

TECHNICAL SPECIFICATION

11KV CLASS METAL CLAD SWITCHGEAR (Incomers-2000Amps, Feeder Panels 1250Amps to be adopted for 31.5 MVA transformers and other stations wherever required)

1.0 SCOPE

The scope of this specification is for design, manufacture, testing and supply of outdoor 11KV - class metal clad switchgear suitable for installation for the use in a 3-phase 50Hz. 11KV solidly earthed system. The switchgear assembly shall consist of incomer transformer VCB panels, outgoing VCB feeder panels, Capacitor bank panel, bus coupler panel, central annunciator cum remote operation (trip / close) panel wherever required and shall be complete with all components such as circuit breakers, control gear, instruments, meters, relays, switches, indicating lamps, test blocks, current transformers, voltage transformers, etc., which are required in each panel for satisfactory and efficient performance of the switchgear. The switchgear shall suit outdoor installation.

The 11Kv class metal clad switchgear shall be compatible with SCADA/DAS system for remote control operation and monitoring.

2.0 APPLICABLE STANDARDS:

The switchgear shall conform to the following standards namely BIS - Bureau of Indian Standards and IEC International Electro Technical Commission.

1.	IS 5	:	Paints, Finishing Exterior
2.	IS 513	:	Cold rolled low carbon steel sheets and strips
3.	IS 641	:	Paints, finishing interior White
4.	IS: 14415		A.C. Electricity meters
5.	IS: 14390		
	IS: 14372		
	IS: 8530		
	IS: 13010		
	IS: 13779		
	• IEC 62052-11, 62053-61		for Class 0.2 S class electronic trivector meter.
	• IS:14697:1999-		AC static Transformer operated Watt hour and VAr-Hour Meters, class 0.2S, 0.5 S, 1.0 S - specification
	• IEC 61000-6-7,		
	• Technical report of specification for AC		Electrostatic discharge

	static Electrical Energy Meters CBIP, New Delhi, publication-304. • IEC 62056: 1997	communication protocol.
6.	IS 1730 :	Steel sheet and strip dimensions
7.	IS 2419 :	Dimensions for panel mounted indicating and electrical recoding instruments.
8.	IS 60947/13118 :	Specification for alternating current Breakers.
9.	IS 2705 Parts I to IV :	Current Transformer
10.	IS: 13947 Part 5 :	AC & DC Contactors
11.	IS 3156 Parts I to III :	Voltage Transformers
12.	IS 3231 :	Electrical relays for power system protection
13.	IS 3427 :	Metal enclosed switchgear and control gear for voltage above 1kV and up to and including 52kV.
14.	IS 3842 Parts I to XII :	Application guide for Electrical relays for protection and other relays
15.	IS 4146 :	Application guide for voltage Transformers.
16.	IS 4201 :	Application guide for current transformers
17.	IS 4794 Parts I & II :	Push button switches
18.	IS 5608 : Parts I to IV	PVC wires and sheaths
19.	IS 6236 :	Direct recording electrical measuring instruments
20.	IS 7118 :	Recommendation for direction movement for control devices/operating electrical devices.
21.	IS 8130 :	Conductors for insulated Electric cables.
22.	IS 8197 :	Terminal markings of Electrical measuring instruments and accessories
23.	IS 8686 :	Static protective Relays.
24.	IS: 13703	Low voltage fuse for voltage not

		exceeding 1000V AC or 1500V DC
25.	IS 9954 :	Pictorial surface preparation standards for painting of steel surfaces.
26.	IS 10118 :	Code of practice for installation of switchgear
27.	IS 10276 :	Edison screw lamp holders
28.	IS 11431 :	Code of practice for packaging of Electrical indicating and recording instruments.
29.	IEC 62271-100 :	High voltage alternating current circuit breakers
30.	IEC 62271-1 :	High voltage switchgear Part 1. Common specification
31.	IS 14697 :	(3) Static transformer operated watt-hour and VAR hour meters class 0.2S and 0.5S

3.0 NORMAL SERVICE CONDITIONS:

Generally as per clause 2 of IS 13118.

4.0 DEFINITIONS AND TERMINOLOGY:

As per

- i) IS: 3427 Clause (3) and sub-class thereof for switchgear
- ii) IEC: 62271-100 Clause (3) and sub-clauses thereof for circuit breakers
- iii) IS: 13118 Clause 3.0 & sub-clauses thereof for circuit breakers
- iv) IS : 2705 (Part I to IV) clauses (3 & 2) and sub- clauses thereof for current transformers
- v) IS: 3516 Part - I Clauses (3) and sub- clauses thereof for voltage transformers

5.0 DESIGN AND CONSTRUCTION:

5.1 GENERAL:

5.1.1 As per IS 3427 Clause 3.0

- 5.1.2 The type of construction shall be welded sheet steel. The minimum thickness of the sheet steel shall not be less than 3mm for the base and load bearing members and not less than 2.5 mm for the top cover, side sheets, doors and partitions. Sheet steel shall be cold rolled conforming to IS-513. The panel door shall be provided with louvers and with translucent plastic covered windows directly opposite the close/open indicating lamps and spring status indicator. The panel door shall be hinged, swing door provided with pad locking facility. Rear door shall also be hinged on one side and bolted on the other side. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-55.

The minimum dimensions of the Switchgear Panels shall be as given below:

Height	-	2000 mm including base channel height.
Depth	-	1600mm(feeder)/2000mm (Incomer)
Width	-	900mm (feeder)/(Incomer).

- 5.1.3 The design and construction shall be with the following features:

- a) Compact and robust construction
- b) Easily extensible on both sides
- c) Dust protected and vermin proof
- d) Fully compartmentalized.
- e) Horizontal draw out type
- f) Safe and positive interlocks
- g) Automatic safety shutters. FRP flap or safety shutters shall be installed so as to prevent accessibility/ exposure for all the HV live parts.
- h) Easy interchangeability of identically rated components including breakers.
- i) Extremely reliable operation
- j) Integral base channel to be fixed below ground level.
- k) Test facility with the truck in the test position and it shall be possible for closing the door in test position.
- l) All relays, instruments, and switches mounted on the instruments panel shall be accommodated at a height in between 0.5 to 2.0 meters from ground level in the outdoor control panel.
- m) Separate doors shall be provided for Circuit Breaker compartment & Relay/Meter compartment with suitable arrangements to close/open Circuit Breaker manually from door.

- 5.1.4 The size of the base channel for cable entry type switchgear shall not be less than 75mm.

5.2 ENCLOSURES:

Generally as per clauses 5.102.1 of IS 3427.

5.3 COVERS:

Generally as per clause 5.102.4 of IS 3427.

5.4 PARTITIONS:

Generally as per clause 5.103 of IS 3427.

5.5 SHUTTERS:

Generally as per clause 5.103 of IS 3427.

5.6 VENTILATING OPENINGS, VENTS OUTLETS:

Generally as per clause 5.102.6 of IS 3427.

5.7 INSPECTION WINDOWS:

Generally as per clause 5.102.5 of IS 3427.

5.8 AUXILIARY DEVICES AND CIRCUITS:

Generally as per clause 5.4 of IS 3427.

5.9 INTERLOCKS

Generally as per clause 5.106 with mechanical interlocks of IS 3427.

5.10 EARTHING:

Generally as per 5.3 of IS 3427, however the earthing conductor shall be of copper flat shall not be less than 25 x 6 mm. 2 Nos. each of M12 size earthing bolts shall be provided at either ends of the switch gears assembly to receive 50 x 6 mm G.1 flat of station earthing system. Earthing of all metallic parts relays covers etc., which are not electrically alive shall be done with stranded insulated copper wire. The earth connections for individual equipment shall be of size not less than 15 Sq. mm and Main earth connection shall be not less than 70 Sq. mm.

6.0 SWITCHGEAR COMPONENTS:

6.1 COMMON COMPONENTS:

The following shall be common components in all the incomer, outgoing, capacitor bank panels and bus inter-connection panels.

- a) Vertical / Horizontal isolation and horizontal draw out truck type circuit breaker.
- b) Current Transformer
- c) Instruments and Protective relays and selector switches.
- d) Copper bus bars.

- e) Cable termination boxes in the incomer and outgoing.
- f) Control switches, indicating lamps, contactors and test terminal blocks.

Incomer shall suit to receive 12 runs of Single Core cable 1000 sq. mm Aluminium XLPE and outgoing feeder panel & capacitor bank panel shall be suitable to receive 1 run of 95/240/400 Sq. mm 3 core Aluminium XLPE cable. Suitable cable glands with gland plates and cable support clamp shall be provided. Gland plates shall be easily removable type, even when the cable termination kit is in fixed position.

A caution board "Ensure fixing of gland plate before energising of cable" should be provided at a conspicuous place in the cable chamber.

A caution board 'Ensure transformer breaker is off for access to cable chamber' is to be provided on front portion of cable chamber of incomer.

6.2 ADDITIONAL COMPONENTS:

Cable termination Chamber shall be provided at the backside of the incomer panel to terminate incoming 9 runs of 1000 sq.mm Single core UG Cable (4 runs/ph/ and CTs & PTs.

The chamber should be rigid of the self supporting type and preferably fabricated with frame work of angle iron fitted with folded sheet metal panels. The chamber shall be of bolted construction with sheet steel not less than 3mm for the base and load bearing members and not less than 2.5 mm for the top cover, side sheets, door and partitions. Sheet steel shall be cold rolled conforming to IS-513. The chamber shall be adequately ventilated and free from projection.

However to prevent immediate access to live parts necessary barriers shall be provided. The bolted type construction is required to provide easy access to the CTs, PTs, Bus and Cable terminations.

Sketch showing typical arrangement is enclosed.

6.3 COMPARTMENTALIZATION

6.3.1 The various switchgear components shall be housed in separate compartments as follows:

- a. Circuit breaker compartment should be located at the bottom portion of the switchgear.
- b. Bus bar compartment.
- c. CT compartment
- d. Cable compartment at the backside.
- e. PT compartment either at bottom or at top or in a separate panel.
- f. Relay, metering, indication and control compartment.

Note: Cable termination Chamber, compartment for CTs & PTs for the incomer shall be as per clause 6.2 above.

6.3.2 It shall not be possible to approach any part of circuit breaker during its service/ test /isolation.

6.4 STANDARD FITTINGS AND ACCESSORIES :

The following shall be provided in each panel as applicable.

- a. Cubicle space heater with thermostat.
- b. View glass for breaker position indication.
- c. Name plates on front and rear sides of switch boards.
- d. Danger board on front and rear switch board
- e. One set of racking handle per switch board.
- f. One set of spring charging handle per switch board
- 9. Control cable duct and supporting clamps
- h. Mimic bus
- i. Test/ service/ isolated positions for the breakers.
- j. Operation counter for the breaker
- k. One set of ramp for withdrawal of breakers.

7.0 GENERAL ARRANGEMENT OF THE SWITCH GEAR PANELS:

7.1 The switchgear assembly consisting of the incomer panels, outgoing feeder panels, capacitor bank panel and Bus Inter connector panel being installed side by side in a straight-line formation. Provision shall be made for future extension of the switchgear board.

However as indicated in Cl. No. 6.2 above the Cable terminations, CTs & PTs chamber shall be provided separately at the bank side of the incomer panel.

7.2 All the outdoor panels shall be provided with a lean to drain rainwater to the rear of the panel. The roof shall be projecting on all sides so that rainwater shall not enter into the body of the panels.

7.3 The central annunciator panel shall be suitable for mounting indoor. Remote close/ Trip facility shall be provided on this panel itself for remote closing /opening of individual breakers.

7.4 The line up of the panels shall be as indicated below:

Feeders/Capacitor bank, Incomer, bus coupler, Incomer and feeders/Capacitor bank.

8.0 SWITCHGEAR RATINGS

8.0.1 CHARACTERISTICS :

- a) Rated voltage as per clauses 4.1 of IS 3427 for nominal system voltage of 11KV.

- b) Rated insulation level 28 KV/ 75 KV Peak- for 11 KV nominal system voltage.
- c) Rated Frequency - 50 Hz.
- d) Rated normal current - 1250A for feeders and capacitor bank and 2000A for incomer as detailed in Cl. No. 9.1.1 (i)
- e) Rated short - time current : 31.5KA
- f) Rated peak short - time current. As per clause 4.6 of IS-3427 and in conjunction with sub-clauses (e) supra.
- g) Degrees of protection. Corresponding to IP 55 of IS : 12063.
- h) The temperature rise limits for the various materials shall be as per table 3 of IS/IEC 62271-1.

9.0 SWITCH GEAR COMPONENTS:

Rated values of the components forming part of the metal enclosed switchgear and control gear are detailed here below individually against each component

9.1.1 Circuit Breakers:

- a) Type: vacuum
- b) Rated voltage 11 KV r m s
- c) Highest system voltage 12 KV r m s.
- d) Frequency 50 HZ
- e) Number of poles - three
- f) Class outdoor enclosed in metal clad enclosure.
- g) Power frequency withstand voltage: 28 KV r m s,
- h) Impulse Withstand Voltage - 75 KVp.
- i) Rated normal current : 1250A for feeder & capacitor bank breaker and 2000A for incomer breaker.
- j) Rated symmetrical Breaking current : 31.5KA.
- k) Rated transient recovery voltage : as per clauses 4.102.2, 4.102.3 of IEC 56, Table - IIA for 12KV rated voltage.
- l) Rated making current peak: : 78.75 KA.

- m) Short time withstand current – 31.5KA.
- n) Operating sequence : As per clause 4.104 (a) of IEC-62271 : O-0.3 Sec - CO-3min-CO.
- o) Rated supply voltage of opening /closing devices with operating limits.
 - i) Closing Coil – 220V or 110V DC to operate satisfactorily between 85 to 100% of rated voltage.
 - ii) Opening coil (shunt trip coil) - 220V or 110V DC to operate satisfactorily between 70 to 110% of rated voltage as the case may be. The DC control voltage will be 220V DC for 220KV stations and 110V in other stations
- p) Rated voltage of auxiliary supplies.
 - i. Space heater - AC 230V, Single Ph, 50Hz
 - ii. Spring charging motor - AC 230V, Single Ph, 50Hz
 - iii. Cubicle illumination - AC 230V, Single Ph, 50 Hz
- q) Method of closing and opening - The breaker shall be capable of being closed by discharging the energy stored in springs. These springs should be capable of being compressed or charged by an AC motor. It should also be possible to charge the springs manually by means of a spring charging handle or lever. During manual charging of the springs an electromechanical device shall be provided to prevent charging of the same by the motor. The springs should also be capable of being charged even with the breaker in the closed position so as to restore tension in the springs. Besides, there should be provision to automatically cut - off power supply to the motor when the springs are fully charged and also to automatically switch - on the power supply to the motor when the springs are fully discharged.

There shall also be provision to indicate spring status namely "FREE" / "Charged," by means of a mechanical lever at the panel. This shall be arranged through potential free auxiliary contacts or limit switches. The mechanism shall be "Trip Free Mechanism" providing priority for "tripping" over "closing". The mechanism shall be provided with an anti-pumping device to prevent closing impulses from being transmitted, to the closing coil when the breaker is in the closed position.
- r) Auxiliary Contacts : 8 NO + 8 NC conforming to clause 5.4 of IEC 60694.
- s) Name Plates - As per clause 5.9 of IEC 56.

- t) Requirements for simultaneity of poles - As per clause 5. 101 of IEC 62271.

9.2 CURRENT TRANSFORMERS:

9.2.1 The current transformer to be mounted in the incomer panels and outgoing panels shall conform in all respects to IS-2705 parts I to IV. CTs are required in Bus-Coupler Panel also.

9.2.2 The CTs shall be of the resin impregnated double bar type with a single CT having multiple cores for each phase. Alternatively, they can be of the ring type with separate cores for each function. They shall be located in separate compartment next to the cable termination end box. Ratio changing is preferred on secondary side of CT. The CT terminal connection arrangement shall be such that it should match with different makes of CT. Pad type terminals shall be provided for CT primary.

9.2.3 CT ratio changing is to be provided on secondary side.

Rating Characteristics :

- | | | |
|-----|----------------------------------|--|
| a. | Nominal voltage | 11KV r m s. |
| b. | Highest system voltage | 12 KV r m s. |
| c. | Frequency | 50 Hz. |
| d. | i. | The Insulation class of CTs shall be suitable for higher voltage class of 15KV |
| | ii. | Power frequency withstand voltage 35 KV rms |
| | iii. | Impulse Withstand Voltage 95KVp |
| e. | Ratio and cores | |
| | i. | Incomer panel-3 cores 2000-1200/1-1-1A |
| | ii. | Bus Coupler panel-2cores 2000-1200/ 1 - 1A |
| | iii. | Outgoing panel & capacitor bank panel -2cores 400-200/ 1-1A |
| f. | Accuracy class /burden | |
| i. | Incomer panel | |
| | Core 1 (Metering) | 0. 2S/ 5VA |
| | Core 2 (OC, EF & REF Protection) | 5P20/5VA |
| | Core 3 (differential Protection) | PS/V _k min 300V |
| ii. | Bus coupler panel | |

	Core 1(Metering)	0. 2S/ 5VA
	Core 2 (OC protection)	5P 20/5VA
iii.	Out going panel	
	Core 1 (Metering)	0.2S/ 5VA
	Core 2 (OC, EF Protection)	5P20/5VA
g.	Instrument security factor	5 at all ratios
h.	Earthing	As per clause 4.3 of IS 2705 (Par-t-1)
i.	Short time current rating	
	i. Thermal rating	31.5KA for 1 Second
	ii. Dynamic rating	As per 5.6.2 of IS 2705, Part -I
j.	Terminal Marking	As per Clause 6.2 of IS 2705 Part -I
k.	Rating plate	As per IS 2705 Part-I Clause 6.1 & 7.1
l.	The minimum creepage distance of insulator shall not be less than 250mm.	

9.3 VOLTAGE TRANSFORMERS:

9.3.1 The voltage transformers in case of cable entry type switchgear, are to be mounted in the incomer panels only and shall conform to IS-3156 parts (I to III). They shall be of the resin impregnated type and shall be connected on the incoming side of the cables in a separate compartments so as to give a positive indication of the supply conditions, even with the incomer breaker in the "open" position. The VTs shall be three phase or 3 single phase Star connected on the primary and secondary sides and provided with HRC fuses on HV side. The star point of PT shall be grounded, to suit 3phase 4wire system.

9.3.2 RATING AND CHARACTERISTICS:

a.	Nominal Voltage	-	11 KV rms.
b.	Highest system voltage	-	12KV rms.
c.	Frequency	-	50 Hz
d.	i.	The Insulation class of VTs shall be suitable for higher voltage class of 15KV	
	ii.	Power frequency withstand voltage	- 35 KV rms
	iii.	Impulse Withstand Voltage	- 95KVp

- | | | | |
|----|---|---|---|
| e. | Ratio & Core | : | $11000V/\sqrt{3}/110V/\sqrt{3}-110V/\sqrt{3}$ |
| | Core-1 Connected in star | | |
| | Core-2 Connected in star | | |
| f. | Accuracy class/ Burden | | |
| | Core-1 | : | 0.2/ 50VA (Metering) |
| | Core-2 | : | 3P/50VA (Protection) |
| g. | Earthing | | As per clause 4.3 of IS 3156 (Part- I) |
| h. | Rated voltage factor 1. 2 | | |
| | Continuous and 1. 5 for | | As per clause 5.6 of IS 3156 (Part- I) |
| | 30 seconds | | |
| i. | Limits of Temperature Rise | | As per Clause 6.2 of IS 3156 (part -I) |
| j. | Terminal Markings | | As per Clause 7.2 of IS 3156 (Part -I) |
| k. | The minimum creepage distance between the line terminal of 11KV PT and the metallic base plate shall not be less than 250mm. The overall mounting height of the PT i.e., vertical clearance shall be minimum 200mm. | | |

9.3.3 The secondary of PTs shall be such that the potential of various meters, relays etc., change-over to second set of PTs located in INCOMER-2, if breaker for INCOMER-1 is opened out. However, under normal condition each set of PTs shall feed potentials to half number of feeder circuits, (one third in case of 3 incomers) and auto-change over as described earlier, should take place when one of the breakers is opened out for maintenance and bus coupler is closed. The PT secondary shall not be paralleled under any circumstance. PT selection shall be carried out through auxiliary contact of breakers.

9.4 BUS BARS AND BUS BAR ARRANGEMENT:

9.4.1 The main Bus Bars shall be of EC grade copper flats in two lams with suitable spacers between lams for aeration, for the continuous current rating of 3000 Amps of size 100mm x 10mm x 2 lams.

9.4.2 All bus bars shall be coated with non-inflammable bus bar paint. The material of bus bars shall be EC grade copper conforming to space VDE 0201 code ECVF 30 IS : 8084.

9.4.3 The Bus-bar risers, connectors and tees shall be of EC grade copper flats for the continuous rating of 3000A.

9.4.4 Bus bar arrangement arranged in a staggered vertical formation.

9.4.5 Bus bar supports-porcelain bus supports shall be used. However epoxy insulators, reputed make with rain-shed type and adequate creepage distance acceptable.

For interpanel Bus extension Epoxy insulator should be used as insulation barrier.

9.4.6 Bus bar joints : All riser, bus bar joints shall be lap bolted joints. All straight joints in the run of the bus shall be butt joints with double cover plates of adequate current carrying capacity. All butt joints shall be provided with expansion spaces at the butt point. The cover plates shall be of the same material as that of the bus bars. All bolts and nuts used in the joints shall be of brass and adequate in number and liberal in current rating.

The bolts & nuts provided to the buses shall be covered with fibrous end caps

9.4.7 CLEARANCES:

- i) Between Phases Not less than 250mm (centre to centre)
- ii). Between Phase to Earth Not less than 120mm

9.5 INSTRUMENTS:

9.5.1 Meters to be mounted shall conform with IS 1248 Parts (I to IX) and dimension shall conform to IS-2419.

9.5.2 All meters shall be CT/VT Secondary operated instruments and shall be flush mounted with only the bezels projection. All meters shall be wired at the back and shall be provided with tropicalised dials, to ensure freedom from warping, discoloration or fading. The lettering/ Numbering on dials shall be in bold black on white dial background.

9.5.3 All meters shall be magnetically shielded.

9.5.4 All indicating analog meters shall be provided with a screw type zero adjuster for the needle with facility to operate from the front of the panel without having to remove the cover of the meter.

9.5.5 All meters shall be wired through test terminal blocks to provide for independent calibration of meters.

9.5.6 Void

9.5.7 TRANSDUCERS:

Void

9.5.8 TYPE RATING AND CHARACTERISTICS:

A) AMMETER:

- a. One No. to be provided in all the panels. Each ammeter shall be provided with a selector switch to read the current in each of the phases.
- b. Type - Moving Iron
- c. Size - 96 x 96 mm
- d. Accuracy - 1.0
- e. Scale - 90 °
- f. Range
 - i. 0-1000-2000 Amps for, ammeter in the incomer/ Buscoupler panel for CTR 2000-1200/ 1A.
 - ii. 0-200-400 Amps for ammeters in the feeder panels for CTR 200-400/ 1A

B). Multifunction Meter:

Microprocessor based, 3 phase 3element 4 wire with accuracy class 0.2S, suitable for respective CT ratios of Incomer, Feeder, & capacitor bank panel and PT ratio $11\text{kV}/\sqrt{3}/110\text{V}/\sqrt{3}$ with RS 485 Modbus protocol, DC supply: project specific (220V/110V DC). It shall display current, Voltage, frequency, power factor, active power, reactive power etc.,

C). ELECTRONIC TRIVECTOR METER With ABT features – 0.2S Accuracy class.

- a. One No. of Trivector meter be provided in all panels except Bus coupler panel.
- b. It shall of static type, 3 phase, 4 wire trivector meter suitable for 1 Amp, CT and 110 volts phase to phase VT secondaries. It must be flush mounted type and tropicalised.
- c. The meter shall conform to detail specification enclosed as in Annexure below;

Annexure:
**NOTE: PLEASE REFER THE UPLOADED DOCUMENT FOR DLMS ICS
COMPLIANT TVM SEPARATELY**

9.6.0 PROTECTIVE RELAYS:

9.6.1 GENERAL EQUIPMENTS:

- a) All relays shall conform to the requirements of IS 3231/IEC 50255/IEC 61000 or other applicable standards & shall type tested as per relevant IEC. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear.
- b) All protective relays shall be numerical type & communication protocol shall be as per IEC 61850 for station with SAS & IEC 60870-5-103 for station with SCADA compatible. Further the test levels of EMI as indicated in IEC 61850 shall be applicable to these.
- c) A detailed note regarding the various quality control procedures adopted by the manufacturer should be given with special reference to static / numerical relay components on their quality assurance tests. Information should be furnished regarding various equipment used for quality assurance tests.
- d) The numerical relays offered must have proven performance. The bidder shall give a detailed account of the field experience of the relays offered, information regarding experience in designing etc.
The make of numerical relays shall be of ABB/Siemens/Alstom/ER/JVS/ASHIDA/SIFANG/CGL.
- e) The relay codes mentioned in the wiring/ schematic diagram, for auxiliary relays etc., which are part of a composite relay, shall be marked on the name plate provided. This is required to facilitate the field staff, to identify the auxiliary relay provided in the composite unit at the time of trouble shooting.
- g) All relays, other components, wiring etc shall withstand a test voltage of 2.5kV RMS, AC, 50 Hz.

- h) The tenderer shall give a detailed account of the field experience of the relays offered. Information regarding experience within the country should be indicated, giving the approximate quantity of similar relays supplied in India. The bidder should also give an account of his experience in designing coordinating similar protective gear within the country.
- i) The tenderer shall indicate what facilities are available with him within the country for repair / recalibration of the relays offered by him. Whether such facilities are available for the repair of imported relays included in his offer shall also be stated in the tender.
- j) The tenderer shall indicate what facilities are available with him for commissioning these Relays. Such facilities shall cover indigenous and imported equipment. The bidder shall arrange to train at his cost the engineering staff of KPTCL for trouble- free operation and maintenance of these relays.

9.6.2 a) The protective and auxiliary relays offered shall be of proven design and based on sound principles and should conform to IS : 3231 and IEC : 60255 wherever applicable. The protection equipment shall be designed and applied to provide maximum discrimination between faulty and healthy circuits and its performance shall be in accordance with the BS standard 3950. The equipment shall remain in operation during transient phenomenon, which may arise during switching or other disturbances to the system. They shall be in standard cases and shall be provided with dust and vermin proof cases and covers, The covers shall be transparent and shall be removable from the front. The relay shall be suitable for semi-flush mounting only the flanges projecting in the front and with connection from the rear. The relays shall be rectangular in space and dull black or egg shell black enamel painted cases.

- b) All protective relays shall be in draw-out cases with proper testing facilities. The testing facilities provided on the relays shall be specifically stated in the tender. Necessary test plugs shall be supplied loose and shall be included in bidder's scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to test block and test plug arrangements the bidder shall also quote alternative testing facility of protective relays by providing a push button which when pressed connects the testing equipment to the relay coils and injects current in the coil and automatically disconnects the trip circuits and on operation of relay gives a signal that the equipment and the circuits are correct. The above tests shall be carried out without short circuiting the CT secondary connections. The Purchaser reserves the right for accepting any one of the above two testing facilities. Unless otherwise specified all auxiliary relays and timers shall be supplied in non-draw out cases/ plug-in type modular cases.

- c) All AC relays shall be suitable for operation at 50 Hz AC Voltage operated relays shall be suitable for 110 Volts VT secondaries and current operated relays for 1 Amp CT secondaries as specified. DC auxiliary relays and timers shall be designed for the DC voltage specified (110V for 33kV, 66kV & 110kV Stations and 220V for 220kV & 400kV stations and also for 66kV & 110kV GIS stations), and all numerical relays shall be suitable for auxiliary supply voltage of 80 - 250V DC. Voltage operated relays shall have adequate thermal capacity for continuous operation.
- d) All relays coils requiring a continuous voltage shall have adequate thermal capacity for continuous operation. The current and voltage coil shall be rated for the current and voltage rating specified under system details and auxiliary supply.
- e) The power supply unit shall be fully rated with liberal design in capacity.
- f) The DC supply for solid state relay shall be from DC / DC converters and these shall be amply and fully rated for all operating conditions in service. Provision of DC stand by power supply will however not be acceptable.
- g) The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts/ suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts. Relay cases size shall be so chosen as not to introduce any limitations on the use of available contacts on the relay due to inadequacy of terminals. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay.
- h) All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators with inscription subject to purchaser's approval. All protective relays which do not have built in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similar separate operating indicator (auxiliary relays) shall also be provided in the trip circuits

of protections located outside the board such as buchholtz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.

- i) There shall be no relay in the protective circuits, which shall cause tripping of the circuit breaker when the relay is de-energized.
- j) Timers shall be of electromagnetic or static type. Pneumatic timers are not acceptable. Time delay in terms of milliseconds obtained by the external capacitor/resistor combination is not preferred & shall be avoided.
- k) Provision shall be made for easy isolation of trip circuit of each relay for the purpose of testing & maintenance.
- l) All protective relays & alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for further use.
- m) The setting range of relays offered, if different from ones specified shall also be acceptable if they meet the functional requirement.
- n) Any alternative/additional protection of relays considered necessary for providing complete effective & reliable protection shall also be offered separately. The acceptance of this alternative/additional equipment shall lie with KPTCL.
- o) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured.
 - i) The operating time of the series seal-in-units shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
 - ii) Seal-in-units shall obtain adequate current for operation when one or more relays operate simultaneously.
 - iii) Impedance of the seal-in-units shall be small enough to permit satisfactory operation of the trip coil on trip relays when D.C supply voltage is minimum.
 - iv) Trip-Circuit seal – in is required for all trip outputs irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal –in the trip outputs but also the relevant initiation signals to other scheme functions (e.g. initiate signals to the circuit breaker failure function, reclosing function etc.,) and the alarm output signals.

- v) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).
 - vi) For the current seal-in method, the seal-in shall be maintained until the circuit breaker opens, at which time the seal-in shall reset and the seal in-method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single –and three –pole tripping.
 - vii) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions.
- p) For numerical relays the scope shall include the following:**
- i) Necessary software & hardware to up/down load the data to/from the relay from/to the personal computer provided in the station.
 - ii) The relay shall have suitable communication facility for connectivity to SCADA/DAS. The relay shall be capable of supporting IEC-60870-5-103 for station with SCADA compatible and IEC-61850 protocol for station with SAS compatible.
 - iii) The Numerical relays shall be provided with minimum 24BI's and 24BO's.
All BI's & BO's of Numerical relays shall be independent & galvanically isolated.

Configuration BI's are as follows

I/P No.	Incomer Panel	Feeder panel	Bus coupler panel
1	CB Open	CB Open	CB Open
2	CB Close	CB Close	CB Close
3	Spring charge status	Spring charge status	Spring charge status
4	Master trip relay operated	Master trip relay operated	Master trip relay operated
5	Breaker in Test position	Breaker in Test position	Breaker in Test position
6	Breaker in service	Breaker in service	Breaker in service

	position	position	position
7	Trip circuit healthy/faulty	Trip circuit healthy/faulty	Trip circuit healthy/faulty
8	Local operation	Local operation	Local operation
9	Remote Operation	Remote Operation	Remote Operation
10	SCADA operation	SCADA operation	SCADA operation
11	Breaker connection unplugged	Breaker connection unplugged	Breaker connection unplugged
12	Master tripping relay reset	Master tripping relay reset	Master tripping relay reset
13	AC supply fail	AC supply fail	AC supply fail
14	Closing command	Closing command	Closing command
15	Tripping command	Tripping command	Tripping command
16	SCADA Open	SCADA Open	SCADA Open
17	SCADA Close	SCADA Close	SCADA Close
18	67-Relay in test mode	67-Relay in test mode	67-Relay in test mode
19	Closing ckt. Healthiness	Closing ckt. Healthiness	Closing ckt. Healthiness
20	Tripping ckt. Healthiness	Tripping ckt. Healthiness	Tripping ckt. Healthiness
21	Master trip relay healthy	Master trip relay healthy	Master trip relay healthy
22	Indication circuit DC healthiness	Indication circuit DC healthiness	Indication circuit DC healthiness
23	Spare	CLI for R phase, Y phase, B phase	Spare
24	Spare	Spare	Spare

Configuration BO's are as follows

O/P No.	Incomer Panel	Feeder panel	Bus coupler panel
1	Close Command	Close Command	Close Command
2	Open command	Open command	Open command
3	Breaker in close position	Breaker in close position	Breaker in close position
4	Breaker in Open position	Breaker in Open position	Breaker in Open position
5	Auto trip	Auto trip	Auto trip
6	Breaker in Spring charge	Breaker in Spring charge	Breaker in Spring charge
7	KPTCL control	KPTCL control	KPTCL control
8	SCADA control	SCADA control	SCADA control
9	86 Relay trip command	86 Relay trip command	86 Relay trip command
10	86 relay reset command	86 relay reset command	86 relay reset command
11	Protection operated	Protection operated	Protection operated
12	Trip circuit faulty	Trip circuit faulty	Trip circuit faulty
13	Command from SCADA	Command from SCADA	Command from SCADA
14	Relay in test mode	Relay in test mode	Relay in test mode
15	IDMT	IDMT	IDMT
16	High set	High set	High set
17	Relay in Test mode	Relay in Test mode	Relay in Test mode

18	AC fail	AC fail	AC fail
19	Indication DC fail	Indication DC fail	Indication DC fail
20	Closing circuit faulty	Closing circuit faulty	Closing circuit faulty
21	R phase operated	R phase operated	R phase operated
22	Y phase operated	Y phase operated	Y phase operated
23	B phase operated	B phase operated	B phase operated
24	Test feed back	Test feed back	Test feed back

- iv). All commands to breaker to be routed through Numerical relay to facilitate for auto logging of events.
- v). The Numerical relays shall be provided with minimum 4CT& 6VT Inputs.
- vi) All numerical relays shall be suitable for auxiliary supply voltage of 80 - 250V DC and BI's shall be suitable for 80-250V DC supply.

- 9.6.3 a) The materials, the components of static/ numerical relays shall be designed to withstand the most severe tropical climatic conditions such as corrosive atmosphere, saline, fog, damp, heat and fungus prone environment. These devices as such shall be tropicalised in such a manner so as to meet with the IEC-68 standard.
- b) The components shall be loaded by less than half of their rated values. The resistor shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes. As per IEC, the relays must meet the requirements of IEC-255-4, appendix 'E'. Class-III regarding HF disturbance tests, IEC-255-4 regarding impulse test at 5kV and fast transient test as per IEC-801-4. Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous source do not cause damage to static circuits.
 - c) The cases, racks and sub-units shall preferably be of stainless steel. The screws used in cases, racks and sub-units shall be either of stainless steel or zinc plated steel.
 - d) The material of connector terminal blocks shall be of dielectric moulded type resin. The connector plugs shall be corrosion resistive and the lugs shall be made of tinned brass with the contact face silver / gold plated. All connections with the connector plug shall be by wire wrapping.
 - e) The static/ numerical components forming the electronic solid state circuitry shall be mounted on printed circuit board of adequate thickness and made of stratified glass epoxid. A protective lacquer shall be applied when all the components are soldered.

Transformers in the circuitry shall also be impregnated with the same lacquer. All components shall be clearly marked and all wiring colour coded and tagged. Flat ribbon cable is exempted from being tagged.

- f) The relays shall be modular units assembled in fully tropicalised draw out cases with the modules or sub-units plugged into racks. They shall be electrically isolated on the measuring side through intensity or voltage input transformers with shield bonded (at the over voltage/fixed voltage) and on the operation side through on/off relays. The layout of measurement inputs, output relays, detection circuits and visual display such as to eliminate mutual interference of the circuits involved. Internal test points shall be provided on the printed circuit at typical points of the relay diagram. These test points, if possible shall be provided on the front of the relay to enable testing during operation without having to disconnect the relay.
- g) Insulation barriers shall be provided to ensure that transients present for CT and VT connections due to extraneous sources do not cause damage to static circuits. The static relays offered shall be tested to withstand both 5 kV impulse tests and high frequency disturbance stipulated by IEC. Details of the equipment used for tests shall be furnished.
- h) The relay shall be designed for designed for shock wave resistance, temperature resistance, humidity resistance, transportation resistance and storage resistance and to be insensitive to radio frequency interferences.
- i) The performance of static/numerical relay shall not be affected by transient, common mode and transient mode electromagnetic interference.
- j) The solid state relays shall be stable and suitably protected against transient/ induced over voltages and noise signals. The bidder shall state clearly in his bid, special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- k) The electromechanical relay contacts shall be protected with non-inflammable plastic covers.

9.6.4 PROTECTION SCHEME:

The over Current & Earth fault protection scheme for 11kV Feeders:

Specification of Over Load Protection Relay

Sl No	Technical Parameters	
1	Type of Relay	Numerical Over Current Earth Fault Relay
2	Mounting type	Draw-Out Type with CT short facility
3	Current Input	1 A/5A site programmable
4	Frequency	50 Hz
5	Auxiliary DC Supply for Relay	80 to 250 V
6	Settings range	
	O/C low-set	5% to 400 % @ in steps of 1%
	O/C high-set	5% to 3000 % @ in steps of 10%
	E/F low-set	5% to 400 % @ in steps of 1%
	E/F high-set	5% to 3000 % @ in steps of 10%
	Operating curves available	3.0s Normal Inverse 1.3s Normal Inverse 1.5s Very Inverse 0.8s Extremely Inverse 0.6s Extremely Inverse 13.3s Long Inverse
	TMS	0.02 to 1.0 @ 0.01
	Def. time Low set	0 to 25s @ 0.1s(0 - Inst)
	Def. time high set	0 to 25s @ 0.01s(0 - Inst)
7	Accuracy	
	Current pickup	100% TO 110%
	Drop-off / pick-up	ABOVE 95%
	Operating Time	± 5% ± 30ms whichever is high ±7.5% or ±30% for VI & EI Curves
	Def. operating time	± 5% ± 30ms whichever is high
	High set operating	± 5% of setting

Note:

The OLP relay shall have provision for group settings with minimum 2 group settings as given below-

Group1: Overcurrent &Earth fault setting

(To get activated automatically when primary current exceeds 5A, with current in all the 3 phases)

Group 2: OLP settings

(To get activated automatically when primary current exceeds 5 A, with current only in 2 phase/1 phase) .

Provision to build suitable logic for operation of relays and change over from one group to another by sensing the currents whether in 3phases or only in 2 phases/1 phase.

9.6.5 Tripping Relay:

Each panel shall be provided with instantaneous DC operated tripping relay. The relay shall have adequate number of normally open and normally close contacts to meet the requirement of scheme, The maximum operating time of the relay shall not exceed ten milliseconds and reset within 20 milliseconds. Relay shall be provided with operation indicator for each element coil.

9.6.6 Tripping Circuit Supervision Relay.

- a) Each trip coil of circuit breaker shall be provided with an independent trip circuit supervision relay. These relays shall be mounted in the control panel associated with the circuit breakers.
- b) These relays shall monitor the healthiness of the trip circuit while the breaker is in open or closed position and give an alarm for the loss of DC supply or for faults in the trip coil or for faults in the trip circuit such as leads, auxiliary contacts. The relay shall have a time delay on drop off of not less than 200 milliseconds and be provided with operation indication.
- c) Trip supervision relay shall be located in the panel.
- d) The relay shall have adequate contacts for providing connection to alarm and event logger.

9.6.7 DC Supply monitoring relay:

The relay shall be capable of monitoring the failure of DC supply to which it is connected. Separate DC supply monitoring relay shall be provided for DC main circuit, control circuit of tripping relay and protection circuit of each panel. It shall have adequate potential free contact to meet the scheme requirement. The relay shall have a time delay on drop off of not less than 100msecs and be provided with operation indicator/flag. Indicating lamp and separate alarm for DC fail shall be provided and shall

be operated by 230V AC single phase supply. Push buttons for test and accept shall be provided.

9.6.8 SCHEDULE OF REQUIREMENTS OF RELAYS:

1. For Incomer, Outgoing feeder & Bus coupler panel

- a) Numerical Over current & Earth fault relay in each incomer & outgoing feeder panel.
- b) Numerical Over current relay in each bus coupler.
- c) Trip circuit supervision relay - One No. in each incomer, bus coupler and outgoing panel (This relay shall detect failure of DC in the breaker closed as well as in open position. A flag indication and auxiliary contact for audible annunciation shall be provided).
- f) Master trip relay – One No. in each incomer, bus coupler & outgoing panel.
- g) DC supervision relay – One No. in each incomer, bus coupler & Outgoing panel.
- h) Live Line/cable detector for Outgoing panel

2. For Capacitor bank panel

- a. Numerical Non directional Over current & Earth fault relay.
- b. Trip circuit supervision relay – One No. (This relay shall detect failure of DC in breaker closed as well as in open position. A flag indication and auxiliary contact for audible annunciation shall be provided).
- d. Master trip relay.
- e. DC supervision relay.
- f. Under voltage relay – Setting range 40 to 90%
- g. Over voltage relay – Setting range 110 to 170%
- h. Timer.
- i. Circulating current Relay - Setting range 10 to 40A

9.7 CONTROL SWITCHES:

9.7.1 GENERAL:

The Control switch shall contain two electrically independent double break contacts and shall be moulded in a self extinguishing plastic compound with inherent arc - quenching and high insulating property enclosed moulding giving a high degree of dust protection. The back of control switch is to be shrouded in transparent cover automatic spring return to neutral switch type to be provided. The switches shall be suitable for 20 Amps continuous rating and 110KV DC or 220KV DC as the case may be.

9.7.2 REQUIREMENT:

- a. One No. in each outgoing / incomer/Capacitor and bus coupler panel.
- b. One No for each incomer/ outgoing breaker in the annunciator panel for remote operation.

9.8 SELECTOR SWITCHES (FOR AMMETER)

9.8.1 GENERAL:

These shall be slow - break, quick make, rotary type, stay put switches, and shall be suitable for flush mounting. These switches shall be suitable for being operated by flush mounting. These switches shall be suitable for being operated by a knob from the front face of the panel. They shall be suitable for 10 Amps continuous rating and 415 V AC. The ammeter selector switches shall short - circuit the CT secondary before it is broken and remove the short circuit after the ammeter is inserted in the circuit. All the switches shall have position indication plates 4 ways i.e., RYB and OFF.

- 9.8.1.1 a) Requirement of ammeter selector switch is one No. in each Outgoing, incomer and bus coupler.

9.9 INDICATION LAMPS:

- 9.9.1 Indicator lamps shall be integral LED module type 0.5 watts suitable for 110V or 220V DC and these shall be integral self-contained LED indicator units which can be directly mounted in the panel. The rated in put voltage can be directly applied to the module input as all the controlling circuitry is built into the module body it self. These modules shall be suitable for panel cutouts of size 22.5 mm dia with the use of Chrome plated standard mounting bezel / adopter sets and of colors, red, Green, Amber/ Yellow, white and blue. The axial light intensity should be min 40 milliCandella.

9.9.2 COLOUR CODE FOR LAMPS;

Breaker open	-	Green
Breaker closed	-	Red
Auto trip	-	Amber
Spring charged	-	Violet/ Blue
Trip Circuit Healthy	-	White

9.9.3 REQUIREMENT LAMPS:

- a. One set of green amber and red lamps in each incomer bus coupler and outgoing panels along with spring status violet, blue and trip circuit healthy white on command.
- b. One set of green, red, amber violet / blue and white lamps for indicating the status of each incomer, bus coupler and outgoing breakers in the remote indoor annunciation panel.

9.9.4 10% of the total of integral LED module type lamps for each panel shall be supplied as spare without extra cost.

9.10 FUSES

9.10.1 GENERAL:

All fuses shall be moulded Bakelite complete with fuse bases, fuse carriage and HRC cartridge fuses. All fuse fittings should be labeled by etching on an anodized plate with details of the fuse rating and the circuit for which the fuse is provided.

9.10.2

a. RATING:

- i. AC 415 V for all supply fuses
- ii. DC 110V / 220V as the case may be, for all DC supply fuses
- b. Rated current: As per clause 5.3 of IS 9224 (part - I) 1979 (preferred value of rated current 32 Amps.)

9.10.3 REQUIREMENTS:

All AC and DC circuits shall be provided with suitable fuses and fuse links for each phase / pole.

9.10.4 10% of the H.R.C fuse cartridge shall be supplied as spares without Extra cost.

9.11 MIMIC DIAGRAM:

6 mm wide mimic bus shall be painted on each panel. The colour shall be signal Red, conforming to IS- 120-1962 shade No. 537. Mimic bus shall also be provided on the remote indoor control panel.

9.12 WIRING:

9.12.1 GENERAL:

The wiring shall be done by using PVC – insulated, FRLS, 1.1kV annealed, stranded copper wire. The wires shall run straight and shall be given right angle bends wherever necessary so as to give a pleasing appearance. The size of wiring in different circuits shall not be less than the sizes specified below:

- a. Metering and Relay circuits : 2.5 Sq. mm copper control cable for DC control wiring and CT's and VT's circuit.
- b. All terminal connections to the equipments and terminal blocks shall be done by using Tin coated copper lugs. All the outgoing wiring from the panel shall be terminated on the terminal block mounted in the front of the panel with suitable provision for connection to the interconnecting control cable. The wiring shall conform to IS 375 with latest amendments if any.
- c. All wiring shall be provided with alphanumeric ferules at either ends as per the wiring schedule.
- d. All terminals shall be nut and stub type of brass coated with Nickle of size M6.

9.13 a. TEST TERMINAL BLOCKS:

The test terminal blocks required are for testing while in service and shall be of the 3 phase 4 wire, front adjustable, link type, projected, mounted with screwed cover and wired at the rear, rated for 10 Amps. The wiring shall be so as to short circuit the CT phase to the star point and it shall be possible to calibrate through external injection.

- b. For circuits, disconnecting type terminals shall be used to enable measurements of current.

9.14 a. PAINTING AND FINISHING:

The frame work and surface of the steel panels shall be sand blasted to remove rust and scales. The pre-painting procedures shall include cleaning, de-rusting, phosphating and priming of the panels in accordance with IS 6005 1970. The base channel shall be painted with Two coats of anti - corrosive black paints. The outdoor panel exterior and interiors shall be painted with Admiralty Grey Epoxy Paint conforming to shade No. 631 of IS - 5. However, pre-paintings procedures by chemical treatment are also acceptable.

- b. Block No. shall be assigned for each compartment and the same shall be stencilled in white paint on the inside of panel.

9.15 TERMINAL PAD / CONNECTORS:

The terminal pads at cable termination points and CT junctions to have minimum two bolt connections in case of feeders and 4 bolt connections in case of incomers.

9.16 FOUNDATION BOLTS:

Foundation bolts with 10% spares are in the scope of supply of the supplier.

9.17 AUXILARY DC SUPPLY:

For the switchgear will be arranged from station battery panel.

9.18 AUXILIARY AC:

Will be arranged from owner's panel.

9.19 INDOOR TYPE COMBINED REMOTE-CONTROL AND ANNUNCIATOR SIMPLEX PANEL.

- a. **General: Panel shall consists of a vertical front panel with visual annunciator facia windows along with annunciator lamp, test, accept and reset push buttons. All control switches of breaker in the run of mimic bus shall be with indicating lamps also provided in the front. Selector switch for selection of Remote and SCADA operation shall also be provided for each Incomer and out going/Capacitor bank feeders. Sufficient (including for spare incomer and feeder/capacitor bamk) contact multiplier relay for SCADA system for control operation shall also be provided.**

Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, Cold rolled sheet steel of thickness not less than 3mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, and resistance to vibration and rigidity during transportation and installation.

The dimensions of the control and relay panels shall be as given below:

Height _____ - 2312 mm including base channel
height of 102mm.

Depth _____ - 610mm

Width _____ - 700mm Maximum

Note: One No. Simplex Panel shall be provided for each 11KV switchgear(Consisting of Incommer,feeder & Buscoupler)

- b. Wiring : All wiring from the outdoor panel shall be terminated on the terminal blocks inside the cubicle and shall be accessed from rear.. The terminal block shall be Brass stud and nut type of size M6. The terminal blocks shall be of moulded resin type provided with plastic shrouds. Sufficient spare terminals shall be provided on the terminal blocks.

- c. Annunciation facia windows - shall be with plastic facia sheet engraved with letters of 5mm size. The inscriptions shall be visible only when the facia is lighted. The lamps shall be suitable for 110V / 220V DC with an in-built resistor. The initiation of annunciation shall be through NO-NC contacts of the relay.

A hooter suitable for 110V / 220V DC shall be installed in the annunciator panel for alarms.

- d. Requirement and engraving in the annunciator desk

A. OUTGOING PANELS.

- | | | | |
|-------|--|---|--------------|
| i. | No. of windows | 6 | |
| | Protection operated | 1 | → Trip alarm |
| | DC fail / Relay faulty | 1 | → Non trip |
| | No. of windows spare | 1 | |
| | Trip Circuit faulty | 1 | → Non trip |
| | Command from SCADA | 1 | → Non trip |
| | Relay in test mode | 1 | → Non trip |
| | Indication lamp | | |
| ii. | Breaker open indication lamp | 1 | |
| iii. | Breaker close indication lamp | 1 | |
| iv. | Spring free / charged indication lamp | 2 | |
| v. | Breaker auto trip indication lamp | 1 | |
| vi. | Feeder under station control indication lamp | 1 | |
| vii. | Feeder under SCADA control indication lamp | 1 | |
| viii. | Trip / Neutral / Close switch | 1 | |

B. INCOMER PANEL:

- | | | | |
|----|------------------------|---|--------------|
| i. | No. of windows | 6 | |
| | Protection operated | 1 | → Trip alarm |
| | DC fail / Relay faulty | 1 | → Non trip |

	No. of windows spare	1	
	Trip Circuit faulty	1	→ Non trip
	Command from SCADA	1	→ Non trip
	Relay in test mode	1	→ Non trip
ii.	Breaker open indication lamp	1	
iii.	Breaker close indication lamp	1	
iv.	Spring free / charged indication lamps	2	
v.	Breaker auto trip indication lamp	1	
vi.	Feeder under station control indication indication lamp	1	
vii.	Feeder under SCADA control indication lamp	1	
viii.	Trip / Neutral /Close switch	1	

C. BUS COUPLER PANEL:

ii.	Breaker open indication lamp	1	
iii.	Breaker close indication lamp	1	
iv.	Spring free / charged indication lamps	2	
v.	Breaker auto trip indication lamp	1	
vi.	Feeder under station control indication indication lamp	1	
vii.	Feeder under SCADA control indication lamp	1	
vii.	Trip / Neutral /Close switch	1	

vi.	Facia		
	No. of windows	6	
	Protection operated	1	→ Trip alarm
	DC/ Relay fail	1	→ Non trip
	No. of windows spare	1	
	Trip Circuit faulty	1	→ Non trip
	Command from SCADA	1	→ Non trip
	Relay in test mode	1	→ Non trip

D. CAPACITOR BANK PANEL:

No. of windows	-	10	
OCR R Phase operated	-	1	
OCR B phase Operated	-	1	
EFR operated	-	1	
Under Voltage Relay operated	-	1	
Over Voltage Relay operated	-	1	
Circulating current Relay operated	-	1	
DC fuse failure	-	1	> Non trip alarm

No. of windows spare	- 1
Trip Circuit supervision	- 1 Non trip alarm
Command from SCADA	1 → Non trip
Relay in test mode	1 → Non trip
Breaker open indication lamp	- 1
Breaker close indication lamp	- 1
Spring free/charged indication	
Lamps	- 2
Feeder under station control indication lamp	1
Feeder under SCADA control indication lamp	-1
Trip/Neutral/close switch	- 1

10.0 TESTS

10.1 TESTS ON SWITCH GEAR:

10.1.1 Type Tests as per clause 6.0 - (a) to (e) and (h) and j) of IS : 3427 –latest version.

10.1.2 Routine tests - as per clause 7.0 of IS-3427-latest version.

10.2 TESTS ON CIRCUIT BREAKERS:

10-2.1 Type tests as per clause 6.0 of IS 13118.

10.2.2 Routine test - as per clause 7.0 of IS 13118.

10.3 TEST ON CURRENT TRANSFORMERS

10.3.1 Type test : As per clause 9.1.1(a) to (f) of IS 2705 (Part- 1) of latest version, as per clause 7.1 of IS-2705 (Part –II) of latest version and Clause 7.1 of IS-2705 (Part –III) of latest version.
Routine Tests: As per Clause 9.1.2 (a) to (f) of IS 2705 (Part – I) of latest version, as per clause 7.2 of IS 2705 (Part –II) of latest version, Clause No. 7.2 of IS 2705 (Part –III) of latest version and Clause 6.0 of IS-2705 (Part – IV).

10.4 TEST ON VOLTAGE TRANSFORMERS;

10.4.1 Type tests: As per clause 9. 1. 1 of IS 3156 (Part -I) of latest version, as per clause 8.1 of IS 3156 (part-II) of latest version & as per clause 10.1.1 of IS 3156 (Part - III) of latest version.

10.4.2 Routine Tests : As per clause 9.1.2 of IS 3156 (part - 1) of latest version, as per clause 8.2 of IS 3156 (Part-11) of latest version and clause 10.1.2 of IS : 3156 (part - III) of latest version.

10.5 TESTS ON RELAYS:

10.5.1 Type tests and routine tests as per IS. 3231 and IEC 255.

10.6 GENERAL:

10.6.1 TYPE TESTS:

The tests reports of all the tests as stipulated in IS 3427 and other tests conducted shall be supplied. The tests reports of all the tests as stipulated in IS 3427 and other tests conducted shall be supplied. Three copies of the test certificates of the type tests shall be furnished along with the bid.

The type test reports shall not be older than Five(05) years as on the last date of submission of bid. The type tests are to be conducted again without any extra cost to the owner in case the type test reports are older than Five(05) years as on the last date of submission of bid. The type test charges are to be indicated in the schedule. The owner reserves right to insist for conducting all or a few type tests even though the type tests are less than Five(05)years old as on the last date of submission of bid, the payment in such cases will be made as per the rates in the schedule.

a) For 11kV Switchgears manufactured in India:

- i. The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii. The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

b) For 11kV Switchgears manufactured Abroad:

- i. Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.
- ii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of

the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term "Purchasing Utility" covers the foreign Utility who has purchased that equipment

10.6.2 All routine tests shall be carried out in the presence of owner's representative for which the contracts shall give sufficient advance intimation.

10.6.3 All tests certificates shall be duly approved by the owners without which no dispatches can be effected.

11.0 Marking and name plates:

11.1.0 As per clause 7.1 of IS 3427-1969.

11.2.0 The above markings shall be in addition to the individual nameplates at their rear and shall be supplied separately as disassembled components.

11.3.0 All instruments, relay and other components shall be provided with nameplates at their rear and shall be supplied separately as disassembled components.

12.0 DOCUMENTS AND DRAWINGS:

12.1 BID DOCUMENTS:

The following drawings, literature and test certificates in duplicate shall accompany the bid.

- a. Principal layout drawings for the switchgear panels and indoor annunciator panel.
- b. Dimensional arrangements of the switch board in accordance with arrangements proposed by the owner as per clause 5.0 of this specification.
- c. Front and rear views of the switch board and annunciator panel with instrument and device positions marked.
- d. Pictorial view of the control switches, terminal blocks, indicating instruments, test blocks and exploded views of drawout type instruments etc.,
- e. Cross-section drawing of incomer, bus coupler and out going panels indicating bus bar clearances and risers in between phase to ground.

- f. Schematic and wiring diagrams for the various circuits.
- g. Illustrative descriptive, literature, general technical data and specification of all devices and components.
- h. Type and Routine test certificates.

12.2 CONTRACT DRAWINGS:

12.2.1 The contractor shall submit the following contract drawings in triplicate for approval by the owner within 3 weeks from the date of order. The owner will convey approval to the drawings after the receipt of contract drawing.

12.2.2 CONTRACT DRAWINGS FOR APPROVAL:

- a)
 - i) Drawings under item No. 12.1.1(a), (b), (c) and (f) mentioned above.
 - ii) Foundation drawings indicating the details of foundation, foundation bolts, cable entries and trenches etc.
- b) Cabling and wiring diagram of the switchgear and annunciator panel. Ferrule numbers, device numbers, grouping of cables etc., shall be distinctly shown.
- c) Inter-connection diagram between switchgear panel and indoor annunciator panel.
- d) Elementary diagrams of all controls, metering, protection, annunciations and other circuits panel wise. All devices shall be numbered as ASA code.
- e) Individual internal wiring diagram of the devices, test blocks, terminal blocks etc.
- f) Construction details of the switches, terminal blocks and test blocks.

12.3.0 DESPATCHES DRAWINGS:

12.3.1 Four copies of the approved drawings and detailed literature shall be directly sent to the consignees.

12.3.2 Four copies of the approved drawings and detailed literature shall be submitted to the Chief Engineer Electy., T&P, KPTCL, Bangalore.

13.0 Requirements of relays, meters, lamps etc., in each switchgear panel.

13.1 INCOMER PANEL

1	Ammeter	0-2000-1200 A	1 No.
2	Multi function meter		1No.
3	Electronic Trivector meter	Accuracy Class 0.2	1 No.

13.1.2 Common for each 2000A Panels

- a. Numerical Over current & earth fault relay -1No.
- b. Trip circuit supervision relay - 1 No.
- c. Master trip relay -1 No.
- d. DC Supervision relay -1 No.

13.1.3 Common for 2000A panels

- a. Control switch for breaker - 1 No.
- b. Ammeter selector switch- - 1 No.
- c. Indicating lamps Green, Red, Amber, Blue, white - 5 Nos.
- e. Fuses, terminal blocks and test terminal blocks. - As required.

Note:

Potential free contacts shall be provided, duly wired up to the operating mechanism housing / control cabinet for the alarms and indications to be provided by the purchaser **both** on his control panels and **SCADA**. To cater to this requirement, sufficient number of potential free contacts shall be provided.

13.2 OUTGOING PANEL:

13.2.1

Sl No.		1250 A panels	Quantity
1	Ammeter	0-200-400 A	1 No.
2	Multifunction meter		1 No.
3	Electronic trivectormeter	Accuracy Class 0.2	1 No.

13.2.2 Common for each 1250A Panels.

- a. Numerical Over current & Earth fault relay-1 No.
- b. Trip circuit supervision relay - 1 No.
- c. Master Trip relay -1 No.
- d. DC Supervision relay -1 No.

- e. Live Line/cable detector for the feeder breaker to ascertain deadline condition before closing of the breaker/racking in/racking out/taking up maintenance works on the feeder.

13.2.3 Common for each 1250A Panels

- a. Control switch for breaker - 1 No.
- b. Ammeter selector switch - 1 No.
- c. Indicating lamps Green, Red, Amber, Blue, white - 5 No.
- d. Fuses, terminal blocks and test terminal blocks. - As required

Note:

Potential free contacts shall be provided, duly wired up to the operating mechanism housing / control cabinet for the alarms and indications to be provided by the purchaser **both** on his control panels and **SCADA**. To cater to this requirement, sufficient number of potential free contacts shall be provided.

13.3 BUSCOUPLER PANEL COMMON FOR 2000A PANELS

- a. Ammeter 0-1200-2000A - 1 No.
- b. Multifunction meter - 1No
- c. Numerical Over current Relay - 1 No.
- d. Trip circuit supervision relay - 1 No.
- e. Master trip relay - 1 No.
- f. DC Supervision relay - 1 No.
- g. Control switch for breaker - 1 No.
- h. Ammeter selector switch - 1 No.
- i. Indicating lamps Green, Red, Amber Blue, white - 1 No. each
- j. Fuses, terminal blocks & test terminal blocks - As required

13.4 INDOOR COMBINED ANNUNCIATOR AND REMOTE CONTROL PANELS - SIMPEX TYPE PANEL.

- a. Control switch - One No. for each breaker
- b. Indicating lamps - One set of the following for each breaker
 - i) Green
 - ii) Red

- iii) Amber
- iv) Violet/ Blue
- v) White
- vi) Yellow

- c. Annunciator windows - as per clause 9.19
- d. Fuse - As Required
- e. Bell - 1 No.
- f. Hooter - 1 No.
- g. Push button
 - i. Accept 1 No.
 - ii, Reset 1 No.
 - iii. Lamp test 1 No.
 - iv. Hooter test 1 No.
- h. Electro-mechanical/Microprocessor based annunciator relay -
As required
 - i. Remote/SCADA selector 1 No.
Switch

13.5 MISCELLANEOUS:

- a. A ramp or trolley shall be supplied two per set of switchgear panels for easy withdraw and insertion of the breaker truck.
- b. One set of test jacks for testing the breaker in the breaker withdraw position.
- c. One set of relay test jacks with accessories.

13.6 Capacitor bank feeder Panel:

- 13.6.1
 - a. Multifunction meter 1 No.
 - b. ETV meter 1 No.
- 13.6.2
 - a. Numerical overcurrent & Earthfault relay 1 No.
 - b. Trip circuit supervision relay 1 No.
 - c. Master trip relay 1 No.
 - d. DC Supervision relay 1 No.
 - e. Under voltage relay 1No
 - f. Over Voltage Relay 1 No
 - g. Timer 1No
 - h. Circulating current Relay 1No
- 13.6.3
 - a. Control switch for breaker 1 No.

- b. Indicating lamps Green, Red, Amber,
Blue, White 1 No. each
- c. Fuses, terminal blocks and test terminal
blocks As required.

Note:

Potential free contacts shall be provided, duly wired up to the operating mechanism housing / control cabinet for the alarms and indications to be provided by the purchaser **both** on his control panels and **SCADA**. To cater to this requirement, sufficient number of potential free contacts shall be provided.

14.0 The schedule of requirement is as per Annexure enclosed.

15.0 SPARES

- a. Bank CTs. 1 No.
- b. Closing Coil 2 No.
- c. Trip coil 2 Nos.

16.0 SCHEDULES:

The tenderer shall fill in the following schedule which form a part of the tender specification and offer. If the schedules are not furnished duly filled in with the offer, the offer shall be liable for rejection.

Schedule 'A'	-	Prices and Delivery
Schedule 'B'	-	Guaranteed Technical Particulars.
Schedule 'C'	-	Schedule of Deviations.
Schedule 'D'	-	Tenderer's experience.

17.0 DEVIATION FROM TECHNICAL SPECIFICATION:

The Tenderer shall furnish the details of deviation/ modification proposed by him to improve overall performance of the system. The deviation shall be brought in the tender clause by clause as per annexure.,

18.0 PERFORMANCE GUARANTEE:

The equipment offered shall be guaranteed for satisfactory performances for a period of 12 months from the date of satisfactory commissioning of equipment. The equipment found defective/failed within the above guarantee period shall be replaced or repaired by the supplier free of cost within one month from receipt of intimation. If the defective/failed transformers are not replaced/repared as per the above guarantee clause, the KPTCL shall recover an equivalent amount plus 15% supervision charges from any of the supplier's bills.

19.0 MINIMUM EXPERIENCE FOR QUALIFYING AS BIDDER:

The bidders shall have a minimum experience of five years in the design, manufacture, testing and commissioning of 11KV Metal clad Switch gear similar to the type specified in the present enquiry. At least 50% of the quantity of similar type of 11KV Metal clad Switch gear called for in the present enquiry shall be in successful operation for a minimum period of two years. The tenderer shall also furnish the details of similar 11KV Metal clad switch gear supplied by them so far giving order reference, name and address of the customer etc., also indicating the period of commissioning. The tenderer shall also furnish performance certificates for a period of minimum two years of similar 11KV Metal clad Switch gear in proof of the satisfactory operation of 11KV Metal clad Switch gear.

20. Following potential free contacts shall be wired terminal block in remote control & Annunciator panel for SCADA:

- a. Breaker ON status
- b. Breaker OFF status
- c. Master trip operated.
- d. Remote/SCADA switch status
- e. OCR operated
- f. EFR operated
- g. DC fail
- h. Trip circuit healthy
- i. IDMT operated
- j. HS operated
- k. Relay in test mode
- l. AC fail
- m. Closing circuit faulty.

21. Breaker control to be extended when Remote/SCADA switch is in SCADA position

- a. Breaker ON control**
- b. Breaker OFF control**

SCHEDULE – B

GUARANTEED TECHNICAL PARTICULARS OF 11KV SWITCHGEAR COMPONENTS

I AMMETERS:

1. Type of Instrument
2. Size
3. Whether magnetically shielded or not
4. Scale length & range
5. Whether tropicalised
6. Short time overload capacity
7. VA burden current coil
8. Power consumption of current coil
9. ISS grade of accuracy
10. Description leaflet
11. Temperature at which instrument calibrated

II. Multifunction Meter:

1. Type of Instrument
2. Size
3. Whether magnetically shielded or not
4. Scale length & range
5. Whether tropicalised
6. Short time overload capacity
7. VA burden
8. Power consumption
9. ISS grade of accuracy
10. Description leaflet
11. Temperature at which instrument calibrated
12. List of display parameter

III. ELECTRONIC TRIVECTOR METER

1. Type & Rating
2. Size

3. Whether Magnetically shielded are not
4. Whether tropicalised
5. Rated VA burden - current coil
- Potential coil
6. Continuous over load rating - current coil
- Potential coil
7. Accuracy class and grade
8. Adjustments provided
9. Limits of error at UPF and at 125%,
25% and 10% of rated current
10. Limits of error 0.5 PF and at 125%,
25% and 10% of rated current
11. Type of Registering Mechanism
12. Display sequence
13. Details of display
 - a. Parameters that can be measured Refer Cl. 9.5.6 E
 - b). Details of print out parameters
14. Whether the meter can be used to get demand details
15. Whether optical readout facility provided.
16. Whether detailed literatures enclosed
17. Additional features provided

VI ANNUNCIATOR :

1. a. Type & particulars of windows
- b. Whether the annunciator is electro mechanical type yes/ No
1. Particulars of wiring

2. Rated voltage
3. Power Consumption
4. Instantaneous making capacity of contacts.
5. Breaking capacity
6. Overall. dimensions of annunciator group
 - i. Descriptive leaflet of schematic diagram.

VII (A) GENERAL PROTECTION RELAY

- I** The tenderer shall furnish guaranteed Technical particulars for all types of meters offered, in the following proforma (separate sheet shall be enclosed for each type of relay :)
 - 1 Manufacturer's name or trade marks
 - 2 Type designation
 - 3 Size and mounting details (whether in draw out case)
 - 4 Rated Values of both input and auxiliary energizing quantities
 - 5 Values of the limits of the operative range(s) of the auxiliary energising quantity (ies)
 - 6 Contacts data, Number and rating of main and auxiliary contacts
 - 7 Rated value or setting range of the characteristic quantities and or angle
 - 8 Limiting short-time thermal withstand values
 - 9 Limiting dynamic values.
 - 10
 - i. Burden data (in case of poly input relays - data shall be furnished for appropriate set of input terminals).
 - a. At highest tap - AC current / voltage coil
 - b. At lowest tap - AC current / voltage (coil)
 - ii. DC power consumption.
 - 11 Impulse and dielectric test voltage(s)
 - 12 Details of accessories (If essential to the relay performance)
 - 13 Details of accessories (Optional items)
 - 14 Whether provided with seal in trip contacts
 - 15
 - a. Type of operating characteristics
 - b. Accuracy of operating characteristics, operating time with details

- 16 H.F. disturbance test voltage (s)
- 17 Whether literature enclosed
- 18 Type of relay flag indicator and rating of target coil

VII PROTECTIVE RELAYS

- 1. Non- directional IDMT/
Inst. OCR/ EFR Relays.
 - a) Type
 - b) Current coil rating
 - c) VA burden
 - 1) Highest tap
 - 2) Lowest tap.
 - d) Tap range
 - e) Power consumption
 - 1) Highest tap
 - 2) Lowest tap
 - f) Time of operation at maximum dial Setting at:
 - 1) 5 times tap setting current
 - 2) 10 times tap setting current
 - g) Type of characteristics
 - h) Whether drawout type or not
 - i) Trip contact rating amps.
 - j). Whether seal in contacts provided or not.
- 2. DIRECTIONAL OVER CURRENT RELAY
 - a) Type
 - b) Current coil rating
 - c) VA burden

- i. Highest tap
 - ii. Lowest tap.
- d) Tap range
- e) Power consumption
 - 1) Highest tap
 - 2) Lowest tap
- f) Time of operation at maximum dial Setting at:
 - 1) 5 times tap setting current
 - 2) 10 times tap setting current
- g) Type of characteristics
- h) Whether draw out type or not
- i) Trip contact rating amps.
- j) Whether seal in contacts provided or not.
- k) Minimum voltage at which relay operates

VIII CIRCUIT BREAKER:

- 1. RATING
 - a. No. of poles
 - b. Rated voltage
 - c. Rated normal current
 - d. Rated frequency
 - e. Making capacity in peak kA
 - f. Breaking capacity :
 - i) Symmetrical in KA and MVA
 - i) Asymmetrical

- ii) The maximum Capacity of the Capacitor bank for which the breaker is designed to open
- g. Short time current in kA
- h. Operating duty

2. DETAILS OF SHORT CIRCUIT

TYPE TEST CERTIFICATES

3. CONSTRUCTIONAL PARTICULARS:

- a. No. of breaks in series per pole
- b. Total length of breaks per pole
- c. Type of main contacts
- d. Type of arcing contacts
- e. Type arc control device
- f. Min. clearance in air
 - a) Between live parts
 - b) Between live parts and earth
- g. minimum clearance in VCB
- h. Mechanical endurance
- i. Electrical endurance
- j. Method of closing mechanism
 - i) Type of operating mechanism
 - ii) Whether hand or power or both
 - iii) Whether the circuit breaker is designed to close and latch on making or is fitted with a making current release.
 - iv) Whether the circuit breaker is trip free.

- v) Time required to charge the spring.
- vi) Details of spring charging motor power required at designed normal voltage
- k. Normal voltage of shunt trip coil
- l. Power required at normal voltage in VA

4. OPERATING PARTICULARS

- a. Opening time
 - a) With no current
 - b) At rated breaking current
- b. Closing arc duration at
 - a) 10% SC breaking current
 - b) 60% SC breaking current
 - c) 80% SC breaking current
 - d) 100% SC breaking current
- C. Speed of Break at -
 - a) 10% SC breaking current
 - b) 60% SC breaking current
 - c) 80% SC breaking current
 - d) 100% SC breaking current

IX CURRENT TRANSFORMER:

- a) Make
- b) Type
- C) Ratio
- d) Burden
- e) Accuracy class as per ISS

X POTENTIAL TRANSFORMERS

- a) Make
- b) Type
- c) Ratio
- d) Burden
- e) Accuracy class

XI AUXILARY TRANSFORMER

- a) Make
- b) Type
- C) Ratio
- d) Details of OFF load taps

XII BUSBARS:

- 1. Size
 - 2. Material
 - 3. Whether insulated
 - 4. Make/ type of busbar insulator
 - 5. Creepage distance of busbar insulator
 - 6. Clearance between phase to phase }
 - 7. Clearance between phase to earth. }
- }For main bus bars / risers/
connectors / ties.

Schedule –C

SCHEDULE OF DEVIATIONS FROM SPECIFICATION

All deviation from this specification, shall be set out by the bidder, clause by clause, in this schedule, unless specifically mentioned in this schedule the bidder shall be deemed to conform to the owner's specification.

Sl. No. justification	Clause No.	Details of deviation with
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SCHEDULE - D
Schedule of Tenderer's Experience

1. Name of the Manufacturer :
2. Standing of the Firm as manufacturer of Equipment :
3. Testing Facility at manufacturer's work. :
4. If the Manufacturer is having collaboration With another Firm, details regarding standing of parent Firm, Period of collaboration :
5. Description of equipment similar to that quoted, supplied and installed during the last 3 years with names of parties to whom the supplies are made along with the names of persons to whom a reference may be made by purchaser in case the considers such a reference necessary : Shall be furnished in the Form indicated below

Sl. No.	Description	Value of Work	Place Where installed	Period of Execution & date	Client	Persons to whom reference can be made
(a)	(b)	(c)	(d)	(e)	(g)	(h)

Signature :.....

Designation:.....

Company:.....

Date :.....