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**11KV 220V DC FEEDER VCBs
WITH CONTROL & RELAY PANELS AND
CURRENT TRANSFORMERS OF RATIO
400-200-100/1-1A WITH IED
(INTELLIGENT ELECTRONIC DEVICE) RELAYS**

1. SCOPE :

This specification covers the manufacture, assembly, supply and delivery of Destination stores of 11 KV (Vacuum) Out Door porcelain clad pad type circuit breakers including current transformers, meters, relays and control panels for outdoor installations. The power system is with neutral solidly earthed. The equipment shall be guaranteed for 5 years.

II. APPLICABLE STANDARDS:

Unless otherwise modified in this specification, the Circuit Breakers, Current Transformers etc. shall comply with the following Standards with latest amendments.

IS	13118/1991 – High Voltage A.C. Circuit Breakers.
IEC	62271-100/2008 – Circuit Breakers (latest version).
IS	2705 (Part I to IV/1992) – Current Transformers.
IS	2099/1986 – Bushings for Alternating Voltages.
IS	13010/2003 IS 13779/1999 – Energy Meters
IS	3231/1986 & 87 – Relays.
IS	1248/2003 – Ammeters & Voltmeters.
IS	13947/Pt 1/93 – Degree of protection provided by Enclosures.

III. CLIMATIC CONDITIONS:

The climatic conditions under which the equipment shall operate satisfactorily are as indicated at clause No.22 of General and Financial terms and conditions for supply of materials.

IV. PRINCIPAL PARAMETERS :**1. CIRCUIT BREAKERS :**

1.1.	Nominal System Voltage	:	11KV
1.2	Type	:	Vacuum porcelain clad
1.3	Service	:	out door
1.4	No. of Poles/Phases	:	THREE
1.5	High system voltage	:	12KV
1.6	Rated Frequency	:	50 Hz
1.7	System of earthing	:	Neutral solidly grounded
1.8	Insulation level	:	
1.8.1.	Impulse withstand Voltage	:	75 KVP
1.8.2	One minute power frequency: withstand voltage.	:	28 KV (rms)
1.8.3	Power frequency withstand :	:	2 KV (rms)/1 Minute voltage on Auxiliary circuit

Note : Please note that the above insulation levels supply at the reference conditions of temperate, pressure and humidity specified below :

Temperature :	20 degree C.
Pressure :	1013 millibars
Humidity :	11 g/m ³

- 1.9 Rated Thermal Current : 1250 A
- 1.10. Rated short circuit breaking current:
- 1.10.1. Symmetrical : 25 KA/3 Sec
- 1.10.2. Asymmetrical : As per IS – 13118/1991 or IEC – 62271-100/2008
- 1.11. Rating making capacity : 2.50 times Rated Short circuit breaking Current (Symmetrical)
- 1.12. Rated short time withstand Current for 3 Sec. : 25 KA
- 1.13 Total break time : **60 m. sec (max)**
- 1.14 Bushing Insulator
Creepage distance : Not less than 300 mm
- 1.15. Mounting : Steel Structure
- 1.16. Rated Operating Sequence : O-0.3S – CO-3min - CO
- 1.17. Operating Mechanism : Motor operated/ manual spring Charged. The standard DC Voltage for the operating devices shall be 250V DC .Operating Voltage for motor spring charging mechanism shall be 250V +/- 20 % DC/ AC single phase. Normally the breaker shall be operated by Power and there shall be provision for manual operation.
- 1.18. Terminal Connector :
- 1.18.1. Material : Aluminium
- 1.18.2. Suitable for : Panther ACSR
- 1.19. Limits of temperature : The limits of temperature shall be in accordance with IS-13118/ IEC-62271-100/2008
- 1.20. Requirement of Simultaneity of Poles : The maximum difference between instants of contact touching during closing and the maximum difference between the instant of contacts separation during opening between 3 poles shall not exceed one half cycle of the rated frequency. The Breaker shall be open and close simultaneously on all three phases for fault on any phase and or all the phases.
- 1.21 Protection : The Breaker shall be provided with
I) Feeder protection IED(Intelligent Electronic Device) Relays (As per Annexure)
II) Anti pumping relay.
III) Master trip relay (H/R)
- Note: The IED (Intelligent Electronic Device) relays shall be draw out type and mechanical relays are of non-draw out type.
- 1.22 Auxiliary Power Supply :
- 1.22.1 A.C. Supply : 250 V + or – 20% (Phase to neutral),
50 HZ + or – 5%,
Effectively earthed system.
- 1.22.2 D.C. Supply : 250V + or – 20%, 2 wire
ungrounded system.

1.22.3. Supply point:

1.22.3.1 Auxiliary power supplies listed above will be made Available to each circuit breaker as below :

A.C. Supply : Single Feeder
D.C. Supply : Single feeder

1.22.3.2 M.C.B. shall be provided at the circuit breaker for each incoming A.C. Supply. For D.C. supply double pole M.C.B. shall be provided. (with different colours for easy identification).
The rating of MCB shall be 10A.

2. Current Transformers (for 11 KV Feeder Breakers only):

2.1	Rated voltage	11 KV	
2.2.	Type	:	Single phase outdoor live tank oil cooled Vacuum impregnated type –
			Solidly earthed
2.3.	Earthing	:	Solidly earthed
2.4	Insulation level		
2.4.1	Nominal system voltage	:	11 KV
2.4.2	.Highest system voltage	:	12 KV
2.4.3.	Impulse withstand voltage	:	75 KV P
2.4.4	One minute power frequency Withstand voltage	:	
	a. Primary	:	28 KV
	b. Secondary	:	3 KV
2.5	Frequency	:	50 Hz
2.6	Transformation ratio	:	400-200-100/1-1A
2.7	Rated secondary current (Amp)	:	
	i) Core I (Protection)	:	1
	ii) Core II (Metering)	:	1
2.8	Rated output (VA)	:	
	i) Protection	:	15 VA
	ii) Metering	:	5 VA
2.9.	Class of accuracy :		
2.9.1.i)	Protection (Core I)	:	5P10
2.9.1.ii)	Metering (Core II)	:	0.2S
2.10	Short time thermal current And its duration	:	The short time thermal current should Suit the breaker rupturing capacity and Duration to suit the maximum tripping Time.
2.11	Accuracy Limit factor	:	--- 10 for protective core ---
2.12	Class of Insulation	:	Immersed in new insulating oil.
2.12.1	Limit of Temp. Rise (Max.)	:	55 Degree C.
2.13	Rated Continuous Thermal Current	:	630 A

NOTE: The CTs shall be live tank out door type and shall be offered with first filling of oil. The oil shall confirm to the latest IS:335.

V. TECHNICAL REQUIREMENTS :

I. CIRCUIT BREAKERS

1.1 DESIGN CRITERIA

The equipment will be used in High Voltage system having characteristics as listed in the specification.

The equipment will be installed outdoor in hot, humid and tropical atmosphere.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

The safety clearances of all live parts of the equipment shall be as per relevant standards.

1.2 TYPE AND DUTY:

The circuit breaker shall be outdoor, 3-pole, vacuum type M2 class (minimum 10,000 operations) in case of 11KV having internal isolation without any sequential interlock.

In the event of order, the tenderer have to offer at least one breaker out of the offered lot in first inspection for testing in respect of Temperature rise test and Mechanical endurance test of 10,000 Mechanical operations (M2 Class) in presence of purchaser representative as an acceptance test.

The duty of the circuit breaker shall involve satisfactory interruption of short circuit currents as listed in the clause-IV (Principal Parameters).

The breaker shall be capable of interruption of reactive current (lagging/leading) without under/over voltage.

1.3 CONSTRUCTION FEATURES :

1.3.1 GENERAL ARRANGEMENTS :

The circuit breaker shall have fixed type construction consisting three single identical poles, complete with a gang operated mechanism for specified duty. The interrupters shall be enclosed in a sealed porcelain housing conforming to protection to IS 13947 Part-1 equivalent IP- 65 protection (IS:2147). All three poles of circuit breaker shall be linked together electrically/mechanically to ensure simultaneous closing/tripping of all poles.

The trip free operating mechanism, 3 phase inter connection links shall be completely accommodated in the base. There shall be sufficient clearance between live parts of the circuit breakers and the ground. The circuit breaker shall be complete with operating mechanism, other accessories/materials to ensure complete assembly and proper functioning. The current transformers shall be externally mounted on the supporting structure integrated with circuit Breaker structure. Terminal connectors suitable for panther ACSR conductor for

11KV should be supplied for Circuit Breakers and CTs. The circuit breaker shall be provided with proper standard earthing and with terminal earth bar for earthing connection. Suitable interconnection cable from breaker terminal, CTs terminal to control relay panel is 2.5 Sq.mm. PVC copper control cable (un-armored) are to be provided.

Neither the circuit breaker nor any part of the switchgear or its supporting structures shall be permanently strained due to vibration etc. when making or breaking the rated short circuit currents.

The details of any device incorporated in the current breakers to limit or control the rate of restriking voltage across the circuit breaking contacts shall be stated.

The vacuum interrupter assembly used in the circuit breakers shall be interchangeable with indigenously available vacuum interrupters (make and type shall be mentioned.).

All metal enclosures shall be fabricated from minimum 2.5mm CRCA steel sheet free from all surface defects. The panel shall have sufficient structural re-enforcement to ensure a plain surface to limit vibration and to provide rigidity during dispatch and installation.

1.3.2 MAIN CONTACTS AND ARC QUENCHING CHAMBER :

The main contacts shall have adequate area and contact pressure for carrying rated continuous and short time current without excessive heating liable to cause pitting and welding.

The tips of the arcing and main contacts shall be special copper-chromium alloy

The contacts that are adjustable to allow for wear, shall be easily replaceable and shall have minimum movable part and adjustments. The arc-quenching device shall be of robust construction and shall not require any critical adjustment. The devices shall be easily accessible and removable for access to the breaker contacts.

Flexible laminations shall be of electrolytic copper. The ends of the laminations shall be solidified with hot pressed /electro fusion/electro solidification method to ensure good electrical contacts and achieve minimum contact resistance.

1.3.3. INTERLOCK :

All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the circuit breaker shall be furnished.

1.3.4. AUXILIARY CONTACTS :

Each breaker shall be provided with 6 normally open and 6 normally closed electrically separate spare Auxiliary contacts in addition to those required for its own operation and indication exclusively for purchaser's use.

The auxiliary contacts shall be rated for 10A for AC and 10A for DC.

Note : 1. 1no Spare tripping coil and 1no closing coil shall be clamped in the Breaker

2. Spring charging multiplier with 2 NO + 2NC shall be available and shall be wired to the spare terminal blocks.
3. Auxiliary switch contact multiplier shall also be incorporated in the control panel and shall be wired to the spare terminal blocks.

1.3.5. INSULATORS :

Bushing insulators for circuit Breakers shall comply with IS2099-1986 specification for High Voltage porcelain bushings.

Insulators shall be wet process porcelain, brown glazed and free from all blemishes. Ferrous metal parts and hardware shall be hot-dip galvanized.

Insulators shall have adequate mechanical strength and rigidity to withstand the duty involved.

When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary, shall be provided. Insulation shall be coordinated with basic impulse level of the system. The creepage distance shall correspond to heavily polluted atmosphere.

1.4. OPERATING MECHANISM:

The operating mechanism shall be motor operated and manual operated spring closing mechanism with trip free features complete with shut trip coils. All three poles of the breaker shall operate simultaneously. It shall operate in principle in such a way that the closing springs after each closing operation, are automatically charged by the motor and locked in the charged position by a latch. Means shall be provided to charge the springs manually also. Provision shall be made for the slow closing of the VCB irrespective of spring charge position.

The contact loading spring shall be designed in such a way that the closing stroke be completed and the opening stroke is commenced only from fully closed position. All the breakers shall be suitable for manual operation as well as slow closing irrespective of spring charge position.

Operation counter and mechanically operated indicator to show whether the circuit breaker is open or closed shall be provided on the circuit breaker operating mechanism.

All manually operating gear shall be so designed that the circuit breaker can be operated by one movement. The mechanism shall be such that the tripping spring can be charged while the circuit breaker is closed and the closing mechanism when charged shall not be operated by vibration caused by the circuit breaker opening under fault conditions.

The mechanism shall be designed for electrical control from remote. Local manual close/trip (lever/button) shall be provided in the mechanism box only.

No mechanical /electrical inter lock shall be inbuilt the manual spring charging of breaker.

Mechanical components other than spring charging mechanism link linkages shaft etc. shall have minimum plating thickness of 10-15 microns. The surface finishing ensures zinc

plating trivalent passivation (ROHS compliance) and should withstand for salt spray test in artificial atmosphere up to 192 hours without white rust.

All fasteners exposed to Air should be of hot dip galvanized of MS 8.8 Grade for M10 and above and below M10 grade shall be of stainless steel.

The maximum power required for closing coil and shunt trip coil should not be more than 200 watts.

1.5 CONTROL CUBICLE (MECHANISM BOX)

A common control cubicle shall be furnished to house electricals, controls, monitoring devices and all other accessories except those which must be located on individual poles.

The cubicle shall have protection as per IS:13947 Pt1 equivalent IP-55 protection (IS:2147) of gasketed weather proof construction, fabricated from sheet steel minimum 2.5mm thick.

The cubicle shall have front access door with lock and keys, and removable gland plate at the bottom for cable entry.

Additional locking arrangement (pad locking facility) is to be provided.

1.6 WIRING & TERMINAL BLOCKS :

1.6.1 WIRING

Wiring shall be complete in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

Wiring shall be done with flexible 1100 V grade, PVC insulated switch board wires with 2.5 sq.mm. stranded copper conductor.

CT wiring. TB must be connected / disconnected type of ledger type 12 way and control wiring terminal ledger must be 16A open type

All CT wiring must be done with 2.5mm/ 4 mm dia ring type lugs only

Each wire shall be identified at both ends with permanent markers bearing wire numbers as per wiring diagram. The wiring schematic may conform to relevant standards.

Wire termination shall be done with crimping type connectors with insulating sleeves.

All spare contacts of relays, push buttons, auxiliary switchers etc. shall be wired upto terminal blocks in the control cubicle.

1.6.2. TERMINAL BLOCKS :

Terminal blocks shall be 1100 V grade, box clamp type (Stud Type).

Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to constructive terminals.

1.7 NAME/RATING PLATE:

BREAKERS : Each circuit-breaker shall be provided with a name plate or plates legibly and indelibly marked with the following information:

- a) Name of manufacturer.
- b) Type of designation and serial number.
- c) Rated Voltage and current.
- d) Rated frequency.
- e) Rated symmetrical breaking capacity.
- f) Rated making capacity and
- g) Rated short-time current and its duration.
- h) P.O.No. with Date
- i) Period of guarantee

- Note :
1. The word "Rated" need not appear on the name plate, recognized abbreviations may be used to express the above quantities.
 2. When the circuit breaker is fitted with closing and/or tripping devices necessitating any auxiliary supply the nature of the auxiliary supply shall be stated either on the circuit breaker name-plate or in any other acceptable position.
 3. The purchase order No. and date and year of supply and the words AP-PDCL must be etched on the name plate.

CONTROL & RELAY PANELS :

2.1 CONSTRUCTION :

The Control panels to house meters, relays and other items shall be weather proof and vermin proof and of rust-free pressed steel cubicle type with hinged door and locking device. Ventilation louvers shall be provided with GI mesh. The frame shall be made of angle iron or structural steel of sufficient weight and strength to ensure permanent rigidly and alignment. The control panel shall be provided with inter connections, small wiring leads, terminal bolts, fuses, earth bar, multi core cable glands, earth connections etc, The panel should be provided with locking handle with built-in door lock and lock shall be provided with duplicate keys.

The outdoor panels shall be preferable of the following dimensions :-

Height 1750 mm (Excluding height of the stand 350mm)

Width 600 mm

Depth 600 mm

The exterior of the panels shall be painted with dark admiral grey colour and interior should be painted with half white colour. The panel shall be provided with fuse units/MCBs

for AC Circuit (both phase and neutral) for all phases of potential Circuit (Potential coil connections to energy meters etc.) DC control circuit etc. The internal wiring of the panels shall be with 2.5 sq.mm 1100 V grade standard copper PVC Insulated wiring of reputed make.

The Gauge of the sheet steel for the front of the panels (where the meters etc. are fixed) and supporting members of the panels shall be of 3 mm thick and for the other members of the panel sheet steel thickness shall be 2 mm.

Wherever control panels are fixed to the breaker structure necessary clearance from the ground to read the meters and to operate the switches shall be maintained. The suitable interconnection cable from breaker terminal, CTs terminal to control relay panel is 2.5 Sq.mm. PVC copper control cable (un-armored) shall be provided. "Weather proof vermin proof control and relay panel shall be either structure mounted/floor mounted".

2.2 PAINTING:

Before painting all non-galvanised parts shall be completely cleaned and made free of rust, scale and grease and all external rough surface cavities on casting shall be filled by metal deposition.

The interior parts and internal structural steel work shall be cleaned of all scale and rust by sand blasting or other approved method.

All metal enclosures shall be treated in 7 tank Pre-treatment process & should be painted with UV Resistant Pure Polyester Powder coating. The powder coated sheet steel fabrication shall fulfill 700Hrs of Salt spray test. The thickness of painting/powder coating shall be of 70-90 microns to withstand tropical heat and extremes of weather. The paint shall be guaranteed for 5 years from the date of receipt of material.

IV. CURRENT TRANSFORMERS :

3.1 CONSTRUCTION

The core shall be high grade non-ageing electrical silicon-laminated steel of low hysteresis loss and high permeability to ensure high accuracy, at both normal and over current.

The secondary terminals shall be brought into a compartment on one side of current transformer for easy access. The Secondary terminal shall be provided with short circuiting arrangements. The secondary taps shall be adequately reinforced to withstand normal handling, without damage.

The current transformers shall be suitable for mounting on steel structures or concrete pedestals. The necessary flanges, bolts, etc, for the base of the Current Transformer shall be supplied and these shall be galvanized. The current transformer tank and other metal parts shall be galvanized.

All windings of Current Transformers shall be made of double paper covering insulation and the manufacturing of the units shall be done in completely closed and air-conditioned room. Fiber glass insulation sleeves are to be provided for primary winding. Details of winding and core shall be furnished.

The Current Transformers shall be complete in all respects with filling of oil conforming to IS:335 and with oil level indicator with minimum/maximum oil levels.

The top cover and terminal box cover should be such that rain water does not enter even through the gaskets.

The cover of the CT should be designed to avoid the stagnation of water. The creepage distance should be 300mm (min).

The minimum clearance required between poles in air required should be 300mm.

Note : Facility for selecting the CT ratio in the control panel by closing the appropriate links in the Control and Relay Panel shall be provided. In no case changing of CT ratio with primary links shall be provided.

3.2 PRIMARY & SECONDARY TERMINALS: Primary terminals of Current Transformers to which the line connections are to be made shall have dimensions as per IS: 10601:1983 and material shall be of tinned cooper.

The secondary terminals shall be brought out into suitable compartment, which shall have a removable cover. The terminal box with the cover closed and tightened and the cable/conduit in position when supplied shall have a degree of protection conforming to IP 54 of IS: 2147. The secondary terminals will be M6 Tinned Brass studs.

3.3. TERMINAL AND EARTH CONNECTORS: Terminal connectors suitable for Panther ACSR Conductor shall be supplied. Suitable earth connectors for earthing connections shall also be supplied.

Thickness of the clamp must be minimum of 12mm and the stud clamp will be bimetallic.

3.4. EARTHING: The assembly comprising of the chasis, frame work and the fixed parts of the metal casing of the CT, shall be provided with two separate earthing terminals. The earthing terminals shall be adequate size protected against corrosion and metallicly clean and identified by means of the sign marked in a legible and indelible manner on or adjacent to the terminals.

3.5. SEALING ARRANGEMENT: Provision for sealing secondary terminal compartment, primary ratio change strips (if any) and tank effectively shall be made such that no fraud etc. such as tampering of the ratio or circuit (current) is possible. The holes provided for the above sealing provision shall be of adequate size and pass the sealing wire of about 14 SWG.

3.6. Each instrument Transformer shall be provided with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

3.7. For compensation of variation in volume of the oil due to temperature variation nitrogen cushion or stainless steel bellows shall be sued. Rubber diaphragms shall not be permitted for this purpose.

3.8. The units shall be vacuum filled with oil, after processing and thereafter hermetically sealed to eliminate air and moisture from entering the tank.

3.9 NAME/RATING PLATE :

Each Current Transformer shall have the following particulars indelibly marked on it or on a label permanently secure to it or its casing.

- a) Manufacturer's Name :
- b) Manufacturer's Sl.No. and /or type of designation:
- c) Rated transformation ratio :
- d) Rated Frequency
- e) Highest system voltage
- f) Insulation level and
- g) Rated short time thermal current with the associated rate time and rated dynamic current.

The Purchase Order No. and date and year of supply and the words "AP-PDCL" must be etched on the name plate.

VI. SCHEDULE OF EQUIPMENT

1. CIRCUIT BREAKERS :

Vacuum Circuit Breaker complete with suitable painted steel support structure (with anchor bolts & nuts) for mounting 1 No. circuit breaker – 3 poles. Mechanism box, control and relay panel and Current Transformers.

- Note :
1. Earth strips as per IS shall be provided for proper earthing of equipments.
 2. Earth bar of copper (suitable for termination of 2 nos. 40 * 6 mm flats) shall be provided on circuit breaker support structure.
 3. Connecting Cable from Breaker to Control panel and Breaker to CTs are to be provided.
 - 3 (i) For feeder breakers, cable from Breaker to CTs – 4 Core Cable of 5 mtrs length from each CT, i.e., 15 mtrs/ Breaker and from Breaker to control panel 10 Core cable of 15 mtrs length.
 - 3 (ii) Size of interconnection cable from breaker terminal, CTs terminal to control relay panel is 2.5 Sq.mm. PVC copper control cable (un-armored).

2. MECHANISM BOX CONTAINING :

- a) Operating mechanism
- b) Mechanical indicator for "ON" and "OFF" coupled to the Circuit breaker operating mechanism.
- c) Mechanical close and trip (with protective flap) lever/push button.
- d) Terminal blocks for control wiring and a spare terminal block (with 20% of the active terminals) (preferably nut & bolts type).
- e) Operation Counter.
- f) Operating handle for manual charging of springs and for slow closing. 2 Nos. cable glands over and above those provided for control cables with suitable dummies.

- g) Not less than 6 numbers normally open and 6 normally closed spare auxiliary contacts over and above those required for normal operation.
- h) 250 V single phase AC Motor/Manual operated spring charging mechanism complete with electrical spring release coil, 2 Nos. shunt trip coil and 1 No. closing coil.
- i) Local – Remote selector switch.
- j) Earth bar (suitable for termination of 2 Nos. 50 x 6 mm class)
- k) 6 Nos. Terminal connectors for incoming and outgoing connectors.
- l) 6 Nos. Terminal connectors suitable for panther conductor for incoming and outgoing connector for outdoor VCB.
- m) Set of 2 pole MCBs for AC and DC supply with different colours.
- n) 1 No. of reputed make anti-pumping relay.
If offered breaker is with anti pumping mechanism plug in relay is also acceptable.
- o) TNC Switch heavy duty piston grip type

3. CONTROL AND RELAY PANEL :

Weather proof vermin proof control and relay panel shall be either structure mounted/floor mounted having equipped as follows:

- a) 3 ½ Digit LED Display CT operated digital A.C. Ammeter with Class of Accuracy 0.5 to suit the CT ranges indicated in Section-IV Schedule of materials of Size (96x96) mm.
- b) One ammeter selector switch with “R”, “Y”, “B”, “Neutral” and “OFF” position of size (96x96) mm..
- c) One Heavy duty Piston grip type Control Switch for VCB trip/Neutral/Close positions with spring return to neutral position.
- d) One Red LED and one Green LED indicating lamps for indicating close and open positions respectively.
- e) One Yellow lamp for healthy trip indication with push button control.
- f) One white lamp for spring charged indication.
- g) One amber Lamp for auto-trip indication.

Note: All indication lamps shall be of LED type of variable voltage of 250V DC + or – 10% preferably of reputed make.

- h) One 3 phase 4 wire static HT Tri vector CMRI compatible as per AP-PDCL standards 0.2S Class of accuracy suitable scaled to work on 110V AC 50 Hz 1 Amp to suit the CT ranges as indicated in this specification.
- i) Numeric Relays shall be of reputed make with the following features.
 - a) Feeder IED relays(As per annexure)

- b) Master trip relay of 250V DC or equivalent shall be provided (Hand Reset type).
- j) Two Nos. cable glands over and above those provided for control CT, PT, Control Circuit cables and auxiliary supplies (AC&DC) with suitable dummies.
- k) 3 ½ Digit LED Display digital A.C. Voltmeter with 7 positions switches with RY-YB-BR-RN-YN-BN-OFF selector switch with size 96x96 Sq.mm
- l) 3 ½ Digit LED Display digital A.C. Voltmeter with selector switch for 11KV Feeder control VCBs size 96X96mm..
- m) Master trip relays (Hand reset type) fast acting relay is to be provided.
- n) DC fail Supervision relay and Trip circuit Supervision relays shall be provided for each Trip coil.

One set alarm bell and push button for acceptance of alarm. Audio alarms shall be static Hooters of reputed make. Voltage rating shall be 220V DC.
- o) Necessary LT Fuses/MCBs for Control Circuit. Set of fine wiring with ferrules with standard code number of respective terminals and with suitable terminal connectors.
- p) 250 V three pin socket with plug & switch.
- q) 3Ph 4wire Test terminal block with CT and PT terminals with screw type for testing ammeter and energy meter.
- r) Stud terminal blocks (Bolt and nut type) for CT and PT control cables suitably wired with 6 Nos. spare terminals.
- s) One suitable copper earth strip of 12 x 3 mm size with adequate number of holes with suitable nuts and bolts.

- NOTE : 1. All the instruments and relays to be proved on control panel shall be flush mounted unless otherwise specified. The relays are to be worked on 1/5 amp secondary current of CTs and with DC Voltage of 250 V.
2. All the indicating meters (Ammeter, Voltmeter meter) shall be of 96mm x 96mm size or standard size and preferable of reputed make.
3. Auxiliary supply for voltmeter and Ammeter should be 110V AC.
- t) 1 No. push button for Trip Circuit healthy check-up.
 - u) 1 No. plug point with switch (10A, 250 V AC)
 - v) 1 No. Illuminator lamp with switch (40W, 250 V AC)
 - w) 1 No. panel space heater with heater switch thermostat.
3. CURRENT TRANSFORMERS. Three numbers outdoor CTs as specified.
4. Terminals connectors suitable for panther ACSR conductor for 11KV shall be supplied for Circuit Breaker (6 Nos.) and CT terminals (6 Nos.)

Suitable interconnection cable from breaker terminal, CTs terminal to control relay panel is 2.5 Sq.mm. PVC copper control cable (un-armored) are to be provided.

Cables from circuit breaker and CTs to control panel shall be provided. As specified in Schedule of equipment.

Note: Other standard accessories which are not specifically mentioned but supplied with breakers of similar type and rating for efficient and trouble free operation shall be provided.

VII. TESTS :

The Circuit breakers and current transformers shall be subjected to the following routine and type tests in accordance with the details specified in the relevant Indian Standards as amended from time to time or any other equivalent international standards.

1. CIRCUIT BREAKER: IS 13118/ IEC-62271-100/2008 (Latest version).

Copy of type test reports shall be enclosed to the tender. The date of type tests shall not be later than 5 years as on the date of bid opening.

1.1. ROUTINE TESTS :

- a) Measurement of resistance of the main circuits.
- b) Operation tests.
- c) One minute power frequency voltage dry withstand test on the circuit breakers.
- d) One minute power frequency voltage dry withstand test on auxiliary circuits.

1.2 TYPE TESTS :Tests shall be done as per IS/IEC.

- a) Temperature rise test for the main circuits.
- b) Measurement of resistance of the main circuit.
- c) Operation tests.
- d) Mechanical endurance tests (M2 class suitable for 10000 operations)
- e) Impulse voltage tests.
- f) One minute power frequency voltage dry withstand tests.
- g) One minute power frequency voltage wet withstand tests.
- h) Tests for short circuit conditions.
- i) Tests for short time current.
- j) Seismic test.
- k) Capacitor switching duty test.

2. CURRENT TRANSFORMERS:

2.1. The following Type tests as per IS 2705 (Latest version) shall be conducted and Type Test Certificates for the Tests shall be enclosed along with the tender. The date of type tests shall not be later than 5 years as on the date of bid opening.

- a) Short time current Test.
- b) Temperature rise test.
- c) Lightning Impulse Test.

- d) High Voltage Power frequency wet withstand voltage test.
- e) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.

2.2 ACCEPTANCE & ROUTINE TESTS: The following tests shall be conducted as per IS:2705:1992.

- a) Verification of terminal marking and polarity.
- b) Power frequency dry withstand Test on primary & secondary windings.
- c) Over Voltage Interturn test.
- d) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.

Note: Satisfactory Valid type test certificates from Central Govt. /NABL/International labs is to be furnished for the tests mentioned above as per the specification along with tender bid. Type tests applicable as per IS:13118 or IEC – 62271-100. The bid without required type test certificates, the offer shall be treated as non-responsive. Provisional/in house type testing reports are not acceptable.

VIII SPECIAL GUARANTEE FOR CIRCUIT BREAKES :

- i) The Circuit Breakers (total equipment including Control relay panel and CTs) shall be guaranteed for satisfactory operation for a period of 5 years (five years) from the date of receipt at stores.

IX. DRAWING

Drawings and technical literature of Breakers, Current Transformers and panels shall be enclosed to the Officer, Tenders not accompanied by the above are liable to be rejected. These drawings and literature are to be supplied in duplicate copies along with each unit in the event of order and are to be housed in a proper weather proof enclosure on the rear of the control panel door. One set of reproducible drawings shall be supplied. Schematic wiring diagrams of the control circuits of the circuit breaker and control & relay panel shall be displayed (embossed on a plate/Laminated) on the doors of the circuit breaker, control cubicle and control & relay panel respectively.

X. OVERALL DIMENSIONS AND FOUNDATION DETAILS:

The manufacturer shall give the necessary information as regards the overall dimensions of the circuit breaker and foundation details.

XI. PACKING :

All the equipments shall be packed in suitable crates with suitable steel bands so as to withstand rough handling and storage at destination.

XII. SPARE PARTS:

A list of recommended spares including vacuum interrupters may be indicated for operation of each type breaker along with their prices.

The prices of the following spares shall be quoted.

1. Spring charging motor
2. 11kV Interrupter 1250Amp,25KA/3Sec
3. TNC switch
4. Breaker Auxiliary Switch.
5. Tripping Coil & Closing coil.

Spring charge motors, tripping & closing coils shall be supplied 5% of the tender quantity as spares.

XIII . Support structure shall be galvanized as per relevant standards.

XIV. DC Fail shall be sensed by a relay or equivalent and indication of DC Fail shall be given with an indication lamp.

GUARANTEED TECHNICAL PARTICULARS FOR CIRCUIT BREAKERS

11 KV Feeder VCBs

1 RATED VALUES AND CHARACTERISTICS :

- a) No. of Poles
- b) Manufacturer's type & designation
- c) Rated Voltage
- d) Rated Insulation-Level.
 - i) Impulse withstand voltage
 - ii) One minute Power frequency withstand voltage.
 - iii) One minute Power frequency withstand voltage on Auxiliary wiring.
- e) Rated Frequency.
- f) Rated Normal Current
- g) Rated Cable charging current
- h) Rated (Single) Capacitor breaking current
- i) Rated Small Inductive breaking current
- j) Rated Symmetrical Short Circuit breaking Current and breaking capacity in MVA.
- k) Rated Transient Recovery Voltage.
- l) Rated short Circuit making current
- m) Rated Operating Sequency
- n) Rated duration of short circuit
- o) Opening time and Break time (milli Sec.)
- p) Closing Time (Milli Sec.)

2 Whether type test Certificate enclosed with the Tender.

3 Weight of complete Circuit Breaker :

- 4
 - i) Pressure maintained in vacuum chamber.
 - ii) Gap between the contacts in Vacuum.
 - iii) Area of contacts.
 - iv) The voltage to which the circuit breaker shall be capable of withstanding indefinitely across open contacts.

5. Minimum Clearance in air

- i) Between Poles
- ii) Between Live parts to earth

6. OPERATING MECHANISM OF CIRCUIT BREAKER AND ASSOCIATED EQUIPMENT :

1. Type of closing mechanism.
2. Whether Circuit breaker is Fixed trip or Trip free.
3. No. and type of auxiliary contacts (No. of spare normally open contacts and No. of spare normally closed contacts are to be indicated).
4. Power requirement :
 - i) Closing coil
 - ii) Opening coil
5. Electrical service life :
 - i) Rated Current (times)
 - ii) Rated interruption current (times)
6. Periodicity of maintenance for the following :

For maintaining Vacuum in interrupting chamber.

 - a. For maintaining Vacuum in interrupting chamber.
 - b. For changing contacts.
 - c. Other maintenance schedules if any.

II. GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMERS 11 KV Feeder CTs

1. Type
2. Manufacturer's Type & designation
3. Rated Voltage
4. Rated Primary current
5. Rated secondary current
 - Core I
 - Core II
6. No. of cores (Secondary core details)
7. Rated Output in VA
 - Core I
 - Core II
8. Class of accuracy
 - Core I
 - Core II
9. Accuracy Limiting factor
 - Core I
 - Core II
10. Method of ratio change and secondary connection details & connection diagram.
11. Secondary voltage
 - Core I
 - Core II
12. Secondary Limiting Voltage
 - Core I
 - Core II
13. One second short time current
14. Rated current dynamic (Peak value)
15. Rated continuous thermal current temp. rise over ambient.
16. One minute power frequency Dry/ Wet withstand voltage in KV (r.m.s.)
17. 1/50 micro sec. Impulse withstand test voltage in KV (Peak)
18. One minute power frequency withstand test voltage on secondaries in KV (r.m.s.)
19. Weight of Oil in Kg.
20. Total weight in Kg.
21. Magnetization curve of CT core.
22. Mounting details
23. Overall dimensions.

III. GUARANTEED TECHNICAL PARTICULARS FOR HT TRIVECTOR METERS

Sl.No.	Characteristics	
1.	Maker's name and country.	
2.	Type of Meter/model.	
3.	Accuracy class.	
4.	Power consumption for phase. i. Voltage circuit ii. Current circuit	
5.	Minimum starting current (% Ib)	
6.	Parameters measured	
7.	No. of digits of display and height of character.	
8.	P.F Range.	
9.	Variation of voltage at which meter functions normally.	
10.	Particulars of readout. a) Continuous display. b) Manually on display c) Auto display i) Parameters. ii) Scrolling period. iii) Display off period between two cycles. d) With CMRI/RMR.	
11.	Details of Meter base and cover i. Type of material ii. Dimensions and weight	
12.	Non volatile memory retention time in absence of power.	
13.	Memory capacity (KB)	
14.	Details of tamper and fraud provisions a) On display. b) With meter reading instrument and data transfer. c) Detailed explanation how the tamper detection made is furnished or not?	
15.	Guarantee for satisfactory operation of meter.	
16.	Standards to which the meter confirms	
17.	Overload capacity	
18.	Dynamic range.	
19.	a) Meter terminal block having sealable extended terminal cover. b) Connection diagram inside the terminal cover. c) Maximum safe current the terminals and screws shall carry.	
20.	Change in errors (accuracy) due to variation in voltage, frequency and temperature to be furnished. a) Voltage. i) +20% to +10-% ii) +10% to - 10%. iii) -10% to -20% iv) -20% to -30%. b) Frequency variation. i) 50 +10-% Hz. ii) 50 ± 5% Hz. c) Temperature.	

21.	Detailed explanation how the tamper detection made is furnished are not	
22.	Sealing of the meter (Nos. of seals) a) Meter cover. b) Terminal Block cover. c) Others, if any.	
23.	Whether meter carries any certification mark.	
24.	Self diagnostic features (provide details)	
25.	Principle of operation (provide details)	
26.	Any additional measuring parameters	
27	Communication ports and protocol	

ANNEXURE – I
STATIC TRIVECTOR METERS FOR USING ON 11KV FEEDERS WITH VCBS.

Three phase 4 wire Static Trivector Meter of reputed make of class 0.2S accuracy suitable to work on $110V/\sqrt{3}$ AC, 50 Hz, -1A for balanced and as well as unbalanced loads at all power factors i.e., Zero-lag-Unity-Zero lead to suit to be installed on 11KV outdoor feeder panels and to suit the CT ranges **indicated in the specification**. The meter should be capable of performing function of metering In all 4 quadrants, load survey etc. The meter shall conform to latest version of IS: 14697/99 CBIP Technical report 88/IEC 687 for accuracy and environmental and other relevant standards.

The meter should be capable of measuring the following electric parameters of poly phase supplies in all 4 quadrants at all power factors lagging or leading.

1. KWH Import and export
2. KVRH Import and export (lag & lead)
3. KVAH Import and export
4. Voltage of individual phases.
5. Currents in each individual phase.
6. Average Power factor.
7. Maximum demand (15 Minutes Integration)
8. Cumulative demand with No. of resets.
9. Real time.
10. Power off and power fully on and power partially on periods.

The meter should be capable of recording the full supply period, partial supply period and no supply period and display the same in separate tables with date, time and duration.

The meter should log the following parameters with 15 min, integration for the last **36 days** in its memory and it should be possible to transfer this data on to a base computer station through a DOS based hand held CMRI.

Parameters for logging shall be in import and export modes

1. KWH
2. Currents in all the three phases
3. KVARH
4. Voltage in all phases.

The base computer shall give complete details of load survey particulars both in numeric data form and in graphic form. Necessary software for invoking the base computer station should be provided.

The meter shall be provided with a galvanically isolated optical communication port (such as IEC-1107, PACT, ANSI etc.,) with removable cover and with locking arrangement so that it can be easily connected to a CMRI for data transfer or transfer of data through remote metering device such as modem/ multiflexer etc. The optical communication port shall also have sealing provision.

The meter shall also be provided with a sealable RS 232 Port with DLMS open protocol in addition to optical port which can be used for AMR metering along with 9 pin D-type male connector so that it can be easily connected to a hand held meter reading instrument for data transfer or subsequently hooked to remote metering device such as modem etc. Necessary protocol software should be loaded into the CMRI and Base computer station of the Board for the purpose of reading and programming the specific make(s) of static meters and accepting data from hand held terminal/CMRI and processing, generating reports and won loading instructions from the base computer station to CMRI respectively.

The supplier is responsible for maintaining the security of the data extracted from the meters using manufacturer's specific algorithms in the software up to down loading to the base computer station.

The meter shall have minimum legible 8-digit display of LCD. The display shall be digital type with non destructive readout and shall be possible to display legend for identification of display. The meter shall have facility of auto display mode where all parameters automatically scroll within the specified time. The number of parameters and the scrolling period shall be field programmable. It shall also be possible to read the parameters by a manual switch.

The non volatile memory shall have a minimum retention time of 10 years.

NOTE: All protocols are to be handed over to purchaser in advance and the memory map of the meter shall be furnished along with the tender

ANNEXURE – II

TECHNICAL SPECIFICATION FOR INTELLIGENT ELECTRONIC DEVICE (IED) FOR FEEDER PROTECTION AND CONTROL

1.0 SCOPE :

The specification covers specification of feeder Intelligent Electronic Devices (IED's) to be fixed control and relay panel.

2.0 STANDARDS :

The applicable standards of IED's are specified here below :

- | | | | |
|------|---|---|----------------------|
| i. | Impulse withstand : 5 KV | : | IEC 60255-5 |
| ii. | Fast Transients, Class IV | : | IEC 60255-22-4 |
| iii. | Electromagnetic Radiation, Class III | : | IEC 61000-4-3 |
| iv. | Degree of Protection, IP 52
on front panel | : | IEC 60529 |
| v. | Vibration, Shocks, Earthquakes, class-II | : | IEC 60255-21-1, 2, 3 |
| vi. | The unit should have conformal coating
for operation in hazardous atmosphere | : | EIA-364-65A |

3.0 SYSTEM DETAILS :

The IED's shall be suitable for outdoor and indoor installations with 3 Phase, 50 Hz, 33KV & 11KV system in which the neutral is effectively earthed and the same shall be suitable for service under fluctuations in supply voltage upto 12% permissible under Indian Electricity Rules and the frequency variation of - 5% and +2% (47, 5Hz to 51.0 Hz).

4.0 CLIMATIC CONDITIONS :

The material used in the construction of the IED's shall be suitable for use under the following climatic conditions.

- | | | | |
|----|-------------------------|---|-----------------------|
| a. | Ambient Air Temperature | : | 5 Deg. C to 70 Deg. C |
| b. | Relative Humidity | : | 0 to 100% |
| c. | Altitude | : | 0 to 100 Meters |

5.0 RATINGS :

The protection and control unit range shall be designed to accommodate all types of control power supply voltages from 75V DC to 250V DC voltages \pm 20%.

6.0 COMPLIANCE :

The relay manufacturers shall furnish the following statements to the AP_PDCL.

PICS	:	Protocol Implementation Conformance statement.
PIXIT	:	Protocol Implementation Extra Information Statement.
MICS	:	Modeling Implementation Conformance statement.

The manufacturer shall furnish a NABL accreditation certificate of Level A /Level B duly noting the relay version that are to be supplied and analyzed the UCA (Utility Communication Architecture) with KEEMA Tool.

7.0 TECHNICAL PARAMETERS :

- The relay should be dual micro processor based relay,
 - One micro processor dedicated to protection function
 - Other to all other functionality of the relays.
- The relay should provide Measurement for all basic and advance parameters like :
 - Phase Currents
 - Neutral current
 - Voltage
 - Frequency
 - Active and reactive power
 - Import and export energy
 - Thermal heat content
 - Time before start
 - No. of operations
 - Cumulative breaking current seen
- The measurement shall also be helpful for switchgear health analysis.
- The relays should have programmable LED's Outputs, Digital inputs for customized requirements.
- The relay should have big alpha numerical display for showing measurement / settings etc.,
- It should be possible to withdraw the unit without prior current circuit short-circuiting.
- The relay should have single button for resetting of the protection output and protection function.

- The relay should have remote and local selection provision.
- The relay should have all the protection functions in a single box like :
 - Instantaneous and Inverse time phase over current protection (50/51).
 - Instantaneous and Inverse time Earth fault protection (51, 51N)
 - Directional Instantaneous and Inverse time phase over current protection (67)
 - Directional Instantaneous and Inverse time Earth fault protection (67N)
 - Instantaneous and Inverse time phase under voltage protection (27)
 - Instantaneous and Inverse time phase over voltage protection (59).
 - Neutral Displacement Protection (59N).
 - Phase unbalance Protection (46)
 - Circuit Breaker failure protection (50BF)
 - Broken conductor detection protection (46BC)
 - Cold load pickup and Inrush (68)
 - Voltage Controlled Over Current (51V).
 - Reverse Power Protection (32)
 - Auto Reclose (79)

The relay should have all the Monitoring functions in a single box like

- CT Supervision (60 CTS)
- PTFP Supervision (60 PTS)
- Trip Circuit Supervision (74 CTS)

The relay should have all the Measurement functions in a single box like

- Three Phase Current
- Neutral current
- Sequence Components of Currents
- Sequence Components of voltages

- Phase to earth, Phase to Phase voltage.
- Phase Angle
- Power factor
- Active Power
- Reactive Power
- Apparent power
- Energy Measurement
- 2nd to 15th harmonic and THD of Currents.
- 2nd to 15th harmonic and THD of Voltages.
- Phasor diagram of Voltages
- Phasor diagram of Currents
- Frequency
- Actual RMS value of Currents
- Actual RMS value of Voltages
- **Setting ranges over current time delayed (51)**
 - PS : 1% to 240% of In or better
 - TMS : 0.002 to 2.00
 - Time delay at 10 I/Is : 0.05 to 300 S
 - Timer Hold Curve DT : 0.05 to 300 S
 - Timer Hold curve IDMT : 0.5 to 20 S
 - The relay should have options for TMS and time delay settings on 10I/Is settings
- **Setting ranges of short Circuit Protection (50)**
 - PS : 10 % to 2400 % of In or better
 - Time delay : 50 ms to 20 S
- **Setting ranges of Earth Fault time delayed (51 N)**

- PS : 1% to 100% of In or better
- TMS : 0.002 to 2.00
- Time delay at 10 I/Is : 0.05 to 300 S
- Timer Hold Curve DT : 0.05 to 300 S
- Timer Hold curve IDMT : 0.5 to 20 S
- The relay should have options for TMS and time delay setting on 10 I/Is settings.
- **Setting ranges of Earth Fault time delayed (50 N)**
 - PS : 10 % to 1500% of In or better
 - Time delay : 50 ms to 300 S
- **Setting ranges of Breaker failure or LBB Protection (51B)**
 - Presence of Current : 0.2 to 2 In
 - Time delay : 0.05 to 300
- **Auto recloser (79)**
 - The relay should have auto recloser function with minimum 4 recloser Cycles.
 - The Relay should have WATCH DOG feature for continuous checking of internal health of the relay and should have dedicated output for alarm and tripping for the same.
 - The relay output should have enough capacity for energizing the 400 W for
 - Direct tripping.
 - Closing of the breaker.
 - Each protection device shall have wide setting ranges, in particular for current protection.
 - The relay should have at least 5 tripping context which shows all values at the time of tripping.
 - The relay should have alarm history of 100 alarms in the alarm history through software.
 - The display of 10 alarms should be displayed on the relay front display

- The relay shall support and the user shall have a choice of curve types.
 - Definite time curve (DT), with time delay settings from instantaneous to 300 s,
 - IDMT curves adjustable either by time delay or TMS factor
 - SIT,
 - VIT,
 - LTI,
 - EIT,
 - UIT,
 - RI,
 - IEC SIT / A,
 - IEC VIT
 - LTI / B,
 - IEC EIT / C,
 - IEEE moderately inverse,
 - IEEE very inverse,
 - IEEE extremely inverse,
 - IAC inverse,
 - IAC very inverse,
 - IAC extremely inverse
- Phase over current and earth fault protection shall have an adjustable timer hold to allow restriking faults detection.
- Earth fault protection shall integrate a 2nd harmonic restraint with a facility to active or inhibit is to be provided.
- The Relay should have at least two setting Groups which are selectable by logical conditions to adapt fast protection plan change as well as remote setting facilities for thresholds and time delay adjustments.
- The unit shall allow for the use of upstream and downstream logic discrimination in order to discriminate correctly when used in a cascade scheme.
- Overload protection will be based on RMS current value

- Facility for measuring up to a minimum 13th harmonic taking into account the ambient temperature shall be provided.
- Alternative overload setting groups will be selectable by logical conditions to adapt operating mode change.
- Setting shall be performed by the direct input of actual current Values.
- Protection tripping shall be indicated on the front of the device by a LED and text indicating the cause of the fault.
- The protection and control unit shall include voltage transformer and current transformer circuit supervision
- The relay CTs secondary input should be programmable for
 - 1 Amp or
 - 5 Amp.
- The relay should have local breaker failure feature in the relay to trip an upstream breaker in case of breaker operation fails.
- Relay should have 14 DI and 10 DO Relay which should also include one dedicated change over contact for relay health check up (watch dog).
- There should an option to increase the number of DI's and DO's on a later stage without dismantling the relay form the site / panel.
- The relay should have at least 4 output contacts of power rating with min cont. rating of 400W for trip/close the breaker directly form the relay.
- Relay should be provided with relay programming software required cables etc. for free with the supplies.

Disturbance recording:

- Triggered on event (automatic or manual).
- Each record will allow or store data
 - At least 400 periods,
 - 12 values per period,
 - Number of periods before the event according to the setup.
 - Total recording time will be 800 periods
- The content of the record will be, as a minimum,
 - Date,

- Channel characteristics,
- 4 current channels (I1, I2, I3, I0)
- 3 voltage channels and the digital inputs
- The event format shall be COMTRADE 97
- The unit will provide time-tagging of minimum 200 events within an accuracy of 1 ms.
- The display indication shall be in 2 languages
 - English
 - Local
- The Protection and Control unit shall include a keypad to allow to perform the following operations :
 - Display of metering and operating data, alarm messages.
 - Clearing of alarms and resetting, acknowledgement.
- Access to setting mode shall be protected by
 - Two different customized passwords of at least 4 characters :
 - One for protecting to access the protection settings,
 - Other to protect access to the unit parameter settings.

8.0 Communication

- IED's shall support IEC 61850 Server component.
- IED's shall have optical Ethernet port connector 62.5/125 Micro meter, Multi mode port.
- IED's should support Ring formation i.e., Loop in–Loop out.
- The relay should have one serial port in front for relay programming.

9.0 Guarantee

- The relays shall be guaranteed for five years from the date of commissioning.
- The manufacturer shall demonstrate the availability of spares for all the above relays.