

**PQR For Numerical Over Current / Earth Fault Protection Relays PI NO. 240932389**

S. No	Description of requirement	Document to be attached
1	Bidder should OEM	Self-Declaration or any other supporting document
2	Bidder should have supplied same <b>or similar type of relays</b> in any one of last five financial Year to BHEL or any Central / State Govt Organization / PSU.	Purchase Order copy(s)/ Invoice(s) / Any other document certifying the supplies
3	Average annual turnover of FY2019-20, FY2020-21 and FY2021-22 should not less than Rs.1 Cr.	Single CA Certificate for average annual turnover details for relevant period. Document must have UDIN number.

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**Item 01:- Numerical over Current / Earth Fault Protection SCADA compatible Relay/IED for 11/33KV Feeder Panel**

Details	Required Parameter	Vendor Compliance
Numerical Multifunction Relay	Over current, Earth fault, Residual Over current, NPS Over current, Broken Conductor and Cold load pick up, LBB features etc as specified subsequently in below clauses.	Complied / Not complied
Minimum Protection required	49, 50/51/51N/50N, 46BC, 50Z	Complied / Not complied
Facility for two independent setting groups depending upon the status of BI shall be provided.	Required	Complied / Not complied
Mounting	Flush Mounted Draw-out type with automatic CT shorting facility	Complied / Not complied
Model	Vendor to inform in Tech. Offer	Complied / Not complied
Operating voltage:	-20% to 20% of rated voltage.	Complied / Not complied
DC Auxiliary Supply	24V DC	Complied / Not complied
Power Supply Burden	3W(DC) 12VA(AC)	Complied / Not complied
Relay Configuration Software	Refer below technical requirement	Complied / Not complied
Standard	The relay shall comply with IS 3231/1986 & 1987 and other relevant standards	Complied / Not complied
CT Input Rating	<b>1A &amp; 5A</b> (Site Selectable)	Complied / Not complied
Digital Inputs / Digital Outputs	Refer below technical requirement	Complied / Not complied
For connecting wire	(A)Rear Access robust ring terminals.	Complied / Not complied
	(B) Each terminal shall be suitable for connecting two wires of 2.5mm square cross-section.	Complied / Not complied
	(C) For termination of CT/PT wires terminals suitable for ring type lugs only are acceptable.	Complied / Not complied
	(D) Special lugs or socket, if required, shall be supplied in	Complied / Not complied

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	adequate quantity along with the relay.	
Frequency	50 Hz	Complied / Not complied
Curve selection provision for IDMT 3 Sec. & 1.3 Sec (Extreme inverse, very inverse, Normal inverse, High set with following IDMT features NI 1(1.3Sec), NI 3Sec, EI, VI, DT IS/IEC/IEEE/Curves of 3.0Sec/1.0Sec (time & current) shall be adopted.		Complied / Not complied
Relay Settings required	As per Table 1a to 1d below	Complied / Not complied
Contact Rating Carry Continuously Breaking capacity Making capacity	16A 250V AC / 24V DC Maximum 1250 VA Minimum 16A	Complied / Not complied
LED	Refer below technical requirement	Complied / Not complied
Push Buttons	For setting the relay	Complied / Not complied
Password facility	Required	Complied / Not complied
Communication	Refer below technical requirement	Complied / Not complied
16x2 Bright Alphanumeric LCD display for settings, readings and fault tripping data of minimum number 5 reports (with date and time stamping)		Complied / Not complied
Burden AC Current input 5 A Rating 1 A Rating	< 0.2 VA < 0.1 VA	Complied / Not complied
Trip circuit supervision and self-health check-up.		Complied / Not complied
Relay/IED should have provision of Disturbance Recording	Refer below technical requirement	Complied / Not complied
The bidder is also required to submit the sample of the offered relay for evaluation by end user, if required.		Complied / Not complied
The bidder must meet additional technical specification detailed below in pages 5 to 13 of this specification.		Complied / Not complied

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**Table-1a - Setting ranges for Instantaneous and Inverse time phase over current protection (50/51):**

I>	Facility for Disabled Trip, Alarm Trip with Inrush blocking Trip Latch Trip-Phase R • Trip-Phase Y Trip-Phase B			Complied / Not complied
[50/51] Phase OC	<b>Setting Range</b>			
	<b>Min.</b>	<b>Max.</b>	<b>Step</b>	
I>	0.05 In	> 2.0 In (IDMT)	0.01 In	Complied / Not complied
Delay Type	DT IEC: NI, VI, EI, LTI IEEE: VI, EI, MI			Complied / Not complied
I> DT	0.05 s	> 60 s	0.1s	Complied / Not complied
I> TMS IEC	0.025	1.00	0.01	Complied / Not complied
I> TMS IEEE	0.025	1.00	0.01	Complied / Not complied
I> Reset Delay Type	DT			Complied / Not complied
I> Reset Delay Time	< 95ms			Complied / Not complied
I >>	Facility for: Disabled Trip, Alarm Trip with Inrush blocking Trip Latch Trip-Phase R • Trip-Phase Y Trip-Phase B			Complied / Not complied
I>>	0.5 In	20 In (DT)	0.01 In	Complied / Not complied
Delay type	DT			Complied / Not complied
I>> DT	0.05 s	> 60 s	0.01 s	Complied / Not complied
I>> Reset Delay Type	DT			Complied / Not complied
I>> Reset Delay Time	< 95 ms			Complied / Not complied

**Table-1b - Setting ranges for Earth Fault Protection:**

Io>	Facility for: Disabled Trip, Alarm Trip with Inrush blocking Trip Latch Trip-Earth fault	Complied / Not complied
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	Setting Range			
	Min.	Max.	Step	
[50N/51N] Earth fault				
Io>	0.05 In	>2.0 In (IDMT)	0.01 In	Complied / Not complied
Delay Type	DT IEC: NI, VI, EI, LTI			Complied / Not complied
	IEEE: VI, EI, MI			Complied / Not complied
Io > DT	0.05 s	> 60 s	0.01 s	Complied / Not complied
Io > TMS IEC	0.025	1.00	0.01	Complied / Not complied
Io > TMS IEEE	0.5	20	0.1	Complied / Not complied
Io > Reset Delay Type	DT			Complied / Not complied
Io > Reset Delay Time	< 95 ms			Complied / Not complied
Io>>	Facility for: Disabled Trip, Alarm Trip with Inrush blocking Trip Latch Trip-Earth fault			Complied / Not complied
Io>>	0.1 In	20 In (DMT)	0.01 In	Complied / Not complied
Delay type	DT			Complied / Not complied
Io>> DT	0.05 s	> 60 s	0.01 s	Complied / Not complied
Io>> Reset Delay Type	DT			Complied / Not complied
Io>> Reset Delay Time	< 95 ms			Complied / Not complied

**Table-1c - Setting ranges for Broken Conductor Detection Protection (46BC):**

Broken Conductor detection (46BC)	Setting Range			
	Min.	Max.	Step	
I2/I1 >	2%	70%	1%	Complied / Not complied
Delay type	DT			Complied / Not complied
46BC DT	1 s	> 60 s	0.1 s	Complied / Not complied

**Table-1d - Setting ranges of Breaker failure:**

Breaker failure	Setting Range			
	Min.	Max.	Step	
Presence of Current	0.05 In	0.2 In	0.1 In	Complied / Not complied
Time delay	0.05 s	0.2 s	0.01 s	Complied / Not complied
Cold load Pickup setting	0.30 In	10 In		Complied / Not complied

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**Additional Technical specification requirement of Relay / IED**

The Supplied should be SCADA compatible IED, with 24 V DC control voltage, with IEC 61850 compliant, Fully Draw-out Type or Semi-draw out Type (where rear terminal connectors can be removed instead of disconnecting & re-connecting the entire wiring in the IED), Intelligent Electronic Devices, for protection of 11 kV Feeder VCB, from original IED manufacturer.

IED should have as minimum 4 CT inputs, 4 VT inputs, 16 DI, 8 DO. IED shall communicate data to RTU, through Dual FO ports. The IED Communication Protocol for RTU Communication will be IEC- 61850.

IED should be wired in the Control and Relay Panel, to meet all requirements of protection and control features/requirements. All wiring required to satisfy the requirement of monitoring from RTU/SCADA to be done. All spare terminals of the IED should be wired till a set of spare terminal blocks in the control and relay panel.

The working voltage of the IED shall be 24V DC.

The successful bidder must extend his full co-operation with SCADA Implementing Agency, who is executing SCADA in APCPDCL, in interfacing RTU/Data Concentrator, to get his IED data and control at SCADA control centre. If required, the bidder must demonstrate the interface and data communication between offered IEDs and RTU with IEC-61850/Data concentrator provided in substation control room.

All configuration files/setting files to be submitted in triplicate on the CD/USB for each substation. The successful bidder will provide training for minimum 3 personals of APCPDCL, on the configuration and setting of the Relays.

IED shall derive metering and protection parameters from protection core only. All Parameters as mentioned in specification document should be configured and reported to RTU/SCADA.

The relay shall support the goose messages and communication with other IED's as per IEC 61850.

The IED/Relay should have WATCHDOG feature for continuous checking of internal health of the relay and should have dedicated output for the same.

**I. STANDARDS for the IED:** The IED should meet the following minimum standards/specifications.

- a) The equipment delivered shall be new and of high quality, suitable for the purpose it is intended for, free from defects and imperfections, or their equivalents, subject to acceptance by APCPDCL.
- b) Materials used in the manufacture of the specified equipment shall be of the kind, composition, and physical properties best suited to their various purposes and in accordance with the best engineering practices.

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- c) The equipment design shall be suitable to render satisfactory operation under the conditions prevailing at site, and the equipment shall operate satisfactorily under normal load and voltage variations and frequency variations (50 Hz. -3% and +3%) ensuring necessary safety.
- d) The applicable Standards for feeder relays are specified below:

IEC 60255-27	Measuring relays and protection equipment - Part 27: Product safety requirements
IEC 60255-26	Measuring relays and protection equipment- Part 26: Electromagnetic compatibility requirements
IEC 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3 : Testing and measurement techniques - Radiated, radiofrequency, electromagnetic field immunity test.
IEC 60255-21-1	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section One: Vibration tests (sinusoidal)
IEC 60255-21-2	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section Two: Shock and bump tests
IEC 60255-21-3	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 3: Seismic tests
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60255-1	Measuring relays and protection equipment - Part 1: Common requirements
IEC 60068-2-78	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state

**II. ELECTRICAL SYSTEM DETAILS:**

There relay shall be suitable for installation in outdoor control and relay panel with 3 Phase, 50 Hz., 33 kV/11 kV system, in which, the neutral is effectively earthed and the same shall be suitable for service under fluctuations in supply voltage, permissible under the CEA Regulations and the frequency variation of -3% and +3%

**III. CLIMATIC CONDITIONS:**

The material used in the construction of the relay shall be suitable for use under the following climatic conditions. The equipment designed shall be capable of withstanding the following climatic conditions:

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Sl. No.	Climate Parameters	Values
i	Max. ambient air temperature (deg. C)	50
ii	Min. ambient air temperature (deg. C)	0
iii	Average daily ambient air temperature (deg. C)	40
iv	Max. Relative Humidity (%)	100
v	Max. altitude above mean sea level (Meters)	1000
vi	Average Annual rainfall (mm)	925
vii	Max. wind pressure (kg/sq. m)	200
viii	Isokeraunic level (days per year)	50

The equipment shall be for use in hot and humid tropical climate, conducive to rust and fungus growth. All material should be suitable for outdoor installation, in such areas near to sea and should have necessary provisions to prevent rusting and decay in such conditions.

Relays and other electronic boards should have conformal coating and should be suitable to install in the area near sea with high humidity and salt.

**IV. COMPLIANCE STATEMENTS FOR PROTOCOL AND MODELING:**

The relay manufacturers shall furnish the following statements to APCPDCL:

PICS: Protocol Implementation Conformance statement

PIXIT: Protocol Implementation Extra Information statement

MICS: Modelling Implementation Conformance Statement

The manufacturer shall furnish a UCA accreditation certificate from a Level-A lab (CPRI/ KEMA) or any international laboratory that are to be supplied and analyzed with UCA approved (Utility Communication Architecture) tool.

**V. 1. PROTECTION FUNCTIONS REQUIREMENT:**

The RELAY/IED should have following protection features as minimum:

- Instantaneous and Inverse time phase over current protection and earth fault protection (50/51) & (50N/51N), with at least 2 high set settings
- Broken conductor detection Protection (46BC)
- Breaker failure

The relay should have Alarm/Trip indication for each phase and earth separately.

**2. Additional requirement**

- Phase over current and earth fault protection shall have an adjustable timer, to allow restriking faults detection.



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- b) 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.
- c) The unit shall allow for the use of upstream and downstream logic discrimination to discriminate correctly when used in a cascade scheme.
- d) Overload protection will be based on RMS current value.
- e) Setting shall preferably be performed by the direct input of actual current values.
- f) Protection tripping shall be indicated on the front of the device by a LED and text indicating the cause of the fault. LED should be programmable for various alarm/fault.
- g) The offered relay shall have trip and close keypad on the face of the relay.
- h) The relay CTs secondary input should be programmable for 1 A or 5 A, preferably on the same terminals.
- i) The relay should have local breaker failure feature in the relay, to trip an upstream breaker, in case of breaker operation fails.
- j) Relay should have Programmable 12 DI (minimum) and 6 DO (minimum), which should also include one dedicated change over contact for relay health checkup (watch dog).
- k) Relay/IED should have facility to increase the number of DI's and DOs on a later stage. Minimum 1 slot for the DI and DO card should be available for the extension.
- l) The relay should have at least 4 output contacts of power rating with min cont. rating of 5 A, 400 W for tripping /closing the breaker directly from the relay. Contacts should be rated at nominal voltage.
- m) Relay should be provided with relay programming software, required cables, etc. for free with the supplies. Minimum One Set of Software and Programming cable (2 Nos.) to be provided for qty. of 20 Relays.
- n) The device's digital inputs shall have minimum activation level of the 70% of the nominal system voltage of 24 V DC.

**VI. IED/RELAY INPUT/OUTPUT DETAILS:****Digital Inputs:**

- 1) Breaker status on
- 2) Breaker status off
- 3) Trip circuit healthy
- 4) SCADA IN (Remote)
- 5) SCADA OUT (Local)

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6) 86 Operated

7) DO contactor operated

8) Balance 9 Nos. utilized as per site requirement

**Virtual Digital Inputs/Status:**

10) IED reset

11) Broken conductor fault operated

12) IDMT O/C fault operated

13) IDMT E/F operated

14) Inst. O/C operated

15) Inst. E/F operated

16) CB failure

17) Balance utilized as per site requirement

**Digital outputs:**

1) Breaker Open/Trip

2) Breaker Close

3) Breaker Tripped on fault

4) Relay Healthy

5) Balance 4 Nos. utilised as per site requirement

**Virtual output - IED remote reset****VII. Metering functionality:**

Metering functionality of the Feeder breaker is derived from the above four CT inputs and three VT inputs. All metering functionalities to be derived from the protection CTs Inputs only.

The relay should have all the Measurement functions as below:

1. Three Phase Current
2. Neutral current
3. Phase to earth, Phase to Phase Voltage
4. Phase Angle
5. Power factor, phase wise
6. Active Power
7. Reactive Power

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8. Energy Measurement of both Active & Reactive

9. THD of Currents

10. THD of Voltages

11. Frequency

12. Actual RMS value of Currents

13. Actual RMS value of Voltages

14. Accumulator Energy - kWh and kVArh

15. Fault currents

The measurement shall also be helpful for Feeder breaker analysis.

**VIII. Control Requirements:**

The IED/Relays will be used for the control of the VCB from the RTU/SCADA Control Centre.

The Command Received from the control centre should not affect the functionality of the protection functions of the relay.

The Relay should have Capability of Switching on and off the feeder breaker with DO, on the receipt of command from RTU/SCADA or the IED front push button. The IED should clearly log the event with time stamping and origin of the command i.e. By Protection Function, Local Front Panel or Remote from RTU/SCADA over IEC-61850 Protocol.

**IX. Front Fascia/Setting:**

The IED/Relay should have big digital alpha numerical display and should show following parameters as minimum:

1. Fault Details
2. Setting details
3. Measurement values
4. Password Entry

The IED/Relay should have LED for the indication of following indication as minimum:

1. Relay Power ON/Running/Healthy Status
2. Alarm Status
3. Fault Status – Minimum 4 LEDs

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The relay should have button for acknowledgement and Single Button for resetting of the protection output and protection function.

Relay should have Button for scrolling/displaying of data/parameters in the display of the IED. 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.

The relay should have at least 5 fault tripping data displaying with fault level and time stamping on LCD.

**X. Disturbance recording:**

Relay/IED should have provision of Disturbance Recording. The Trigger for the DR should be selectable from Digital Input/Virtual Input/trip or Alarm condition. Relay/IED should have Facility to communicate the disturbance recording in COMTRADE 2000 Format through IEC 61850. The Display of the DR should be in English.

The Disturbance Recording should have:

- Samples/cycles should be settable or selectable
- Minimum no. of recordings at a time 14 Lines
- DR Triggering should be selectable from DI/Alarm/Trip
- DR should have a facility to record the following parameters in each DR: All analogue channels , All Binary Inputs, All Binary outputs, All alarm signals and All Trip signals

The display of minimum 100 events shall be provided through the relay software. The event recordings shall be in different colour mode for an alarm event.

**XI. COMMUNICATION:**

The IED/Relay will have IEC 61850 protocol, with Dual FO ports. The relay should have RS 232/USB Port for local programming.

Parameters to be Monitored/Communicated to RTU/SCADA from relay:

Sl. No.	Parameters to be monitored from the Feeder IED
A	Digital Inputs

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1	Breaker ON
2	Breaker off
3	Breaker Trip circuit Healthy
4	SCADA IN
5	SCADA OUT
6	86 Operated
7	DO contactor operated
	Virtual Inputs
8	IED reset
9	Broken conductor fault operated
10	IDMT O/C fault operated
11	IDMT E/F operated
12	Inst. O/C operated
13	Inst. E/F operated
14	CB failure
B	Digital outputs
1	Breaker Open/Trip
2	Breaker Close
3	Breaker Tripped on fault
4	Relay Healthy
C	Breaker fault tripping analysis
1	Breaker tripped on 51R> with set values and acted values
2	Breaker tripped on 51Y>with set values and acted values
3	Breaker tripped on 51B>with set values and acted values
4	Breaker tripped on 51N>with set values and acted values
5	Breaker tripped on 50R>>with set values and acted values
6	Breaker tripped on 50Y>>with set values and acted values
7	Breaker tripped on 50B>>with set values and acted values
8	Breaker tripped on 50N>>with set values and acted values
9	Breaker failure protection
10	Breaker Tripped on Broken conductor
D	Measurement parameters
1	Current of R
2	Current of Y
3	Current of B
4	Voltage of RY
5	Voltage of YB

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6	Voltage of BR
7	kWh Import and Export
8	kVAh Import and Export
9	kVArh Import and Export
10	PF Phase wise and Average
11	MD Average
12	MD Max.
13	THD Voltage
14	THD Current
15	Fault currents

All digital inputs and outputs from IED, including all the mandatory parameters, as per IEC 61850, including the above parameters, shall be mapped.

**XII. SPARES:** The manufacturer shall demonstrate the availability of spares for the above IED.

The manufacturer shall furnish a declaration that he will be maintaining 5% of offered relays as spares and shall give documentary evidence regarding the company service point maintained by OEM and other details including the proof of address.

**XIII. GUARANTEE:**

The IEDs and its associated equipment offered shall be guaranteed for 5 years from the date of Commissioning.