 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 fulfil 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 Employer.

6.1.4 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.

6.1.5 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.

6.1.6 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. If such is the case, he shall declare source of oil/grease /other consumables in the GTP/Drawings, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Bidder. The same shall be applicable to other consumables too.

6.2 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.

6.2.1 Space Heaters

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On off switch and fuse shall be provided.

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

6.2.2 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust.

6.2.4 Degree of Protection

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

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

The degree of protection shall be in accordance with IS/IEC60947; IS/IEC/60529 . Type test report for of relevant Degree of Protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 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, Customer 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 Employer. The rating plate of each equipment shall be according to IS/ IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual as per approval of Employer.

6.4 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 operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

For all items under this Contract, the Bidder shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers.

Lubricating oils, insulating oils and greases etc. required for first filling in the plant and equipment supplied by the Bidder under this Contract shall be supplied in quantity 20% (twenty percent) higher than the actual capacity for first filling.

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.2 The Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.

7.3 The Bidder will be called upon to attend design co-ordination meetings with the Engineer, other Bidder's and the Consultants of the Employer (if any) during the period of Contract. The Bidder shall attend such meetings at his own cost at PSPCL office, Patiala (Punjab) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Bidder shall ensure suitable quality assurance programme to control such activities at all points necessary.

A quality assurance programme of the Bidder shall be in line with ISO requirements & shall generally cover the following:

a) The organisation structure for the management and implementation of the proposed quality assurance programme.

b) System for Document and Data Control.

c) Qualification and Experience data of Bidder's key personnel.

d) The procedure for purchases of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

e) System for shop manufacturing and site erection controls including process controls, fabrication and assembly control.

f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.

g) Inspection and test procedure both for manufacture and field activities.

h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.

i) System for indication and appraisal of inspection status.

j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.

k) System for authorising release of manufactured product to the Employer.

l) System for maintenance of records.

m) System for handling, storage and delivery.

n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer approved Field Quality Plan to be followed.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Bidder/his vendor's quality management and control activities.

8.2 **Quality Assurance Documents**

The Bidder shall ensure availability of the following Quality Assurance Documents:

i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.

ii) Welder and welding operator qualification certificates.

iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.

iv) Raw Material test reports on components as specified by the specification and in the quality plan.

v) The Manufacturing Quality Plan(MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.

vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.

vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

The Bidder shall get the quality plans finalized and approved after the award of the Contract. Four copies of 'Quality Assurance Plan giving details of inspection, tests and customer witness / hold points shall be submitted. The quality plan shall contain the details of inspection and tests to be carried out' for each major component of each functional assembly. The approved quality plan shall form the basis for inspection and acceptance of the equipment. The Customer shall have the right to ask for more relevant tests if the same could not be included in the quality assurance plan at the time of their approval due to non-availability of final design drawings.

8.3 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of Employer. Wherever equipment similar to the one being offered has already been type tested as specified in the specification. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

The Employer reserves the right to increase or decrease their involvement in inspections at Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work based on performance of Bidder/sub-bidder.

9.0 Deleted

10.0 Deleted.

11.0 PACKAGING & PROTECTION

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Bidder shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into

account. 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. Employer/BHEL takes no responsibility of the availability of the wagons.

11.2 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.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness 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 Zinc coating on structures shall be 610 gm/sq.m and 375 gm/sq.m for hardware.**

12.2.2 The galvanized surfaces shall consist of 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.

12.2.3 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 or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 Hot Phosphating shall be done for phosphating process under pre-treatment of sheets After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be **Grey or RAL 7032** for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. as per customer approval during contract stage. Glossy white colour inside the equipments /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted during detailed engineering for Employer's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline/NIFPS	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line –Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures, the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting. For stainless steel surfaces, no painting is envisaged.

12.3.8 Band colour is required for Emulsifier system detection line only if both water and air detection lines are present at the same substation. Further, band colour shall be applied at an interval of 2 meters approx. along the length and minimum width of band shall be 25mm.

13.0 Deleted.

14.0 SPECIAL TOOLS AND TACKLES

The bidder shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

All spare parts shall be protected against corrosion and shall be marked with identification labels. The identification scheme for spares shall be sent for customer/BHEL approval before dispatch of any spare.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

The Bidder shall provide 5%, but at least two pieces of all types of bolts, screws, nuts, washers, spanner rings and cotters.

15.0 AUXILIARY SUPPLY

15.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following table:

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	Isolated 2 wire System	-
110V	95V to 120V	DC	Isolated 2 wire System	-
48V	--	DC	2 wire system (+) earthed	-

Combined variation of voltage and frequency shall be limited to ± 10%.

15.2 Pickup value of binary input modules of Intelligent Electronic Devices, Digital protection couplers, Analog protection couplers shall not be less than 50% of the specified rated station auxiliary DC supply voltage level.

16.0 SUPPORT STRUCTURE (ONLY OF CIRCUIT BREAKER)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 5.9 meter from plinth level for 220kV substation. All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 The minimum vertical distance from the bottom of the lowest porcelain/polymer part of the bushing, porcelain/polymer enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS (For Lightning Arrester & Wave Trap only)

17.1 All power clamps and connectors shall conform to IS:5561 or other equivalent international standard and shall be made of materials listed below:

Sl. No.	Description	Materials
a)	For connecting ACSR conductors/AAC conductors/ Aluminium tube	Aluminum alloy casting, conforming to designation **4600** of IS:617 and all test shall conform to IS:617
b)	For connecting equipment terminals mad of copper with ACSR conductors/AAC conductors/ Aluminium tube	Bimetallic connectors made from aluminum alloy casting, conforming to designation **4600** of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617
c)	For connecting G.I	Galvanised mild steel shield wire
d)	Bolts, nuts & plain washers	Electro-galvanised for sizes below M12, for others hot dip galvanised.
e)	Spring washers	Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic 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 parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner/strip of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic liner/strips shall be provided for Bi-metallic clamps.

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

17.7 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 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.

17.8 Current carrying parts (500A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV and above.

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

17.10 Power Clamps and connectors shall be designed to control corona as per requirement.

17.11 Tests

Clamps and connectors should be type tested on minimum three samples as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval. Type test once conducted shall hold good. The requirement of test conducted within last ten years, shall not be applicable.

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Corona (dry) and RIV (dry) test [for 132kV and above voltage level clamps]

iv) Resistance test and Pullout strength test

v) Cantilever Strength test on bus support clamps & connectors

vi)

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS/IEC 61439-0, as applicable, and the clauses given below:

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases. Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as approved or directed by the Customer.
The cubicles and panels shall be adequately ventilated, if required, by vents or louvers. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm2.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Customer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise. Switched interior light and socket outlets shall be provided for all cubicles and control panels. All cubicles and control panels shall be provided with nameplates, identifying the purpose of the panel and all of its components.

A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

Cabinet/boxes with width more than 700 mm 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.

All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene/PU gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingression of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.

All boxes/cabinets shall be designed for the entry of cables 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 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. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

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.

LED based illumination of minimum 9 watts 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.

All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

Earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire 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.

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.

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

i) Check for wiring.

ii) Visual and dimension check.

The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS/IEC60947 including application of 1kV rms for 1 (one) minute, after IP-55 test.

19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

20.1 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.

20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. 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 the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.

20.3 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.

20.4 The terminal 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.

20.5 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.

20.6 The terminal blocks shall be of extensible design, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.

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

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, nondeteriorating 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.

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

a)	All circuits except CT/PT circuits.	Minimum of two of 2.5 sq mm copper flexible.
b)	All CT/PT circuits	Minimum of 4 nos. of 2.5 sq mm copper flexible.

20.10 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.

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

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 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

21.0 LAMPS & SOCKETS

21.1 Lamps & Sockets

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

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.

21.2 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.

21.3 Switches and Fuses:

21.3.1 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 / switch fuse units. Selection of the main and Sub-circuit 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.

21.3.2 All fuses shall be of HRC cartridge type conforming to relevant IS 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 of the fuse rating and voltage.

22.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

22.1 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 hollow insulators, conforming to IEC-61462.

22.2 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.

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

22.4 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.

22.5 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.

22.6 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.

22.7 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.

23.0 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.

23.1 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.

23.2 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 having the particulars as given in Clause 15.0 of this Section.

23.3 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 along with 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 under Clause 15.0 shall be capable of withstanding atleast 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.

23.4 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.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Bidder shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the Employer without any extra cost to the Employer. The Bidder shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Employer for approval.

(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.

ANNEXURE-A

LIST OF APPLICABLE STANDARDS

S.No.	DESCRIPTION		INDIAN
1.	Electrical and instrumentation		
2.	Rotating electrical machines	IEC 34	IS:47221968
3.	Direct action indicating electrical measuring instruments	IEC 51	
4.	Paper-insulated metal-sheathed cables for rated voltages up to 18/30 kV	IEC 55	
5.	High voltage alternating current circuit breakers IEC 56	IS:25161980	
6.	Basic environmental testing procedures	IEC 68	
7.	Insulation co-ordination	IEC 71	
8.	Dimensions and output ratings for rotating electrical machines '	IEC 72	
9.	Colours for indicator lights and push buttons	IEC 73	
10.	Power Transformers	IEC 76	IS:2026
11.	Classification of materials for the insulation of electrical machinery	IEC 85	
12.	Primary Batteries	IEC 86 -	
13.	Lead Acid Starter Batteries	IEC 95	
14.	lightening Arrestors recommended graphic symbols	IEC 99	
15.	Alternating current disconnecters (isolator) and earthing switches	IEC 129	
16.	Bushings for alternating voltages above 1000 V.	IEC 137	
17.	Degrees of protection for low voltage switch gear and control gear	IEC 144	
18.	Low voltage switchgear and control gear	IEC 157	
19.	Low voltage control gear tests on indoor and outdoor post insulators for voltages greater than 1000 V.	IEC 168	
20.	Current transformers	IEC 185	IS:2705
21.	Voltage transformers	IEC 186	IS:3156
22.	Low frequency cables and wires with P.V.C. insulation and PVC sheath	IEC 189	
23.	On-load tap changers	IEC 214	
24.	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V.	IEC 227	
25.	Conductors for insulated cables	IEC 228	
26.	Impulse tests on cables and their accessories	IEC 230	
27.	Electrical relays	IEC 255	IS:32311965

28.	Low voltage fuses calculation of the continuous current rating of cables (100% load factor)	IEC 287
29.	Low voltage motor starter	IEC 292
30.	Specification for new insulating oil for transformers and switchgear	IEC 296
31.	AC metal-enclosed switchgear and control gear for rated voltages above 1 kV up to and including 72.5 kV	IEC 298
32.	Standard colours for insulation for low frequency cables and wires	IEC 304
33.	Guide to the calculation of resistance of plain and coated copper conductors of low-frequency cables and wires.	IEC 344
34.	Loading Guide for oil immersed transformers	IEC 354
35.	Marking of insulated conductors	IEC 391
36.	Report on synthetic testing of high voltage alternating current breakers.	IEC 427
37.	Factory-build assemblies of low voltage Switchgear and control. gear	IEC 439
38.	Identification of insulated and bare conductors by Colours	IEC 446
39.	Standard directions of movement for actuators which control the operation of electrical apparatus	IEC 447
40.	Methods off measurement of radio equipment used in their mobile services	IEC 489
41.	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto 30 kV	IEC 502
42.	Class 0.5, 1 and 2 alternating current Watt-hour Meter	IEC 521
43	Test methods for insulations and sheaths of electric cables and cords	IEC 540

INDIAN STANDARDS

Sr.No.	IS:CODE	DESCRIPTION
1.	IS:4722-1968	Rotating electrical machines.
2.	IS:325-1978	Three phase induction motors
3.	IS:8789-19'18	Values of performance for three-phase induction motors
4.	IS:3156	Voltage transformers
5.	IS:L3156(Pt.I)-1978	General requirements
6.	IS:3156(Pt.II)-1978	Measuring voltage transformers

7.	IS:3156(Pt.III)-1978	Protective voltage transformers
8.	IS:3156(Pt.IV)-1978	Capacitor voltage transformers
9.	IS:2705	Current transformers
10.	IS:2705(Pt.I)-1981	General requirements
11.	IS:2705(Pt.II)-1981	Measuring current transformers
12.	I5:2705(Pt.III)-1981	Protective current transformer
13	IS:2704(Pt.N)-1981	Protective current transformers for special purpose applications
14.	IS:2026	Power transformers
15.	IS:2026(Pt.I)-1977	General
16.	IS:2026(Pt.II)-1977	Temperature-rise of Power transformers.
17.	IS:2026(Pt.Itl)-1981	insulation level-, and dielectric tests
18.	IS:2026(Pt.IV)-1977	Terminal markings, tappings and connection
19.	I5:335-1983	New insulating oils
20.	IS:3231-1965	Electrical relays for power system protections
21.	IS:3043-1966	Code of practice for earthing
22.	IS:1651-1979	Stationary cells and batteries lead-acid type with tubular positive plates)
23.	IS:2516-1980	Circuit-breakers
24	IS:2147-1980	Degree of protection provided by enclosures for low voltage switchgear and control gear
25.	IS:L1554(Pt.II)1976	For working voltages upto and including 1100 V
26.	IS:5613(Pt.USec.I) 1978	Lines upto and including 11 kV, section 1 Design.

ANNEXURE-B

LIST OF GENERAL STANDARDS AND CODES

CODES	TITLE
--	India Electricity Rules
--	Indian Electricity Act
--	Indian Electricity (Supply) Act
--	Indian Factories Act
IS-5	Colors for Ready Mixed Paints and Enamels
IS-335	New Insulating Oils
IS-617	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	Methods of Test for Petroleum and its Products
IS-2071 (P1 to P3)	Methods of High Voltage Testing
IS-12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS-2165 ; P1:1997, P2:1983	Insulation Coordination
IS-3043	Code of Practice for Earthing
IS-6103	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids
IS-6792	Method for determination of electric strength of insulating oils
IS-5578	Guide for marking of insulated conductors
IS-11353	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	Methods for Radio Interference Test on High voltage Insulators
IS-9224 (Part 1,2&4)	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	High Voltage Test Techniques
IEC 60068	Environmental Test

ANNEXURE-B

IEC-60117	Graphical Symbols
IEC-60156	Method for the Determination of the Electrical Strength of Insulation Oils
IEC-60270	Partial Discharge Measurements
IEC-60376	Specification and Acceptance of New Sulphur Hexafloride
IEC-60437	Radio Interference Test on High Voltage Insulators
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems
IEC-62271-1	Common Specification for High Voltage Switchgear & Control gear Standards
IEC-60815	Guide for the Selection of Insulators in respect of Polluted Conditions

CODES	TITLE
IEC-60865 (P1 & P2)	Short Circuit Current - Calculation of effects
ANSI-C.1/NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21, C63.3	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	Techniquest for Dielectric Tests
ANSI-C76.1/EEE21	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings
ANSI-SI-4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	Drawing Symbols
ANSI-Z55.11	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	General Standards for Industrial Control and Systems Part ICSI109
CISPR-1	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	Quality Assurance Program Requirements

ANNEXURE-B

CSA-Z299.2-1979h	Quality Control Program Requirements
CSA-Z299.3-1979h	Quality Verification Program Requirements
CSA-Z299.4-1979h	Inspection Program Requirements
TRANSFORMERS AND REACTORS	
IS:10028 (Part 2 & 3)	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	Power Transformers
IS-3347 (part 1 to Part 8)	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres
IS-3639	Fittings and Accessories for Power Transformers
IS-6600	Guide for Loading of oil immersed Transformers
IEC-60076 (Part 1 to 5)	Power Transformers
IEC-60214	On-Load Tap-Changers
IEC-60289	Reactors
IEC- 60354	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise

CODES	TITLE
ANSI-CG,1EEE-4	Standard Techniques for High Voltage Testing
IEC 60076	Power transformers
IEC 60076-1	Part 1: General
IEC 60076-2	Part 2: Temperature rise

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IEC 60076-3	Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-4	Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
IEC 60076-3-1	Part 3-1: Insulation Levels and Dielectric Tests –External Clearances in Air
IEC 60076-5	Part 5: Ability to withstand short circuit
IEC 60076-6	Part 6: Reactors
IEC 60076-7	Part 7: Loading guide for oil-immersed power transformers
IEC 60076-8	Part 8: Application guide
IEC 60076-10	Part 10: Determination of sound levels
IEC 60076-10-1	Part 10-1: Determination of sound levels - Application guide
IEC 60076-11	Part 11: Dry-type transformers
IEC 60076-12	Part 12: Loading guide for dry-type power transformers
IEC 60076-13	Part 13: Self-protected liquid-filled transformers
IEC 60076-14	Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials
IEC 60076-15	Part 15: Gas-filled power transformers
IEC 60076-16	Part 16: Transformers for wind turbine applications
IEC 60076-18	Part 18: Measurement of frequency response
IEC 60076-19	Part 19: Rules for the determination of uncertainties in the measurement of losses in power transformers and reactors
IEC 60076-21	Part 21: Standard requirements, terminology, and test code for step-voltage regulators
IEC 60044, BS 3938	Current transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60050(421)	International Electrotechnical vocabulary- Chapter 421 : Power Transformers and Reactors
IEC 60060	High Voltage test techniques
IEC 60060-1	General definitions and test requirements
IEC 60060-2	Measuring systems

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IEC 60071	Insulation co-ordination
IEC 60071-1	Part 1: Definitions, principles and rules
IEC 60071-2	Part 2 : Application guide
IEC 60137	Bushing for alternating voltage above 1000V
IEC 60214	On-Load Tap changers
IEC 255-21-3	Relays vibration

CODES	TITLE
IEC 60270	Partial discharge measurements
IEC 60296	Specification for Unused Mineral Oil for Transformers and Switchgear
IEC 60422	Supervision and Maintenance guide for Mineral Insulating Oil in Electrical Equipment
IEC 60475	Method of Sampling Liquid dielectrics
IEC 60529	Classification of Degrees of Protection provided by Enclosures
IEC 60542	Application Guide for On-Load Tap-Changers
IEC 60567	Guide for the Sampling of Gases and of Oil from Oil-filled Electrical Equipment for the Analysis of Free and Dissolved Gases
IEC 60651	Sound Level Meters
IEC 61083	Digital Recorders and Software for High Voltage Impulse testing
IEC 61083-1	Part 1: Requirements for digital recorders in high voltage impulse tests
IEC 61083-2	Part 2: Evaluation of software used for the determination of the parameters of impulse waveforms
CISPR 16	Specification for radio disturbance and immunity measuring apparatus
CISPR 16-1	Radio disturbance and immunity measuring apparatus
CISPR-18	Radio Interference Characteristics of Power Lines and High Voltage Equipment
ISO 9001	Quality system-Model for Quality Assurance in Design /development

ANNEXURE-B

Cigre Publication 202	Guidelines for conducting design reviews for transformers 100 MVA and 123 kV and above. August 2002-Cigre Working Group 12.22
WG 12-15	Guide for Customers Specifications for Transformers 100 MVA and 123 kV and above
WG 12 19	Short Circuit Performance of Transformers.
BS-4360	Specification for weldable structural steel
BS-5135	Specification for arc welding of carbon and carbon manganese steels
BS-5500	Specification for unfired fusion welded pressure vessels
IS-3618	Specification for phosphate treatment of iron & steel for protection against corrosion
IS-6005	Code of practice for phosphating of Iron and Steel
ISO-8501	Preparation of steel surface before application of Paints and related product
IEC-60599	Mineral oil impregnated electrical equipment in service – guide to the interpretation of dissolved and free gases analysis
IS-10593	Method of evaluating the analysis of gases in oil filled electrical equipment in service
IS-2099	Bushings for alternating voltages above 1000 volts

CODES	TITLE
IS-3347 Part I to 8	Dimension for porcelain transformer bushing
DIN-42530	Bushing up to 1000kV from 250A-5000A for liquid filled Transformer
IS-2026 Part 1 to 5	Power transformer
IS-4691	Degrees of protection provided by enclosure for rotating electrical machinery
IEC-60034-5	Degrees of protection provided by integral design of rotating electrical machines(IP Code) classification
IS:325 / IEC -60034	Performance of cooling fan / oil pump motor
IS-13947 part 1 to 5	Specification for low voltage switchgear and control gear

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IS:3400	Methods of test for vulcanised rubber
IS:7016 part 1 to 14	Methods of test for coated and treated fabrics
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
IS:3637	Gas operated Relays
IS:335	New Insulating oils – Specification
IEC-62271-203	Gas insulated metal enclosed switchgear for rated voltage above 52kV
IEC-61639	Direct connection between power transformers and gasinsulated metal enclosed switchgear for rated voltages of 52.5 kV and above.
IS:3400 / BS 903 / IS:7016	Air cell (Flexible Air Separator)
IEC 60529 / IP : 55	Degree of protection for cooler control cabinet , MOLG, Cooling fan , oil pump, Buchholz Relay
IEC 60529 / IP : 56	Degree of protection for Pressure Relief Device
IEC 60529 / IP : 43	Degree of protection for Remote tap Changer cubicle (RTCC)
CIRCUIT BREAKERS	
IEC-62271-100	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC-62271-101	High-voltage switchgear and control gear - Part 101: Synthetic testing
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V
IEC-62271-110	High-voltage switchgear and control gear - Part 110: Inductive load switching
IEC-62271-109	High-voltage switchgear and control gear - Part 110: Inductive load switching
CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS	
IS-2705- (P1 to P4)	Current Transformers

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CODES	TITLE
IS:3156- (P1 to P4)	Voltage Transformers
IS-4379	Identification of the Contents of Industrial Gas Cylinders
IEC-61869 (Part-1)	Instrument transformers - Part 1: General requirements
IEC-61869 (Part-2)	Instrument transformers - Part 2: Additional requirements for current transformers
IEC-61869 (Part-3)	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
IEC-61869 (Part-4)	Instrument transformers - Part 4: Additional requirements for combined transformers
IEC-61869 (Part-5)	Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers
IEC-61869 (Part-6)	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers
IEC-61869 (Part-9)	Instrument transformers - Part 9: Digital interface for instrument transformers
IEC-61869 (Part-102)	Instrument transformers - Part 102: Ferroresonance oscillations in substations with inductive voltage transformers
IEC-61869 (Part-103)	Instrument transformers - The use of instrument transformers for power quality measurement
BUSHING	
IS-2099	Bushings for Alternating Voltages above 1000V
IEC-60137	Insulated Bushings for Alternating Voltages above 1000V
SURGE ARRESTERS	
IS-3070 (PART2)	Lightning arresters for alternating current systems : Metal oxide lightning arrestors without gaps
IEC-60099-4	Metal oxide surge arrestors without gaps
IEC-60099-5	Selection and application recommendation
ANSI-C62.1	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	Surge Arresters

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CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS	
IS-722, IS-1248	Electrical relays for power system
IS-3231, 3231 (P-3)	Protection
IS:5039	Distributed pillars for Voltages not Exceeding 1000 Volts
IEC-60068.2.2	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	Degree of Protection provided by enclosures
IEC-60947-4-1	Low voltage switchgear and control gear
IEC-61095	Electromechanical Contactors for household and similar purposes
IEC-60439 (P1 & 2)	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	Switchgear Assemblies, including metal enclosed bus
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power

CODES	TITLE
	Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS: 8623: (Part I to 3)	Specification for Switchgear & Control Assemblies
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB-1	Panel Boards
NEMA-SG-5	Low voltage Power Circuit breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SG-6	Power switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (P1 to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories
Disconnecting switches	
IEC-62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches

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IEC-60265 (Part 1 & 2)	High Voltage switches
ANSI-C37.32	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	Test Code for high voltage air switches
NEMA-SG6	Power switching equipment
PLCC and line traps	
IS-8792	Line traps for AC power system
IS-8793	Methods of tests for line traps
IS-8997	Coupling devices for PLC systems
IS-8998	Methods of test for coupling devices for PLC systems
IEC-60353	Line traps for A.C. power systems
IEC-60481	Coupling Devices for power line carrier systems
IEC-60495	Single sideboard power line carrier terminals
IEC-60683	Planning of (single Side-Band) power line carrier systems
CIGRE	Teleprotection report by Committee 34 & 35
CIGRE	Guide on power line carrier 1979
CCIR	International Radio Consultative Committee
CCITT	International Telegraph & Telephone Consultative Committee
EIA	Electric Industries Association
Protection and control equipment	
IEC-60051: (P1 to P9)	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories
IEC-60255 (Part 1 to 23)	Electrical relays
IEC-60297 (P1 to P4)	Dimensions of mechanical structures of the 482.6mm (19 inches)

CODES	TITLE
	series
IEC-60359	Expression of the performance of electrical & electronic measuring equipment

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IEC-60387	Symbols for Alternating-Current Electricity meters
IEC-60447	Man machine interface (MMI) - Actuating principles
IEC-60521	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	Screw threads
ANSI-B18	Bolts and Nuts
ANSI-C37.1	Relays, Station Controls etc
ANSI-C37.2	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	Requirements for electrical analog indicating instruments
MOTORS	
IS-325	Three phase induction motors
IS-4691	Degree of protection provided by enclosure for rotating electrical machinery
IEC-60034 (P1 to P19:)	Rotating electrical machines
IEC-Document 2	Three phase induction motors
(Central Office) NEMA-MGI	Motors and Generators
Electronic equipment and components	
MIL-21B, MIL-833 & MIL-2750	Environmental testing
EC-60068 (P1 to P5)	Printed boards
IEC-60326 (P1 to P2)	Material and workmanship standards
IS-1363 (P1 to P3)	Hexagon head bolts, screws and nuts of product grade C
IS-1364 (P1 to P5)	Hexagon head bolts, screws and nuts of products grades A and B
IS-3138	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	Fasteners: Bolts, screws and studs

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ASTM	Specification and tests for materials
Clamps & connectors	
IS-5561	Electric power connectors
NEMA-CC1	Electric Power connectors for sub station
NEMA-CC 3	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors
Bus hardware and insulators	
IS: 2121	Fittings for Aluminum and steel cored Al conductors for overhead

CODES	TITLE
	power lines
IS-731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IS-2486 (P1 to P4)	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V
IEC-60120	Dimensions of Ball and Socket Couplings of string insulator units
IEC-60137	Insulated bushings for alternating voltages above 1000 V
IEC-60168	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V
IEC-61462	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	Insulators for overhead lines with nominal voltage above 1000Vceramic or glass insulator units for ac systems Characteristics of String Insulator Units of the cap and pin type
IEC-60372 (1984)	Locking devices for ball and socket couplings of string insulator units : dimensions and tests

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IEC-60383 (P1 and P2)	Insulators for overhead lines with a nominal voltage above 1000 V
IEC-60433	Characteristics of string insulator units of the long rod type
IEC-60471	Dimensions of Clevis and tongue couplings of string insulator units
ANSI-C29	Wet process porcelain insulators
ANSI-C29.1	Test methods for electrical power insulators
ANSI-C92.2	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	Iron and steel hardware
CISPR-7B	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	Zinc Coating (Hot-Dip) on iron and steel hardware
Strain and rigid bus-conductor	
IS-2678	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube
IS-5082	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes
ASTM-B 230-82	Aluminum 1350 H19 Wire for electrical purposes

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CODES	TITLE
ASTM-B 231-81	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)
Batteries	
IS:1651	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	Synthetic Separators for Lead-Acid Batteries
IS:266	Specification for Sulphuric Acid
IS:1069	Specification for Water for Storage Batteries
IS:3116	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	Indicating Instruments
IS:10918	Vented type nickel Cadmium Batteries
IEC:60896-21&22	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	Vented type nickel Cadmium Batteries
IEC:60622	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	Sizing of Ni-Cd Batteries

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IEEE-1187	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	Guide for selection of VRLA Batteries
Battery Charger	
IS:3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment
IS:6619	Safety Code for Semiconductor Rectifier Equipment
IS:2026	Power Transformers

CODES	TITLE
IS:2959	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	Indicating Instruments
IS:2208	HRC Fuses
IS:13947 (Part-3)	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:6005	Code of practice for phosphating of Iron and Steel
IS:3231	Electrical relays for power system protection
IS:3842	Electrical relay for AC Systems
IS:5	Colours for ready mix paint
IEEE-484	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations
IEEE-485	Sizing large lead storage batteries for generating stations and substations
Wires and cables	

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ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC insulated cables for working voltages upto and including 1100 Volts
IS-1255	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 kV upto and including 11kV
IS:1753	Aluminium conductor for insulated cables
IS:2982	Copper Conductor in insulated cables
IS-3961 (P1 to P5)	Recommended current ratings for cables
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables
IS-5831	PVC insulating and sheath of electric cables
IS-6380	Elastometric insulating and sheath of electric cables
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts
IS-7098	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV
IS-8130	Conductors for insulated electrical cables and flexible cords
IS-1753	Aluminum Conductors for insulated cables
IS-10418	Specification for drums for electric cables
IEC-60096 (part 0 to p4)	Radio Frequency cables
IEC-60183	Guide to the Selection of High Voltage Cables

CODES	TITLE
IEC-60189 (P1 to P7)	Low frequency cables and wires with PVC insulation and PVC sheath
IEC-60227 (P1 to P7)	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC-60228	Conductors of insulated cables
IEC-60230	Impulse tests on cables and their accessories

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IEC-60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor)
IEC-60304	Standard colours for insulation for low-frequency cables and wires
IEC-60331	Fire resisting characteristics of Electric cables
IEC-60332 (P1 to P3)	Tests on electric cables under fire conditions
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	Tests on gases evolved during combustion of electric cables
AIR conditioning and ventilation	
IS-659	Safety code for air conditioning
IS-660	Safety code for Mechanical Refrigeration
ARI:520	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	Shell and tube type heat exchanger
ASHRAE-24	Method of testing for rating of liquid coolers
ANSI-B-31.5	Refrigeration Piping
IS:2062	Steel for general structural purposes
IS:655	Specification for Metal Air Dust
IS:277	Specification for Galvanised Steel Sheets
IS-737	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	Hot rolled cast steel sheet & strip
IS-3588	Specification for Electrical Axial Flow Fans
IS-2312	Propeller Type AC Ventilation Fans
BS-848	Methods of Performance Test for Fans
BS-6540 Part-I	Air Filters used in Air Conditioning and General Ventilation
BS-3928	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	Method of cold DOP & hot DOP test
MIL-STD-282	DOP smoke penetration method

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ASHRAE-52	Air cleaning device used in general ventilation for removing particle matter
IS:3069	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials

CODES	TITLE
IS:4671	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	Bonded Mineral Wool
IS:3346	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	Centrifugal Fans
BS:848	Method of Performance Test for Centrifugal Fans
IS:325	Induction motors, three-phase
IS:4722	Rotating electrical machines
IS:1231	Three phase foot mounted Induction motors, dimensions of
IS:2233	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	Vertical shaft motors for pumps, dimensions of
IS:7816	Guide for testing insulation resistance of rotating machines
IS:4029	Guide for testing three phase induction motors
IS: 4729	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	Guide for testing single-phase ac motors
IS:2148	Flame proof enclosure for electrical apparatus
BS:4999(Part-51)	Noise levels
Galvanizing	
IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot-Dip galvanizing on iron and steel

ANNEXURE-B

IS-2633	Methods for testing uniformity of coating of zinc coated articles
ASTM-A-123	Specification for zinc (Hot Galavanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM-A-121-77	Zinc-coated (Galvanized) steel barbed wire
Painting	
IS-6005	Code of practice for phosphating of iron and steel
ANSI-Z551	Gray finishes for industrial apparatus and equipment
SSPEC	Steel structure painting council
Fire protection system	
--	Fire protection manual issued by tariff advisory committee (TAC) of India
HORIZONTAL CENTRIFUGAL PUMPS	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	Code for acceptance test for centrifugal & axial pumps

CODES	TITLE
IS:5120	Technical requirement – Rotodynamic special purpose pumps
API-610	Centrifugal pumps for general services Hydraulic Institutes Standards
BS:599	Methods of testing pumps
PTC-8.2	Power Test Codes - Centrifugal pumps
DIESEL ENGINES	
IS:10000	Methods of tests for internal combustion engines
IS:10002	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	The performance of reciprocating compression ignition (Diesel) engines, utilizing liquid fuel only, for general purposes
ISO:3046	Reciprocating internal combustion engines performance
IS:554	Dimensions for pipe threads where pressure tight joints are required on threads

ANNEXURE-B

ASME Power Test Code	Internal combustion engine PTC-17
--	Codes of Diesel Engine Manufacturer's Association, USA
PIPING VALVES & SPECIALITIES	
IS:636	Non percolating flexible fire-fighting delivery hose
IS:638	Sheet rubber jointing and rubber inserting jointing
IS:778	Gun metal gate, globe and check valves for general purpose
IS:780	Sluice valves for water works purposes (50 to 300 mm)
IS:901	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	Suction hose couplings for fire-fighting purposes
IS:903	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	SP for weldable structural steel
IS:2379	Colour Code for the identification of pipelines
IS:2643	Dimensions of pipe threads for fastening purposes
IS:2685	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	Basket strainers for fire-fighting purposes (cylindrical type)
IS:3589	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	Foot valves for water works purposes
IS:4927	Unlined flax canvas hose for fire fighting

CODES	TITLE
IS:5290	Landing valves (internal hydrant)
IS:5312 (Part-I)	Swing check type reflex (non-return) valves

ANNEXURE-B

IS:5306	Code of practice for fire extinguishing installations and equipment on premises
Part-I	Hydrant systems, hose reels and foam inlets
Part-II	Sprinkler systems
BS:5150	Specification for cast iron gate valves
MOTORS & ANNUNCIATION PANELS	
IS:325	Three phase induction motors
IS:900	Code of practice for installation and maintenance of induction motors
IS:996	Single phase small AC and universal electric motors
IS:1231	Dimensions of three phase foot mounted induction motors
IS:2148	Flame proof enclosure of electrical apparatus
IS:2223	Dimensions of flange mounted AC induction motors
IS:2253	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	Dimensions of vertical shaft motors for pumps
IS:3202	Code of practice for climate proofing of electrical equipment
IS:4029	Guide for testing three phase induction motors
IS:4691	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	Rotating electrical machines
IS:4729	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	Designation of methods of cooling for rotating electrical machines
IS:6381	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	Guide for testing insulation for rotating machine
IS:4064	Air break switches

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IEC DOCUMENT 2 (Control Office) 432	Three Phase Induction Motor
VDE 0530 Part I/66	Three Phase Induction Motor
IS:9224 (Part-II)	HRC Fuses
IS:6875	Push Button and Control Switches
IS:694	PVC Insulated cables
IS:1248	Indicating instruments
IS:375	Auxiliary wiring & busbar markings

CODES	**TITLE**
IS:2147	Degree of protection
IS:5	Colour Relay and timers
IS:2959	Contactors
PG Test Procedures	
NFPA-13	Standard for the installation of sprinkler system
NFPA-15	Standard for water spray fixed system for the fire protection
NFPA-12A	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	Standard on Automatic Fire Detectors
--	Fire Protection Manual by TAC (Latest Edition)
NFPA-12	Standard on Carbon dioxide extinguisher systems
IS:3034	Fire of industrial building
--	Electrical generating and distributing stations code of practice
IS:2878	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	DC (Dry Chemical Powder) type
IS:940	Pressurised Water Type
D.G. SET	
IS:10002	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	Method of tests for internal combustion engines
IS:4722	Rotating electrical machines-specification

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IS:12063	Degree of protection provided by enclosures
IS:12065	Permissible limit of noise levels for rotating electrical machines
--	Indian Explosive Act 1932
Steel structures	
IS-228 (1992)	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3)	Code of practice for use of structural steel in overhead transmission line towers
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel beam, column channel and angle sections
IS-814	Covered electrodes for manual arc welding of carbon of carbon manganese steel
IS-816	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding
IS-875 (P1 to P4)	Code of practice for design loads (other than earthquake) for buildings and structures
IS-1161	Steel tubes for structural purposes

CODES	TITLE
IS-1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS-1363 (P1 to P3)	Hexagonal head bolts, screws & nuts of products grade C
IS-1364	Hexagon head bolts, screws and nuts of product grades A and B
IS-1367 (P1 to P18)	Technical supply condition for threaded steel fasteners
IS-1599	Methods for bend test
IS-1608	Method for tensile testing of steel products
IS-1893	Criteria for earthquake resistant design of structures
IS-1978	Line Pipe

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IS-2062	Steel for general structural purposes
IS-2595	Code of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws
IS-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS-7205	Safety code for erection of structural steel work
IS-9595	Recommendations for metal arc welding of carbon and carbon manganese steels
ANSI-B18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	Specifications of structural steel
ASTM-A47	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	Specification for high strength low alloy structural steel
ASTM-A283	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	Specification for High strength low alloy structural manganese vanadium steel
ASTM-A572	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	Code for welding in building construction welding inspection
AWS D1-1	Structural welding code
AISC	American institute of steel construction
NEMA-CG1	Manufactured graphite electrodes

ANNEXURE-B

CODES	TITLE
Piping and pressure vessels	
IS-1239 (Part 1 and 2)	Mild steel tubes, tubulars and other wrought steel fittings
IS -3589	Seamless Electrically welded steel pipes for water, gas and sewage
IS-6392	Steel pipe flanges
ASME	Boiler and pressure vessel code
ASTM-A120	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	Seamless carbon steel pipe for high temperature service
ASTM-A284	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping components
ASTM-A307	Carbon steel externally threated standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2.1	Pipe threads (Except dry seal)
ANSI-B16.1	Cast iron pipe flangesand glanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	Factory-made wrought steel butt welding fittings
ANSI-B16.11	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	Ferrous pipe plug, bushings and locknuts with piple threads

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ANSI-B16.25	Butt welding ends
ANSI-B18.1.1	Fire hose couplings screw thread
ANSI-B18.2.1	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
NSI-B18.21.1	Lock washers
ANSI-B18.21.2	Plain washers
ANSI-B31.1	Power piping
ANSI-B36.10	Welded and seamless wrought steel pipe
ANSI-B36.9	Stainless steel pipe
Other civil works standards	

CODES	**TITLE**
IS-269	33 grade ordinary portland cement
IS2721	Galvanized steel chain link fence fabric
IS-278	Galvanized steel barbed wire for fencing
IS-383	Coarse and fine aggregates from natural sources for concrete
IS-432 (P1 and P2)	Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement
IS-456	Code of practice for plain and reinforced concrete
IS-516	Method of test for strength of concrete
IS-800	Code of practice for general construction in steel
IS-806	Steel tubes for structural purposes
IS-1172	Basic requirements for water supply, drainage and sanitation
IS-1199	Methods of sampling and analysis of concrete
IS-1566	Hard-dawn steel wire fabric for concrete reinforcement
IS-1742	Code of Practice for Building drainage
IS-1785	Plain hard-drawn steel wire for pre-stressed concrete
IS-1786	High strength deformed Steel Bars and wires for concrete reinforcement
IS-1811	Methods of sampling Foundry sands

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IS-1893	Criteria for earthquake resistant design of structures
IS-2062	Steel for general structural purposes
IS-2064	Selection, installation and maintenance of sanitary appliancescode of practices
IS-2065	Code of practice for water supply in buildings
IS-2090	High tension steel bars used in pre-stressed concrete
IS-2140	Standard Galvanized steel wire for fencing
IS-2470 (P1 & P2)	Code of practice for installation of septic tanks
IS-2514	Concrete vibrating tables
IS-2645	Integral cement waterproofing compounds
IS-3025 (Part 1 to Part 48)	Methods of sampling and test (Physical and chemical) for water and waste water
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles
IS-4111 (Part 1 to P5)	Code of practice for ancillary structures in sewerage system
IS-4990	Plywood for concrete shuttering work
IS-5600	Sewage and drainage pumps
National building code of India 1970	
USBR E12	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	test for moisture-density relation of soils using 10-lb (4.5 kg)

CODES	TITLE
	rame and 18-in. (457 mm) Drop
ASTM-D1586(1967)	Penetration Test and Split-Barrel Sampling of Soils
ASTM-D2049-69	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression
BS-5075	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures

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CPWD	Latest CPWD specifications
ACSR MOOSE CONDUCTOR	
IS:6745 BS:443-1969	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973 NEMA:107-1964 CISPR	Test on High Voltage Insulators
IS:209, BS:3436-1961	Zinc Ingot
IS:398 Part - V IEC:209-1966	Aluminum Conductors for Overhead Transmission Purposes
BS:215(Part-II), IEC:209-1966	Aluminium Conductors galvanized steel reinforced extra high voltage (400 kV and above)
IS:1778, BS:1559-1949	Reels and Drums for Bare Conductors
IS:1521, ISO/R89-1959	Method for Tensile Testing of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles
IS:4826/ ASTMA-472-729	Hot dip galvanised coatings on round steel wires
GALVANISED STEEL EARTHWIRE	
IS:1521, ISO/R:89-1959	Method for Tensile Testing of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles
IS:4826/ ASTM: A 475-72a BS:443-1969	Hot dip Galvanised Coatings on Round Steel Wires
IS:6745/ BS:443-1969	Method for Determination of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209/ BS:3463-1961	Zinc ingot

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IS:398 (Pt. I to P5:1992)/ BS:215 (Part-II	Aluminum Conductors for overhead transmission purposes

CODES	TITLE
Lighting Fixtures and Accessories	
IS:1913	General and safety requirements for electric lighting fittings
IS:3528	Water proof electric lighting fittings
IS:4012	Dust proof electric lighting fittings
IS:4013	Dust tight proof electric lighting fittings
IS:10322	Industrial lighting fittings with metal reflectors
IS:10322	Industrial lighting fittings with plastic reflectors
IS:2206	Well glass lighting fittings for use under ground in mines (nonflameproof type)
IS:10322	Specification for flood light
IS:10322	Specification for decorative lighting outfits
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps
IS:1258	Specification for Bayonet lamp fluorescent lamp
IS:3323	Bi-pin lamp holder tubular fluorescent lamps
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings
IS:2215	Starters for fluorescent lamps
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes
Conduits, Accessories and Junction Boxes	

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IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel
Lighting Panels	
IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold and similar installations
IS:5	Ready mix paints
IS:2551	Danger notice plates
IS:2705	Current transformers

CODES	TITLE
IS:9224	HRC Cartridge fuse links for voltage above 650V(Part-2)
IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes
IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC
IS:1248	Direct Acting electrical indicating instruments
Electrical Installation	
IS:1293	3 pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing
IS:3646	Code of practice of interior illumination part II & III

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IS:1944	Code of practice for lighting of public through fares
IS:5571	Guide for selection of electrical equipment for hazardous areas
IS:800	Code of practice for use of structural steel in general building construction
IS:2633	Methods of Testing uniformity of coating on zinc coated articles
IS:6005	Code of practice for phosphating iron and steel
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES
LT SWITCHGEAR	
IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
CODES	**TITLE**
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters

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IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

Note: If any standard is expired or does not exist anymore than other standard which has substituted it, shall be applicable.

ANNEXURE-C

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & 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 132kV and above.

2. 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. 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 carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

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, 400 kV, 220 KV 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. 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 3 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 three values at which visible corona (negative or positive polarity) disappears.

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

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 Employer's inspector if, in his opinion, it will not prejudice other test.

5. 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.

f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

SECTION-4

GUARANTEED TECHNICAL PARTICULARS

Bidder shall furnish the technical parameters for offered Circuit Breaker in the below mentioned format after award of contract (to be filled separately for each voltage class).

220 KV & 66 KV CIRCUIT BREAKER

Sr. No.	Description	Unit	Values (to be filled by bidder)
1.	Name of Manufacturer		
2.	Manufacturer's type/destination		
3.	Rated Voltage Maximum continuous service voltage	kV kV	
4.	Current ratings: At reference ambient temp. of 40°C ambient Under site conditions at 48°C ambient	Amps. Amps.	
5.	Rated frequency	Hz	
6.	Short time current rating for: 1 Second 3 Seconds	kA(rms) kA(rms)	
7.	Temperature rise in current carrying parts at rated current and the maximum temperature attained by any part over an ambient of 48°C.	°C	
8.	Breaking current: Rated short circuit current (A.C. component) % D.C. component Asymmetrical breaking current including DC component. Is it possible to increase the rupturing capacity at a later date?	kA at KV kA at KV Yes/No	
9.	Total break time: At 10% rated interrupting capacity At 30% rated interrupting capacity At 60% rated interrupting capacity At 100% rated interrupting capacity	 ms ms ms ms	

10.	Making capacity	kA peak at __kV			
11.	Rated Operating sequence				
12.	a) Total opening time b) Arcing time c) Pre-arcing time	ms ms ms			
13.	Make time (closing time)	ms			
14.	Is the circuit breaker suitable for rapid three phase auto reclosing? Minimum reclosing time at full rated interrupting capacity from the instant of trip coil energisation. Minimum dead time Minimum reclaim time	 ms ms ms			
15.	Limits of adjustment of dead time (if applicable) for 3-phase reclosing.	ms			
16.	Data on restriking voltage	100% rated capacity	60% rated capacity	30% rated capacity	10% rated capacity
	(i) Amplitude factor				
	(ii) Phase factor				
	(iii) Natural frequency	c/s			
	(iv) Rate of rise of restriking voltage	Volts/mi croseconds			
17.	First pole to clear factor				
18.	Rated transient recovery voltage for terminal faults				
19.	Maximum interrupting capacity under phase opposition conditions	MVA			
20.	Maximum line charging current breaking capacity	Amps.			
21.	Over-voltage recorded during test conditions at Sr. No. 20 above.				
	Line side	kV			
	Supply Side	kV			
22.	Max. line charging current breaking capacity and corresponding over voltage recorded in tests :				
	Line side	kV			
	Supply Side	kV			

23.	Maximum cable charging current breaking capacity and corresponding over voltage recorded in tests	Amps.	
	Line side	kV	
	Supply Side	kV	
24.	a) Maximum shunt capacitor bank switching capacity Single bank Two banks in parallel b) i) Is the circuit breaker restrike free? Means adopted, if any, to check voltage rise.	 MVA MVA	
25.	Maximum over voltage for capacitive breaking conditions as per Sr. No. 24(a)	kV	
26.	Rated characteristics and max. breaking capacity for kilometric fault.	kV	
27.	Maximum transformer charging breaking current and the assigned over voltage	Amps.	
28.	No. of breaks per pole Type of device used, if any, to obtain uniform voltage distribution across the breaks per pole :		
29.	% recovery voltage distribution across individual breaks of complete pole.		
30.	Difference in the instant of closing/opening of contacts between three poles: a) Opening b) Closing	 ms ms	
31.	Dry/wet one-minute power frequency withstand test voltage for complete circuit breaker: a) Between line terminal and grounded objects (breaker closed) b) Between line terminals with circuit breaker contacts open	 kV (rms) kV (rms)	
32.	Dry and wet 1 minute power frequency withstand test voltage for the bushing	Kv (rms)	

33.	1.2/50 micro-second wave impulse withstand test voltage for the bushing.	kV (peak)	
34.	Creepage distance (total and protected) per pole: Across terminals	mm	
35.	Minimum clearance in air: Live parts to grounded objects. Live parts to ground level (Section clearance) Ground clearance Phase to phase clearance recommended.	Mm mm mm mm	
36.	1.2/50 micro-second wave impulse withstand test voltage for circuit breaker. Between line terminal and ground (breaker closed) Across terminal with circuit, breaker contacts open	 kV peak kV peak	
37.	Radio interface voltage for circuit breaker (between pole to earth) for following frequencies: a) 0.5 MHZ b) 1.0 MHZ c) 1.5 MHZ d) 2.0 MHZ	 Micro volts Micro volts Micro volts Micro volts	
38.	i) Material of main contacts ii) Cross – sectional area of main contacts.		
39.	Material of auxiliary contacts		
40.	Designed current density for contacts: a) Rated (normal) b) Thermal (short time)	 Amp/sq. mm Amp/sq. mm	
41.	Whether main contacts adequately and durably silver plated or not?	Yes/No	
42.	Whether auxiliary contacts adequately and durably silver plated?	Yes/No	

43.	Thickness of silver plating, if provided: a) For main contacts b) For auxiliary contacts	 Micron Micron	
44.	Number of trip coils provided for circuit breaker/per pole	Nos.	
45.	Variation in control voltage at which coils can operate satisfactorily: a) Closing Coil: i) Maximum voltage ii) Minimum voltage b) Tripping Coil: i) Maximum voltage ii) Minimum voltage		
46.	Normal air/pressure for operation :	kg/sq.mm	
47.	Normal working pressure of SF6 gas	kg/sq.mm	
48.	Range of air pressure for satisfactory operation	from-to- kg/cm^2	
49.	Range of SF6 gas pressure for satisfactory operation	from-to- kg/cm^2	
50.	Quantity of air in litres (at NTP) required for: One opening operation One closing operation One closing – open operation One opening – closing – opening operation Scavenging and leakage in 24 hrs.	 Litres Litres Litres Litres Litres	
51.	Governing standards to which the circuit breakers shall be manufactured.		
52.	Whether the cable/wiring used is fire resistant or not?	Yes/No	
53.	The maximum current which the breaker can satisfactorily interrupt at twice the maximum phase to ground applied voltage under phase opposition conditions.		
54.	The minimum transformer charging current which can be interrupted by the breaker and corresponding over-voltage under such conditions.		

55.	Type of main contacts		
56.	Type of auxiliary contacts		
57.	Contact pressure		
58.	Total number of auxiliary switch contacts: Those closed when breaker is open Those open when breaker is open Those adjustable with respect to the position of main contacts.	Operating in common to all 3 pole	
59.	Number of spare auxiliary switch contacts provided: a) Those closed when breaker is open b) Those open when breaker is open.		
60.	Type of operating mechanism: a) Opening b) Closing		
61.	Tripping and closing control circuit voltage	Volts DC	
62.	Power required for trip coils of complete 3 phase breaker	Watts	
63.	Power required for closing coils of complete 3 phase breaker	Watts	
64.	Arrangement provided for preventing closing/tripping within sufficient air pressure.		
65.	Air receiver volume for one phase	Litres	
66.	Number of closing opening cycles possible without recharging the breaker air receivers.		
67.	Weight of three phase breaker complete with operating mechanism, bushing and frame work.	kg	
68.	Over all dimensions		
69.	Number of operations at rated current after which routine inspection of breaker is necessary.		
70.	Number of operations at full rupturing capacity after which routing inspection of breakers is necessary.		
71.	Qty. of SF6 gas required for each three pole circuit breakers.		

72.	Number of operations after which gas replacement is necessary: i) at full rupturing capacity ii) at 50% rated rupturing capacity iii) at 10% of rated rupturing capacity at rated current.		
73.	Maximum temperature and temperature rise attained by various parts of breaker when in service under continuous full load conditions and exposed continuously to direct sun rays.		

SCHEDULE OF TECHNICAL PARTICULARS FOR SF-6 GAS	
Physical properties i.e. colour small/and whether flammable or not?	
Density at 200C and 1 bar	
Dielectric – strength	
Compatibility with Nitrogen in electrical construction material	
Toxic impurities as per clause 22 of IEC 376 – 1971 OR required IS.	
Maximum allowable quantities of impurities like CF4(%) Oxygen + Nitrogen (air) (%) Water (PPM) Acidity expressed at HF(%) Hydrolysable fluorides expressed at HF (PPM) Oil contents%	
Size of cylinders (Litres)	
Test pressure of cylinders (bars)	
Maximum filing ratio for tropical country.	

SCHEDULE OF TECHNICAL PARTICULARS FOR SPRING CHARGING MECHANISM

	Number of Springs per operating mechanism Springs (a) Design/type Closing/opening Material of spring Whether operation by compression, tension or torque Type of charging Type of spring charging motors AC/DC Voltage Wattage of motors Protection Whether Spring mechanism used for closing/opening operation or both. Time required for charging the spring provision for spring charging in case of outage/failure of spring charging motor. Provision for local and remote indication of "spring charge" exists or not. Auto cut off provisions on fully charged conditions. Provisions for auto recharging after spring release.		

SECTION-5

ANNEXURE - A

Checklist

1	**Technical Qualifying Requirement**		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/No
1.2	The bidder's scope includes supply and services such as Supervision of installation, Testing and commissioning.	Confirmed	Yes/No
2	**Un-priced BOQ**		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof) Record the same in schedule of technical deviations.	Confirmed	Yes/No
3	**Technical**		
3.1	Minimum Number of auxiliary contacts on each Circuit Breaker - Besides requirement of technical specification, the manufacturer shall wire up 10 NO + 10 NC contacts of each phase/ pole exclusively for purchaser's use and shall be wired up to common marshalling box of 220kV and 66kV CB.	Confirmed	Yes/No
3.2	Catalogues, indicative OGA of the offered equipment is attached.	Enclosed with bid	Yes/No
3.3	**Confirm that the supplied 220kV & 66kV Circuit Breaker shall comply with relevant IEC/IS standards.**	Confirmed	Yes/No
4	**Technical Deviations**		
4.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
5	**GTP**		
5.1	All equipment being supplied shall conform to Guaranteed Technical Particulars as per technical specification and applicable IS / IEC	Confirmed	Yes/No
6	**TYPE TESTS REQUIREMENTS**		

6.1	All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.	Confirmed	Yes/No
6.2	In case the test reports are not found technically valid during contract stage by BHEL/Customer, the bidder shall repeat these test(s) at no extra cost to the purchaser and no delivery implication. **Technical valid** - Any error or incompleteness (any/all additional type tests not carried out) or discrepancy in the test reports vis-à-vis offered equipment due to any design / manufacturing changes (including substitution of components) or non-compliance with the requirement stipulated in the Technical Specification.	Confirmed	Yes/No

Date:

Bidder's Stamp & Signature

Contact Details: