

20. Transducer Panel:

- There shall be separate Transducer Panel installed in GIS switchgear building having all types of required transducer in centrally located panels.
- There shall be separate vertical segregation for each 220 KV / 33 KV feeders and bus.
- Following transducers minimum but not limited to shall be installed in each 220 KV / 33 KV bays and bus:
 - a) Active Power MW Transducer (2 Nos. for ECS + 2 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required)
 - b) Reactive Power MVar Transducer ((2 Nos. for ECS + 2 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required))
 - c) Voltage Transducer (All 3 phase) ((1 Nos. for ECS + 2 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required))
 - d) Current Transducer (All 3 Phase) ((1 Nos. for ECS + 1 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required))
 - e) Frequency Transducer ((2 Nos. for ECS + 2 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required))
 - f) Power Factor Transducer (((1 Nos. for ECS + 1 Nos. for LMS + 1 No. For SCAP + 1 No. For SCADA and spares as required))

The list of transducers above is minimum lot and is not limited to the details provided above and shall be based on the actual project requirement.

- There shall be dedicated Transducers for following requirement in all 220 KV feeders.
 - a) ECS
 - b) SCADA/SCAP
- There shall be redundant transducers for ECS requirement. The accepted value in ECS shall be highest of values of the two transducers.
- There shall be one set of spare transducers of each type in all 220KV feeders.
- All the transducers shall be provided with two outputs 4-20 mA only.
- Auxiliary Voltage shall be self-powered or 110 V AC UPS.
- Voltage Input shall be 110 V and Current input shall be 1A.
- The output of the transducers shall be routed up to ECS, SCADA and SCAP panel. All required *internal* cabling for inputs, CT, PT auxiliary supply, output upto destination points as per project requirements will be in bidder's scope including its engineering, supply and termination complete with all accessories.
- Since the distance from Transducer panel to PNC is approximately six KM so the required interface between transducers and various systems at PNCP end like LMS, ECS, and SCADA shall be through Optical Fiber link with suitable converters The data link should be design with redundancy and propagation delay is less than 10 milli second. *NECESSARY EQUIPMENTS/CABINETS AT PNCP END SHALL BE INCLUDED BY BIDDER IN THE PRICE QUOTED AGAINST CENTRAL TRANSDUCER PANEL.*

- Transducer Panels shall be provided in project along with its complete engineering, interconnection details, supply, erection and commissioning including supply of transducers, wiring (hard wired, Optical Fiber, D/A & A/D conversion) as per detailed engineering.
- All the wiring including Auxiliary Voltage, CT/PT input shall be in scope of bidder.
- ~~All the output wiring from transducer to ECS, SCADA and SCAP panel installed at PR & PNC shall be in scope of bidder.~~
- Separate provision of hard wire (Sheathed armoured signal cable 2 runs X 36 core X 1.5 sqmm Cu cable) up to PNC for six KM for all type of electrical parameters.

21. GENERAL IMPORTANT POINTS

1. The successful bidder shall ensure looping of Numerical relays of all the bays for inter communication and time synchronization. All required hardware, cabling for time synchronization with GPS system supplied in this project as per specification mentioned elsewhere shall be in bidder scope.
2. Any modifications in wiring required by the purchaser at site shall be carried out by the successful bidder at the time of commissioning, free of cost.
3. The successful bidder has to provide reproducible tracings/ soft copy for all the drawings as a part of supply contract to IOCL for documentation.
4. The successful bidder has to quote optionally and supply if asked by the purchaser, necessary tools/kits/instruments/testing accessories required for testing, commissioning of relays and devices, as a part of supply contract to each consignee / destination.
5. The successful Bidder has to provide instruction manual, all drawings, literature etc. for all relays and devices, write up for testing and commissioning procedures, relay setting calculations etc. detailed circuit diagrams with trouble shooting protocols to all consignee destinations as well as to the Engineer-In-Charge. The bidder has to do testing/commissioning of Control & Protection Panels at site by deputing his Service Engineer free of cost.

IOCL, PANIPAT REFINERY	CONTROL & PROTECTION SYSTEMS	
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PROTECTION SCHEME FOR LINES:

MAIN- I NON-SWITCHED DISTANCE PROTECTION [FOR 220 kV LINES]:	The scheme shall:-
	1) Be numerical & modular in construction. Relay shall have continuous self monitoring & diag- nostic feature.
	2) Have high speed non-switched distance relays for three phase systems to clear all type of line faults within the set reach of the relay.
	3) It should cover at least line sections completely with 20% in hand margin.
	4) Have shaped quadrilateral, polygonal characteristics to prevent relay operation during max. Load conditions and shall be suitable for short as well as long lines. Selectable mho characteristic for phase fault is preferable depending upon the requirement at the time of technical scrutiny.
	5) Have non-switched measurement. Independent measuring loop for all type of faults in each zone which implies processing of all possible fault loops for each phase.
	6) Have independently adjustable reactive impedance and resistive readies for all zone characteristic for maximum selectivity and maximum fault resistance coverage.
	7) The relay shall use the memory voltage for proper directional discrimination at close in 3 phase fault which shall be based on positive sequence voltages. The directional discrimination and phase selection based on negative sequence measurement techniques is not acceptable.
	8) All the zones shall have setting such that they can detect the fault on line from minimum 0.3 km to 50 km.
	9) Have a minimum operating time up to Trip impulse to circuit breaker (complete protection time including applicable carrier and trip relay time) with CVT being used on the line for all types of Faults anywhere in the protected line section during both max and min generation condition.
	10) Have independent continuously variable time setting ranges for each zone.
	11) The relay shall be suitable for use with CVT having non-electronic damping and transient response as per IEC.
	12) Have a continuous current rating of two times rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of preferably 70 times of rated current or suitable as per project requirements and applicable standards without damage during a period of 1 sec.
	13) It shall be ensured that there is no additional delay in relay operating time created intentionally, to have stable operation.
	14) Numerical full scheme distance protection terminal shall be suitable for use with any communication scheme (permissive under reach, over reach, blocking) and have facility for connection to sub — station control system.
	15) The scheme shall have input transformation modules, analogue and digital Routers, processing units, A/D and D/A converters, DC supply modules etc.

16) The sampling rate of analogue inputs, the processing speed and processing cycle of digital values shall be selected so as to achieve the operating time specified.
17) Have a front RS 232 or Communication port suitable for use with a PC/laptop locating for local access to settings. Events and records.
18) Have two rear communication port on fiber optic medium to support (1 all the facilities available via the integral user interface and facilities supported under IEC-61850-8-1 interface.
19) Have mutual zero sequence compensation factor setting. The relay shall have facility to select different group settings to cater for mutual coupling on account of multi circuit line conditions. The minimum no. of group should be four.
20) Operate instantaneously far a close-in three-phase fault and switch on to fault.
21) Be suitable for single and multi-phase tripping
22) Be selective for internal and external faults.
23) Include power swing blocking feature which shall:
a) Have separate measuring element for power swing detection.
b) Have fast detection of power swing
c) Shall be on the principle of measurement of the rate of impedance vector change and monitoring of the vector path.
d) Have selective blocking of zones.
e) Have settable unblocking criteria for earth faults, phase faults and three phase faults.
f) Have the Earth fault detection feature which shall over ride power swing blocking and allow the relay to operate for trip as per zone detection.
g) The relay shall be blocked for the set time for the first PS sensed and remain unblocked for the set time for the successive PS.
24) Include fuse failure protection.' Loss of voltage feature which shall:
a) Monitor all three phase fuses of capacitance electro-magnetic voltage transformer and associated cables against open circuit.
b) Inhibit tripping on sudden total loss of voltage or one/two fuse fail condition and initiate annunciation.
c) Remain operative for system earth fault.
25) Have minimum 06 no. of heavy duty contacts on trip relays to provide for energizing two trip coils of each of the main and TBC breaker through the two separate DC source.
26) Have a suitable number of programmable binary input and programmable binary output contacts to cater the complete system requirement including DRSER carrier aided tripping auto re-closing and 20% spares.
27) Have built in supervision and testing facility including continuous DC supply supervision.
28) Be provided with a continuous self-monitoring and diagnostic unit to give alarm in case of abnormalities and locate defective units immediately. Self-monitoring should cover microprocessor. EPROM contacts, measuring elements, battery status and ail associated program.
29) Include built-in distance to fault locator with features as below.
a) An accurate fault locator is an essential complement to the line protection. It shall have an accuracy of 2% or better for all types of faults and fault levels.

b)It shall provide digital indication of distance to fault in percentage of the supervised line length of kilometres directly without requiring further calculations.
c)It shall provide distance to the fault together with information about the measuring loop that has been used in the calculations.
d) Information of the last 08 disturbances should be available.
e)The fault locator algorithm compensates the effect of the load currents, the apparent fault resistance and zero sequence mutual impedance.
f) It shall meet IEC-255 or other equivalent recognized standards.
g)It shall be suitable for breaker operation time of 2 cycles.
h)The above accuracy shall not be impaired under the following conditions.
i. Presence of remote end in feed.
ii Predominant DC components in fault current.
iii. High fault Arc resistance.
iv Severe GVT transients.
30) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications. analysis of fault etc.
31) Have Provision of Broken Conductor Detection /protection with alarm trip facility to detect open conductor condition by way of level detector or negative sequence measurement.
32) Have built in an independent directional/non-directional (selectable) Earth fault protection element to detect highly resistive faults. This elements shall have a standard IEC IDMT characteristic and sensitivity of 10% minimum.
33) Have directional-bidirectional (selectable) back up over current function in built. This elements shall have IEC IDMT characteristic and 50-200 % rated current and a characteristic angle of 45 degrees.
34) Provide protection against short circuit and interruption in the secondary wiring of the V.T. supply circuit supplying the relay.
35) Be capable of performing basic Instrumentation functions and display on demand of various measured parameters like voltage, current, active power. Reactive power, etc. in primary values. Additionally all sequence current and voltage values, direction of power flow, alarms and clock relay identification. Settings etc. during normal as well as fault conditions on individual phase basis shall be displayed on line. Pre fault and fault values of current and voltage must be available for fault analysis purpose.
36) Measure all type of faults without the need to switch the measuring elements to the faulty phase or phases. Zone switching to extend the reach of the measuring elements is not allowed. The reach of each zone shall be independently & individually adjustable and shall have setting in steps of 1%. Memory circuits with defined characteristics shall be provided in all three phases to ensure correct operation during close-up 3 phase faults and other adverse conditions.

- 37) Have a max. operating time up-to trip impulse to circuit breaker (complete protection time including applicable carrier & trip relay time) under source to line impedance ratios (SIR) under all possible combinations of fault with PT being used on the line (with all filters included) at 50% of zone-1 reach : for SIR 0.01-4:as 40 ms at nearest end & 60 ms at other end of line. for SIR 4-15 :as 45 ms at nearest end & 65 ms at other end of line. (carrier transmission time is taken as 20 ms provided that any reduction in carrier time shall be directly reflected as reduction in maximum operating time).
- 38) Have stepped time-distance characteristics and shall have at least four independently variable time graded distance protection zones to cover two adjacent line sections out of which Zone-1,2 & 3 should be selectable in forward direction and Zone-4 should be selectable in reverse direction.
- 39) The relay shall have mho or quadrilateral or other suitably shaped characteristics for zone-1, 2, 3 & 4. The relay shall have an adjustable characteristics angle setting range of 30- 85 degree or shall have independent resistance(R) & reactance(X) setting..
- 40) ensure that this long coverage is consistent with limitations imposed by heavy loading and sound phase component of fault current. If the characteristics of starting relays are such that it cannot pick-up because of very low in-feed, under-voltage relays may also be used as supplementary relays.
- 41) have two independent continuously variable time setting range of 0-3 seconds for zone- 1 & 2 and 0-5 seconds for zone-3 & 4.
- 42) have a maximum resetting time of less than 35 milli-seconds.
- 43) have facilities for offset features with adjustable 10-20% of Zone-3 setting.
- 44) have residual compensation variable from 30-150%.
- 45) operate instantaneously when circuit breaker is closed to zero-volt 3 phase fault.
- 46) be suitable for single & three phase tripping.
- 47) be selective between internal and external faults.
- 48) have adequate contacts to meet the complete scheme requirements & if required incorporate three separate high speed self reset trip relays for single phase faults and a fourth high speed trip relay for multi-phase faults.
- 49) be suitable for 1 Amp. rated CT secondary, 110V (phase to phase) VT supply and 220 V DC supply. Mode of conversion of DC supply from 220 V DC to the voltage level required for their scheme may be mentioned in detail. Requirement of CTs & VTs for the satisfactory working of the scheme may also be indicated in the tender.
- 50) The relay shall be suitable for series compensated line and must have a current reversal guard feature.
- 51) For disturbance recorder and event logger features, it shall have 8 analog and 32 digital channels (out of which at least 16 shall be external digital inputs). It shall have its own time generator and the clock of the time generator shall be such that the drift is limited to +0.5 seconds/day, if allowed to run without synchronization. Further, it shall have facility to synchronize its time generator from Time Synchronization Equipment having output of following types or any other open protocol
- Voltage signal: (0-5V continuously settable, with 50m Sec. minimum pulse duration)
 - Potential free contact (Minimum pulse duration of 50 m Sec.)
 - IRIG-B

	• RS232C The recorder shall give alarm in case of absence of synchronizing pulse within specified time. a) The disturbance recorder shall meet the following requirements: • The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side. • Scan rate shall be 1000 Hz/Channel or better. • Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system disturbance occurs during one post-fault run time, the recorder shall also be able to record the same. However, the total memory of acquisition unit shall not be less than 5.0 seconds. b) The event logger shall meet the following requirements: • The time resolution shall be 1 milli second. • Cope with up to 40 changes in any one 10 milli seconds interval. • The date and time should be printed to the nearest 1 milli second followed by a message describing the point which has operated. • Events occurring whilst a previous event is in process of being printed are to be stored to await printing. Over 100 such events must be stored. c) The distance to fault locator shall meet the following requirements: • Be On-Line type and suitable for breaker operating time of 2 cycles. • The display shall be directly in percent of line length or kilometers without requiring any further calculations. • Shall have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays. The above accuracy should not be impaired by presence of remote end infeed, predominant D.C. component in fault current, high fault arc resistance, severe CVT transients.
MAIN -II NON-SWITCHED DISTANCE PROTECTION	For Main-II distance protection, scheme shall be numerical and shall have same features as that of Main-I protection above but with different measuring technique.
Line Differential Protection	The relay shall have all the features as per Distance protection relay over and above following feature. 1. It shall be working on phase segregated current Differential protection principle. 2. It shall have multiple slope characteristic (preferably) to have stability against CT saturation and heavy through faults as well as sensitivity for internal faults. 3 It shall measure Differential as well as restrain current continuously and shall display the same as measurement, 4.it shall use fiber optic cable or multiplexed digital network to exchange telegrams. 5.It shall communicate to remote end through IEEE C37.94 format. 6. It shall have redundant communication channels for protection communication. 7. It shall communicate analogue as well as digital signals to remote end. 8. It shall have various communication options for remote communication i.e. Mono-Mode / Multi mode for direct communication/ communication through multiplexer. 9.It shall have Line charging current compensation feature for better sensitivity.

	10.Distance protection function can be utilized as in or as back up of Differential protection in case of failure of remote communication.
	11.It shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS shall also be possible.
	12.It shall monitor individual communication link continuously and switchover to standby link after preset time in case of failure of one link.
	13.It shall supervise individual telegrams.
	14.It shall detect reflected telegrams.
	15 It shall detect change in communication delay time,
	16: It shall measure delay time (or remote end along with dynamic compensation of the same in differential Protection algorithm,
	17. It shall also supervise maximum permissible delay time.
	18)Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
	19).. It shall generate alarm for heavily disturbed communication link.
Backup Impedance PROTECTION	The relay shall
	1)Be triple pore type with faulty phase identification : indication.
	2)Have single zone under impedance relay suitable for phase/phase and phase to ground fault with characteristic suitable for system and standard requirements.
	AC - V 110 Phase — Phase
	AC - I lamp
	3)Have impedance setting suitable for project requirements with suitable taps with E/F compensation.
	4 Have timer have time range as per system requirements and selectable at site.
	5 Have an adjustable characteristic angle of 30-85 degree
	6) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation, Data acquisition and optional trip facility to be connected by purchaser where needed.
	7)Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
	8)Be auxiliary DC voltage operated not self powered relay.
	9) Include VT failure relay which shall block the tripping during VT fuse failure condition.
Directional O/C & E/F PROTECTION	The 3 O/C & 1 E/F elements shall be either independent or composite units. The relay shall be numerical type. IDMT curves of all stages shall be selectable as per standard IEC curves.
	(A) Features:
	a) Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
	b) Shall have 2 over current and 1 Earth Fault element
	C) TRUE RMS Measurement.
	d) Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC /ANSI Characteristic.

	e) Site Selectable CT Secondary .i.e. 1A/ 5A f)High set over current with selectable time delay_ g)High set Earth fault with selectable time delay h)Have adjustable characteristic angle, lead, lag, for Directional over current/Earth Fault respectively. i) Shall decide directionality by internally derived zero sequence quantity through software. j) Shall have in built Breaker Failure Protection. k) include hand reset Flag/LED indicators for fault l) Readable Human Machine Interlace with LCD display_ m)Be supplied along with all suitable Original customized licensed software & communication cable for local and remote communications, analysis of fault etc.
Non-Dir. O/C & E/f Protection	(A) Features: a)Shall be Numerical type. Detailed specification for the subject relay is attached as Annexure-S-3/C-5/3. b)Shall have 3 over current and 1 Earth Fault element c) TRUE RMS Measurement. d) Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSI Characteristic. e) Selectable CT Secondary. i.e. 1A/5A. f) High set over current with selectable time delay_ g High set Earth fault with selectable time delay h) Shall have in built Breaker Failure Protection_ l) Include hand reset Flag/LED indicators for fault j) Readable Human Machine Interface with LCD display.
Reverse Power relays (Active and Reactive Power based)	Suitable numerical relays to be provided for Power (active and reactive) based directional protection for grid system. It will be used for Grid islanding protection requirement. Relay should have suitable blocking feature for loss of PT input and power swings. Metering CT's core shall be used as CT inputs for the subject relays. Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
Frequency Relay :	Suitable numerical relays to be provided for frequency and rate of change of frequency (in both direction) for grid system. It will be used for Grid islanding protection requirement. Relay should have suitable blocking function for loss of PT input, and harmonic restrains, ferro-resonance. Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
FEEDER OVER LOAD ALARM RELAY:	It is proposed to provide a single pole over current relay for the purpose of monitoring the load flow on feeders to sound an alarm whenever load flow in the line exceeds the setting for a given period of time to draw the operator's attention. The relay shall have <u>CONTINUOUS VARIABLE</u> setting range of 50-200% of 1 Amp. and shall be supplemented by a continuously variable timer of 1 to 10 seconds.
LINE OVERVOTAGE & UNDERVOLATGE	The relay shall, (a) monitor all three phases

**PROTECTION
RELAY :**

- (b) have two independent stages, stage- I & II relay are acceptable as built in with line distance relays Main I & II both .
 - (c) Overvoltage shall have an adjustable setting range of 100%-170% of rated voltage with an adjustable time delay range of 0 to 60 seconds for the first stage for over voltage. For under voltage minimum 2 stage based scheme with setting range from 40 % to 100 % with time delay range of 0- 60 seconds to be provided. Separate protection relay may be provided for Under voltage if required with independent stages
 - (d) have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 mill seconds for the second stage.
 - (e) be tuned to power frequency
 - (f) provided with separate operation indicators (flag target) for each stage relays. (g) have a drop-off to pick-up ratio greater than 95%.
 - (h) provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements.
 - i) Shall have suitable blocking features in case of PT fuse failure . Suitable fuse supervision scheme shall be provided in the relay
 - j) The relay operation shall be selectable for all three phases as well as single phase basis.
 - k) Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
- Note:- The Feeder over Load Alarm Relay in-built with numerical distance protection relay or Over current & Earth Fault Protection Relay is acceptable provided it meets the above specification.

**TRANSFORMER
DIFFERENTIAL
PROTECTION**

- i) Be triple pole numerical type. The transformer differential zone is extended from 220 KV transformer feeder + Transformer + 33 KV cable up-to existing Generation bus system for PR part. The Selection and design of the same shall be done accordingly.
- ii) Be triple pole numerical type. The transformer differential zone is extended from 220 KV transformer feeder + Transformer + 33 KV cable up-to new LIB at PR for power evacuation system of PNC part. The Selection and design of the same shall be done accordingly.
- ii) For 2 nos of power transformer for PR section, differential zone will be inclusive of GIB + transformer + 33 KV cable of length approximate 500 meters up to existing generation bus. Relay shall be suitable to handle 3 full set of CT inputs (of all 3 phases i.e total of 9 CTs for one transformer) as their will be 2 outgoing feeders in secondary side of each transformer . The distance of 33 KV end CT would be around 500 meters. Accordingly CT and relay design to be ensured. Actuation of transformer differential shall trip all three breakers directly.
- iii) For 2 nos of transformer of PNCP, transformer differential will also inclusive of GIB + transformer + 33 KV cable up to LIB breaker in PR end which is around 500 mtrs from 220 KV switchgear. The scheme shall be design accordingly including supply of all required material by bidder for 220 KV & 33 KV systems both.

iv)The design of scheme as per existing CT detail of existing Generation bus is in vendors scope. If any additional CT required to be installed in identified feeders of existing generation bus , than its design, supply, installation and connection including cabling is fully in the scope of bidder.
v)Have 2 or more instantaneous high set over-current units.
vi)Relay/scheme shall have feature of CT supervision with sufficient high sensitivity. In case of operation of CT supervision , CT circuit shorting, blocking of differential protection and remote alarm shall be generated.
vii) Have second harmonic restraint or other inrush proof feature and be stable under normal & over fluxing condition.
viii) Have fifth harmonic by pass filter or similar other arrangement to prevent mal-operation of the relay under operating conditions.
ix) Be suitable for rated current of both 1A and 5A. The ratio correction as well as phase shift correction shall be part be available in the relay itself. Provision of ICT is not accepted.
x)Have operating current setting sufficiently low (15% or less) so as to cover practically the whole of the transformer against all types of faults.
xi)Have adjustable dual bias setting range as per project requirements.
xii)Have maximum operating time of 30 milli seconds at 5 times the rated current.
xiii)Be provided with necessary terminals & links to measure current in restraining circuits & in the operating circuits of all the phases under load without making any wiring changes.
xiv)The Scheme shall have in-built features of disturbance recorder and event logger.
xiv) Cover the lightning arrestors (if provided very close to the transformer) in the zone of protection.
xv) For disturbance recorder and event logger features, it shall have 6 analog and 8 digital channels (out of which at least 8 shall be external digital inputs). It shall have its own time generator and the clock of the time generator shall be such that the drift is limited to ± 0.5 seconds/day, if allowed to run without synchronization. Further, it shall have facility to synchronize its time generator from Time Synchronization Equipment having output of following types.
• Voltage signal: (0-5V continuously settable, with 50m Sec. minimum pulse duration)
• Potential free contact (Minimum pulse duration of 50 m Sec.)
• IRIG-B
• RS232C
• IEC 61850
• Or any other open protocol
The recorder shall give alarm in case of absence of synchronizing pulse within specified time.
a)The disturbance recorder shall meet the following requirements:
• The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.

	• Scan rate shall be 1000 Hz/Channel or better.
	Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system disturbance occurs during one post-fault run time, the recorder shall also be able to record the same. However, the total memory of acquisition unit shall not be less than 3.0 seconds.
	b) The event logger shall meet the following requirements:
	• The time resolution shall be 1milli second. • Cope with up to 40 changes in any one 10milli seconds interval.
	The date and time should be printed to the nearest 1milli second followed by a message describing the point which has operated.
	• Events occurring whilst a previous event is in process of being printed are to be stored to await printing.
	xv)Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
	xvi)Display resolution of differential/pickup current should be 0.01A (10mA).
OVER FLUX FEATURE	An over fluxing detecting relay for the protection of the transformer against over-fluxing conditions is proposed to be provided on each of the transformer RELAY panels covered by this specification. The relay shall be numerical in design with adjustable setting so as to avoid its operation on momentary system disturbances. The relay shall be suitable for 220 Volts DC. The relay shall have inverse time characteristics, matching with transformer over-fluxing withstand capability curve. The relay shall provide an alarm with v/f setting range of 100% to 130% of rated values or suitable as per transformer design limits and time delay continuously settable from 0.1 to few seconds to draw the operator's attention about the existence of over-fluxing conditions. The tripping time shall be governed by v/f versus time characteristics to cause tripping of transformer controlling circuit breaker if the over-fluxing conditions continue to exist. i)Operate on the principle of voltage to frequency ratio and shall be phase to phase connected. ii)Have inverse time characteristics, matching with transformer over fluxing withstand capability curve_ iii)Provide an independent -alarm' with the time delay continuously adjustable between 0.1 to few seconds_ iv)Tripping time shall be governed by V/F vs Time characteristic of the relay_ v)V/F setting shall be adjustable from 1.0 to 1.05 times rated flux. vi)Have a set of characteristics for various time multiplier settings.. vii)have an accuracy of operating time as per applicable standards viii)Provide sufficient number of potential free contacts with 20% spares to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected as per requirement.
Restricted Earth fault Protection	It shall be of High impedance differential protection with following features for both winding of the transformers. 1)Be single pole type 2)Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming

	systems.
	3) Be high speed circulating current type
	4) Have current setting of 10-40% of rated current
	5) Be tuned to the system frequency.
	8) Shall provide stability against through fault..
	7) Be suitably protected against high voltages.
	8) Have alarm and trip output contacts.
	9) Be high speed with typical operating time of less than 25 ms with provision of high set differential current 5-10 times.
	10) Provide sufficient number of potential free contacts with 20% spares to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility as per requirement.
	11) Be supplied along with all suitable original customized licensed software & communication cable. for Local and remote communications, analysis of fault etc
Standby Earth fault Protection	It shall have following features for both winding of the transformers.
	1) Shall be site selectable for both 1 Amp and 5 Amps CT input
	2) Be of numerical type, software based logic programmable as per site requirements with the use of PSL and other programming systems.
	3) It shall have all type IEC IDMT curves .
	4) Have current setting and characteristics shall be possible for required co-ordination with downstream feeder earth fault protections.
	5) Be tuned to the system frequency.
	6) Have alarm and trip output contacts
	7) Provide sufficient number of potential free contacts with 20% spares to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility as per requirement.
	8) Be supplied along with all suitable original customized licensed software & communication cable. for Local and remote communications, analysis of fault etc
Auxiliary Relays for TRANSF TROUBLES.	(1) Buchholz trip. - 1 no.
	(2) Buchholz alarm -- 1 no.
	(3) OLTC Surge Relay trip — 3 no
	4) Oil temperature trip -- 1 no
	5) Oil Temperature alarm - 1 no.
	6) Winding temperature trip — 1 no
	7) Winding temperature alarm -- 1 no
	8).P.R.V. trip — 3 no
	9) Deluge valve operated - 2 no
	10) Low oil level alarm - 1 no
	11) Cooling system trouble alarm. —1 no
	12) Spare- 2nos
	13) All incipient faults and alarms tag shall be wired to numerical relays as dedicated digital inputs via suitable interposing relays (VAJH or equivalent). Also dedicated spare contacts must be kept for hook-up at manned locations.
	14) Provide sufficient number of potential free contacts to cater the needs of connection to UV relay I & 2, alarm/annunciation, DR/SER/Data acquisition and a spare contact to be connected.

NUMERICAL BUS BAR PROTECTION RELAYS

The independent bus bar protection scheme shall be provided for each bus system for 220kV with independent CT and relays for each bus. The scheme shall have redundancy for each bus section in the concept of main and check zones. Numerical Bus Bar Protection scheme shall have the following features.

- a) It shall be a Numerical Bus Bar Protection scheme.
- b) Operate selectively for the bus bar faults.
- c) Include protection in / out switch.
- d) Provide 100% stability up to 50 KA fault level.

One bus bar protection scheme shall be provided for each main bus for 220kV having double bus arrangement. Bus bar protection scheme shall have following features:-

- i. be of numerical, low impedance type and modular in construction. The scheme shall be complete in all respects to cater the need of at-least 14 feeders/ bays.
- ii. have an operating time up-to trip impulse to trip relay for all types of faults **less than or equal to 15 milli seconds** at 5 times setting value.
- iii. incorporate main zone and check zone features.
- vi. incorporate continuous supervision for CT secondaries against any possible open circuit and if it occurs, shall tender the relevant zone of protection inoperative and initiate an alarm.
- vii. not give false operation during normal load flow in bus bars.
- viii. incorporate clear zone indication.
- ix. be of phase segregated, triple pole type and provide independent zones of protection for each bus.
- x. include necessary auxiliary relays for each circuit as required for the scheme.
- xi. shall be biased differential type and shall have operate and restraint characteristics.
- xii. be transient free in operation.
- xiii include continuous DC supply supervision for alarm and trip circuits separately
- and provide separately non-trip alarm for B/B protection alarm circuit DC fail & B/B protection trip circuit DC fail conditions.
- xiv. shall include necessary suitable CTs for each bay.
- xvii. bus bar protection scheme should overlapping in bus-coupler to avoid any blind zones. Bus-bar differential shall be overlapped with transformer/feeder differential protection.
- xviii. Include high speed tripping relays for each bay.
- xix The Scheme shall have in-built features of disturbance recorder and event logger.
- The disturbance recorder should record the disturbance data bay-wise (all bays phase and neutral current).
- g) Be inoperative for through faults, but shall operate correctly and positively for Faults within the protected zone(s) even under condition of CT saturation.
- k) The Bus bar Protection shall have a distributed structure comprising a Central Unit and Bay Units. All the Bay Units and the Central Unit shall be located in Bus bar protection panel.
- l) The secondary of the bay CT's shall be connected directly to the respective Bay Unit. Ratio correction shall be through software means. External auxiliary CTs shall not be used in the connections to the Bay Units for compensating different CT ratios.

m) Filtering and evaluation of the analogue quantities (bay level currents) shall be performed in the Bay Units. The Central Unit shall evaluate the differential currents for each phase and for each zone. The tripping contacts on the Bay Unit shall be directly wired to trip the respective bay breaker, which may have two trip coils. The contacts should be of adequate rating.
n). The looping of CT shall be done in Hard wired, so that Bus coupler panel is also included in the protection.
p) The normally open NO and normally closed (NC) auxiliary contacts on each isolator shall be used for selection of bus bar zones.
q) No CT switching relays shall be use for connecting correct CT inputs to the protected zone. If both isolators of a particular bay are closed, an audible isolator alarm shall be given and the bus bar zones should act as single zone. This monitoring of the integrity of the isolator auxiliary contacts shall be performed in software form without the use of external relays and timers.
r) To enhance security, the Bus bar Protection scheme shall have two independent measurements and tripping criteria. A trip signal shall be initiated only if both criteria are simultaneously satisfied. Neither criterion shall be voltage dependent.
s) Preferably, these two criteria shall be the stabilized differential current and the phase (directional) comparison of currents in the different bays.
t) Where suppliers are offering check zone feature for the low impedance bus bar protection, have to prove that check zone will operate reliably under all conditions and for all internal faults
u) The Bus bar Protection shall be insensitive to transients and harmonics and be fully reliable and selective even under CT saturation conditions.
v)The Bus bar Protection shall be capable of operating with CT's of widely different ratios with different rated secondary currents. The matching of CT ratios in each bay shall be done by a simple setting via the HMI without the use of external auxiliary CT's.
w) The numerical bus bar protection shall be with extensive self-supervision and diagnostic facilities.
x) The HMI programme should graphically display the bus bar configuration and the bus bar Image. The HMI programme shall facilitate setting of the protection and read out of various information such as bus differential current in each zone, phase currents, positions of the isolators & breakers etc. The HMI programme shall also permit dialogue with the protection from a remote location without the need for additional software. The HMI programme should be based on MS Windows environment
y) The HMI programme shall facilitate free assignment of the Opto-coupler inputs and signal relay/trip relay outputs to a given list of inputs and outputs. It shall be possible to programme the output relays to be of the
latched or non-latched type.
bb) The Disturbance Recorder and Event Recorder buffer memory shall be of non-volatile type and shall not require the use of batteries.

cc) If the bus tiebreaker is equipped with one set of CTs only and when bus tiebreaker is in open position, the Bus bar Protection shall exclude this CT in the evaluation of the Bus bar Protection measurement. This will ensure that when the bus tie breaker is in open position and a fault occurs between the CT and the bus tiebreaker, the faulted bus section is selectively tripped and isolated without any delay. The healthy bus section will not be tripped.
dd) A Local Display Unit (LDU) shall be provided on the Central Unit and on each Bay Unit
ee). The LDU on the ~~Central~~ Unit shall permit read out of the following information
•Differential currents in each Bus bar zone and each phase on line as well as at the time out of the fault.
■Alarm conditions
■Trip conditions
■State of all the inputs and outputs in the Central Unit
•Setting values
■Phase currents (and optionally. phase voltages) in each bay
•State of all the inputs and outputs in each bay
■Positions of the isolators in each bay
Positions of the breakers in each bay
■Setting values
■Resetting of output relays
ti) The LDU on each Bay Unit shall permit read out of the following information'.
■Phase currents (and optionally. phase voltages)
in each bay
■Alarm conditions
■Trip conditions
■State of all the inputs and outputs in the
respective bay
■Positions of the isolators in The respective bay
■Position of the breaker in the respective bay
✓ Setting values
■Resetting of output relays
gg) Provide sufficient number of potential free contacts to cater the needs of connection to alarms annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed_
hh) Shall have immunity against system transients.
II) Include continuous DC supply supervision.
jj) Incorporate clear zone indication..
kk) Should not operate during the change over operation of a circuit from one bus to another bus and during normal load flow in the bus bars.
ll) Trip both the breakers i.e. the breakers being bypassed and the transfer breaker if the bus fault occurs during the change over operation.
mm) Have provision to reset trip bus through a single push button to be provided For the purpose.

	nn) It shall be possible to prepare the Bus bar Protection to include, in the protection scheme, future bays as and when they are added. In such cases, the system shall be easily extendable by adding Bay Units for the new bays and activating the same in the Bus bar Protection_ Such extension work shall not require any other wiring changes to the existing system. oo) The bus bar protection offered shall have communication port for integrating with the local station automation or to a station monitoring system_ One of the protocols offered for the communication port shall be an international standard protocol I E C 61850
LOCAL BREAKER BACK UP PROTECTION SCHEME	The relay shall be provided to take care of stuck breaker conditions. The local breaker back up protection scheme will under such conditions, immediately after the operation of primary / back up protection, transmit the tripping impulse to all the circuit breakers connected to that bus zone of which the circuit breaker forms part. The scheme shall be supplemented with a timer suitable for station DC supply and continuously adjustable setting of .05 to .5 sec. on pick up. The separate relay shall be provided for LBB protection in every bay. The DC supply of this relay shall be separate from DC supply of the primary relay. The relay shall be, i) be triple pole type with a suitable setting range of of rated current. ii) have operating time of not more than 15 m-sec. iii) have a resetting time of not more than 15 m-sec. iv) be of numerical type. v) have a continuous thermal with stand of two times rated current irrespective of setting. Note:- The LBB protection scheme in built in separate numerical relays with separate DC system
TIME SYNCHRONISATION EQUIPMENT	i) The Time synchronisation equipment shall receive the co-coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronizes equipments to the Indian Standard Time in a substation. ii) Time synchronisation equipment shall include antenna, all special cables and processing equipment etc. iii) It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realized through optic fibre bus. iv) The synchronisation equipment shall have 2 micro second accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage & temperature variations, propagation & processing delays etc). v) Equipment shall meet the requirement of IEC 60255 for storage & operation. vi) The system shall be able to track the satellites to ensure no interruption of Synchronisation signal. vii) The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement. viii) The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:

	• Voltage signal : Normally 0-5V with 50milli Seconds minimum pulse duration. In case any other voltage signal required, it shall be decided during detailed engineering. • Potential free contact (Minimum pulse duration of 50milli Seconds.) • IRIG-B • RS232C • IEC 61850 ix) The equipment shall have a periodic time correction facility of one second periodicity. x) Time synchronisation equipment shall be suitable to operate from 220V DC as available at substation xi) Equipment shall have real time digital display in hour, minute, second (24 hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height.
CABLE DIFFERENTIAL PROTECTION	The cable differential protection shall be provided for the following: * a) 33 KV cables from 220 KV GIS sub-station upto new LIB at PNCP S/s-9. b) 33 KV cables from new LIB at PNCP S/s-9 to existing generation bus at PNCP S/s-9. The relay shall be numerical type with dedicated OFC based communication connectivity, software based logic programmable as per site requirements with the use of PSL and other programming systems. The detailed technical specification for cable differential protection relay is attached as Annexure- S-3/C-5/5. The relay must have redundant OFC link connectivity The direct inter-trip through BI transfer function must be available in the relay. All the required CTs, relays, OFC cabling in HDPE pipe work is in the scope of ~~10000~~ contractor including supply of all materials and accessories. The numerical relay shall have dual rear port for IEC- 61850 based communication. One no. Of front port for communication with laptop for parameterisation purposes. The relay shall have minimum of 6 DIs and 4 power DOs. The relay shall have supply voltage of 220 V +-10%. Provision of new CTs will be required in the existing incomer breaker at PNCP generation bus for cable differential protection. Same shall have to be designed and supplied by LSTK contractor. Any modification in panel of CT installation shall be in the scope of the LSTK contractor including supply of all required materials. The CT ratio correction and polarity correction feature must be software based and available in the relay only. No use of ICT is recommended.
Fast Bus Transfer	Fast bus transfer scheme is required for 220 KV Bus-coupler. The offered relay shall have all the following options for auto-bus transfer. a) Fast Transfer b) In phase transfer c) Residual voltage transfer d) Time delay transfer

* REQUIREMENTS OF CABLE DIFFERENTIAL RELAYS SHALL BE AS PER ATTACHED KSLD IN SECTION-4.
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	The detailed specification is attached as S-3/C-5/4.
TRIP CIRCUIT SUPERVISION RELAY	The relay shall be capable of monitoring the healthiness of each trip coil and associated circuit of circuit breaker during "on & off" conditions. The relay shall have time delay on drop-off of min. 200 milli seconds and shall be provided with operation indicator. For monitoring of entire trip circuit (from control & relay panel terminal to the trip coil of circuit breaker) both in 'open' & 'close' position of the circuit, 2 No. automatic trip circuit supervision relays are proposed The relay shall a) Monitor the complete trip circuit with circuit breaker rr: pre-close & post-close condition b) Monitor loss of battery supply. c) Have a delay on drop off d) Provide alarm output. e) include hand reset flag indicator. f) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to the connected by purchaser where needed. 1) Provide sufficient number of potential free contacts to cater the needs Of connection to trip circuits, alarm/ annunciation, LBB relay, DR/SER/Data acquisition and spare contacts to be connected. As per the system design sufficient relays having potential free contacts For (lock out) trip circuit 1 & 2 for all the breakers of GIS system. The contacts for trip circuit shall be Heavy Duty. 2) be provided with operation indicators.
DC SUPPLY SYSTEM	Dual redundant DC control supply shall be provided each switchgear section, relay panels and SCAP.
D.C. FAIL ALARM RELAY:	A suitable relay for monitoring the Trip Circuit D.C. wiring of the control and relay panels shall be provided. The relay shall have time delay on drop-off of min. 100 milli seconds and shall be provided with operation indicator.
VOLTAGE SELECTION SCHEME:	The bus PTs exist on all the phases of both the ,220kV buses at substations having double bus arrangement. Proper voltage selection scheme shall be provided on panels. All kind of interlocks related with PT supervision , fuse supervision shall be incorporated in the scheme
CHECK SYNCHRONIZING & DEAD LINE CHARGING SCHEME :	Check synchronizing relay and dead line charging equipment shall be provided for 220 kV Both incomer feeders, all 4 transformer feeders, 220 KV bus coupler feeder, 4 Nos. 220 KV spare bays, all 6 nos 33 KV feeders of Generation system in respective SCAP. The check synchronizing relay shall compare the phase angle, frequency & rate of change of frequency of the 'incoming' and 'running' supplies and allow the auto/manual close to take place only if the said parameters are within the permissible limits. The dead line charging equipment shall ensure closing a circuit breaker on to a 'dead' line leaving the checking of synchronism of two supplies to the other end of it. Scheme shall also check blocking if Close command given continuously while synchronising conditions are not in limit.

Synchronizing check relay with necessary auxiliary equipments shall be provided which shall permit breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 20 degree and have voltage difference setting not exceeding 2-5%. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met within preset limits and with the timer disconnected. The relay shall have a continuously adjustable time setting range of 0.5-3secs.

GAURANTEED TECHNICAL PARAMETERS

This schedule of GTP for all the possible devices/components of the the control and protection panels. However the GTP is to be filled up in this format for the required devices/components for the control and protection panels required in the tender only and, in the page of tender specification only. The guaranteed technical parameters are to be submitted during details detailed in event of order by the ~~GC&A~~ contractor.

A	Description	Vendor's comments
i	Make	
ii	Panel Details 1. Type of panel (Simplex/Duplex) with swing frame front door. 2. Equipment mounted on which side of the panel 3. No. Of door and on which side of the panel. 4. Thickness of sheet steel a. Front b. Door Frame c. Base Frame d. Side e. Cubicle Roof f. Door 5. Overall dimension of each panel (in mm)	
iii	Detail of painting 1. IS code of practice for phosphating iron and steel in which accordance the sheet steel work is done 2. Shed no. And IS of color. 3. Paint thickness	
iv	Largest package by transport 1. Gross wight 2. Overall dimensions	
v	GA drawings , no. attached	

vi	Mounting details	
vii	Other details, if any.	
B	<u>PANEL WIRING</u>	
i	Insulation grade and type	
ii	It shall be single core multi strand flexible wire.	
iii	Conductor used (Copper or Aluminum)	
iv	Size of wiring conductor for following. 1) PT Circuits 2) CT Circuits 3) DC supply circuits 4) Other circuits	
v	Colour code of wiring for following. 1) PT Circuits 2) CT Circuits 3) CVT Circuits 4) DC supply circuits 5) Other circuits	
vi	Type of Lugs, Sleeves and Ferrules to be used for panel internal wiring.	
C	<u>TERMINAL BLOCKS</u>	
i	Make	
ii	Construction details	
iii	Voltage grade	
iv	Current rating	
v	Type of TB for CT, CVT, PT wiring and other wiring.	
vi	No. of 2.5 sq. mm Cables that can be connected.	
vii	No. of spare terminals.	
D	<u>EARTHING</u>	
i	Conductor or material used for earthing	
ii	Size of the earthing conductor	
iii	Colour and size of the wire used for earthing of different devices in the panel to the earthing bar.	
E	<u>CIRCUIT LABEL</u>	
i	Material size and color.	
F	<u>CONTROL SWITCHES FOR CIRCUIT BREAKERS:</u>	
i	Make	
ii	Type of switch 1) Stay put/spring Return type 2) Control discrepancy type	
iii	Rating of contacts 1) Voltage 2) Make and carry continuously. 3) Make and carry for 0.5 sec. 4) Break resistive load with L/R ratio of 40	

	ms.	
iv	Whether locking arrangement provided.	
v	Type of handle standard	
vi	Dimensions	
vii	Red Base or Handle	
viii	Mounting details and drawing no.	
ix	Detailed technical literature furnished.	
x	Other information, if any.	
G	<u>PUSH BUTTONS</u>	
i	Make	
ii	Type	
iii	Contact type(momentary/maintained)	
iv	Whether shrouding provided to prevent inadvertent operation.	
v	Whether integral engraved integral plates provided.	
vi	No. of NO/NC contacts.	
H	<u>AUXILIARY RELAYS</u>	
i	Make	
ii	Type & Designation	
iii	Mounting (Flush/ Semi Flush & on Front/ Rear)	
iv	Nominal voltage and % variation	
v	Contacts (hand reset/self reset)	
vi	No. of pairs of contacts i) Make contacts ii) Break contacts	
vii	Speed operation of relay	
viii	Pick up / drop off ratio	
ix	Burden of relay – VA	
x	(i) Contact rating (ii) Voltage (iii) Making current and duration (iv) Breaking current a) Resistive b) Inductive 0.3 PF c) Inductive L/R 10m sec 40m sec	
xi	Detailed literature furnished.	
xii	Standard	
I	<u>CONTACT MULTIPLICATION REPLY:</u>	
i	Whenever auxiliary relay is used as contact multiplication purpose, the relay should be latched & electrically reset type.	
ii	Other specification as Auxiliary relay. i) Make ii) Type and designation	

	iii) Nominal voltage and % variation. iv) Contacts, hand reset/self reset. v) No. of pairs of contacts. a) Make contacts b) Break contacts vi) Speed of operation of relay vii) Pick up/drop off ratio viii) Burden of relay – VA ix) i) Contact rating ii) Voltage iii) Make current and duration x) Breaking current a) Resistive b) Inductive 0.3 PF c) Inductive L/R 10m sec. 40m sec.	
iii	Detailed literature furnished.	
iv	Standard	
J	<u>TRIP CIRCUIT SUPERVISION RELAYS</u>	
i	Make	
ii	Type designation	
iii	Rating	
iv	i) Operating principal ii) Literature write-up enclosed.	
v	Minimum voltage for satisfactory operation.	
vi	Burden	
vii	Monitoring of breaker trip coil in both open and close position provided.	
viii	Safety resistor provided to limit the current if the relay coil is short circuited.	
ix	Output contacts i) No. of NO/NC contacts ii) Rating of contacts	
x	Time delay on drop off	
xi	Type of indication	
xii	Standard	
xiii	Any other relevant details.	
K	<u>TRIPPING RELAYS</u>	
i	Make	
ii	Type designation	
iii	Rating	
iv	i) Operating principal ii) Literature write up enclosed	
v	Operating time at rated voltage.	
vi	Relay suitable for being continuously monitored.	
vii	Electrical reset contacts i) No. of NO & NC contacts	

	ii) Rating of contacts.	
L	DIRECTIONAL OVERCURRENT AND EARTH FAULT RELAY	
i	Make	
ii	Type	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical and have true RMS measurement.	
v	Display type for HMI	
vi	Give the details of self monitoring (Hardware & Software) and indication/ alarm facility on internal relay failure	
vii	- Current Input (CT Secondary) - Whether selectable from front panel at site	
viii	Auxiliary Supply and its burden with permissible tolerance.	
ix	No. of poles	
x	Current setting range for Over Current element	
xi	Current setting range for Earth Fault element	
xii	- Type of Characteristics available - Whether selectable from front panel at site	
xiii	- MTA setting for Phase fault - Whether site adjustable	
xiv	- MTA setting for Earth Fault - Whether site adjustable	
xv	Criterion for decision of directionality	
xvi	High set current setting range for Over Current	
xvii	High set current setting range for Earth Fault	
xviii	Time multiplier	
xix	Reset Ratio	
xx	Built-in Breaker Failure Protection - Current Setting range - Timer range - No. of poles - Operating time - Resetting time - No. of O/P Contacts available for this feature.	
xxi	Burden at CT inputs	
xxii	- No. of fault event can be stored - Type of data stored on fault	
xxiii	Maximum duration for DR on each fault	
xxvi	No. of Binary Inputs	
xxvii	No. of outputs. (Trip/ Signaling)	
xxviii	Contact rating - Make and carry continuously - Make and carry for 0.5 sec. - Break resistive load and inductive load	

	with 40m sec. time constant iv) Whether self reset or hand reset	
xxix	Communication a. Type of port (Front) b. Type of port (Rear) c. Comm. Protocol d. Time sync port	
xxx	Ref. no. of descriptive leaflet enclosed	
xxxi	Temp. rise over ambient temperature	
xxxii	One minute power frequency withstand volt.	
xxxiii	Degree of Protection	
xxxiv	Mounting and dimensional details.	
xxxv	Overall dimensions	
xxxvi	Weight	
xxxvii	Temperature and humidity (e) Ambient temp (f) Relative humidity Non Condensing (g) Operate range (h) Storage temp.	
xxxviii	Any other information	
M	<u>NON-DIRECTIONAL OVERCURRENT AND EARTH FAULT RELAY</u>	
i	Make	
ii	Type	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical and have true RMS measurement.	
v	Display type for HMI	
vi	Give the details of self monitoring (Hardware & Software) and indication/ alarm facility on internal relay failure	
vii	- Current Input (CT Secondary) - Whether selectable from front panel at site	
viii	Auxiliary Supply and its burden with permissible tolerance.	
ix	No. of poles	
x	Current setting range for Over Current element	
xi	Current setting range for Earth Fault element	
xii	- Type of Characteristics available - Whether selectable from front panel at site	
xiii	High set current setting range for Over Current	
xiv	High set current setting range for Earth Fault	
xv	Time multiplier	
xvi	Reset Ratio	
xvii	Built-in Breaker Failure Protection 1. Current Setting range 2. Timer range	

	3. No. of poles 4. Operating time 5. Resetting time 6. No. of O/P Contacts available for this feature.	
xviii	Burden at CT inputs	
xix	- No. of fault event can be stored - Type of data stored on fault	
xx	Maximum duration for DR on each fault	
xxi	No. of Binary Inputs	
xxii	No. of outputs. (Trip/ Signaling)	
xxiii	Contact rating i) Make and carry continuously ii) Make and carry for 0.5 sec. iii) Break resistive load and inductive load with 40m sec. time constant iv) Whether self reset or hand reset	
xxvi	Communication a. Type of port (Front) b. Type of port (Rear) c. Comm. Protocol d. Time sync port	
xxvii	Ref. no. of descriptive leaflet enclosed	
xxviii	Temp. rise over ambient temperature	
xxix	One minute power frequency withstand volt.	
xxx	Degree of Protection	
xxxi	Mounting and dimensional details.	
xxxii	Overall dimensions	
xxxiii	Weight	
xxxiv	Temperature and humidity (a) Ambient temp (b) Relative humidity Non Condensing (c) Operate range (d) Storage temp.	
xxxv	Any other information	
N	DISTANCE RELAYS	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Auxiliary DC Voltage with permissible tolerance.	
vi	CT input, specify whether selectable at site. Permissible over load.	
vii	PT input with permissible over load.	
viii	Type and no. of measuring elements.	
ix	No. of zones.	
x	Type and no. of starting units.	

xi	Minimum operating current for each element.	
xii	Max. Reactive reach range First zone element Second zone element Third zone element Fourth (Reverse) zone element Power Swing Load Encroachment	
xiii	Max. Resistive reach range First zone element Second zone element Third zone element Fourth (Reverse) zone element Power Swing Load Encroachment	
xiv	Minimum and maximum line length in Km for which the fault can be detected.	
xv	Reset ratio for Distance Protection function	
xvi	Reset ratio for SOTF	
xvii	Type of power swing blocking (state type and characteristic)	
xviii	Operating time range First zone Second zone Third zone Fourth (Reverse) zone element PS Blocking timer PS Deblocking timer	
xix	Relay characteristics angle range for Measuring units Starting units Power swing blocking relays	
xx	Whether suitable for any communication scheme.	
xxi	Have all carrier auxiliary relays been provided (give technical particulars)	
xxii	No. of Binary Inputs and their ratings.	
xxiii	No. of Binary outputs and their ratings.	
xxvi	Tripping time carrier (maximum and minimum)	
xxvii	Type of auto re-close scheme and time range for i) Dead time ii) Reclaim time	
xxviii	VA burden of each phase relay. i) Current circuit ii) Potential circuit	

	iii) DC circuits	
xxix	Whether continuous self monitoring and diagnostic feature is available.	
xxx	Relay characteristics available	
xxxi	Change in characteristics possible	
xxxii	Burden on CT and VT per phase.	
xxxiii	i) No. of tripping relays provided ii) No. of NO/NC contacts of each tripping relays suitable for use in auto reclosure scheme.	
xxxiv	All aux. relays for the scheme provided.	
xxxv	All external resistors as required provided.	
xxxvi	Carrier ON/OFF provided.	
xxxvii	Auto re-closure scheme with check relay as per specification in annexure III	
xxxviii	Measurements of functions list here.	
xxxix	No. of Disturbance Records and their different time periods.	
xl	Manual online testing facility provided through test plug without isolation of any circuit from panel TB.	
xli	Communication Protocols	
xlii	Time Synchronization	
xliii	Is the scheme exactly as per specification?	
xliv	If not, list out deviations.	
O	Line Differential Protection Relay	
i	The relay shall have all the features as per Distance protection relay	
ii	It shall be working on phase segregated current Differential protection principle	
iii	It shall have multiple slope characteristic (preferably) to have stability against CT saturation and heavy through faults as well as sensitivity for internal faults	
iv	It shall measure Differential as well as restrain current continuously and shall display the same as measurement	
v	It shall use fiber optic cable or multiplexed digital network to exchange telegrams.	
vi	It shall communicate to remote end through IEEE C37.94 format	
vii	It shall have redundant communication channels for protection communication	
viii	It shall communicate analogue as well as digital signals to remote end.	

ix	It shall have various communication options for remote communication i.e. mono-mode / multi-mode for direct communication / communication through multiplexer.	
x	It shall have Line charging current compensation feature for better sensitivity	
xi	Distance protection function can be utilized as independent or as back up of Differential protection in case of failure of remote communication	
xii	It shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS shall also be possible	
xiii	It shall monitor individual communication links continuously and switchover to standby link after preset time in case of failure of one link	
xiv	It shall supervise individual telegrams	
xv	It shall detect reflected telegrams	
xvi	It shall detect change in communication delay time	
xvii	It shall measure delay time for remote end along with dynamic compensation of the same in differential protection algorithm	
xviii	It shall also supervise maximum permissible delay time	
xix	It shall generate alarm for heavily disturbed communication link	
	Differential Protection setting	
xx	Minimum operating current	
xxi	Slope (Single/dual)	
xxii	End section (Single/dual)	
xxiii	Highset operating current	
xxiv	2 nd Harmonic blocking	
xxv	Typical operating time	
xxvi	Operating time for high set	
xxvii	Charging current compensation	
	Remote Communication	
xxviii	Nos. of Analogue signal transfer	
xxix	Nos. of Binary signal transfer	
xxx	Dual Remote Communication module a. 1300 nm - multi-mode OR b. 1300 / 1550 nm – mono-mode	

xxxi	Synchronization mode - GPS Echo	
xxxii	Time delay alarm for communication fail	
xxxiii	Time delay for switching to redundant channel	
xxxiv	Asymmetric delay (For echo mode)	
xxxv	Max. Transmission delay time	
P	<u>BACKUP IMPEDANCE RELAY</u>	
i	Make	
ii	Type & designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Auxiliary DC Voltage with permissible tolerance.	
vi	CT input with Permissible over load.	
vii	PT input with permissible over load.	
viii	Type and no. of measuring elements.	
ix	No. of zones.	
x	Type and no. of starting units.	
xi	Relay characteristics	
xii	Impedance setting range	
xiii	Timer range	
xiv	Relay characteristics angle range for Measuring units Starting units	
xv	Max. VA burden per phase. Current circuit Potential circuit DC circuits	
xvi	Whether continuous self monitoring and diagnostic feature is available.	
xvii	Is the scheme exactly as per specification?	
Q	<u>FUSE FAILURE RELAY</u>	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	i) Rating V AC	
v	i) Operating principle ii) Literature write up enclosed	
vi	Operating time	
vii	Burden	
viii	Output contacts i) No. of NO and NC contacts	

	ii) Rating of contacts	
ix	i) Additional fuses required at line VT ii) Arc fuses provided	
R	<u>DC SUPERVISION RELAY</u>	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	General design	
v	DC rating (voltage)	
vi	Output contacts	
vii	Any other data	
S	<u>DIFFERENTIAL RELAYS</u>	
i	Make	
ii	Type and designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Whether continuous self monitoring and diagnostic feature is available	
vi	Current circuit rating	
vii	Voltage circuit rating	
viii	Operating principle	
ix	Number of poles	
x	Max. V.A burden i) Operating circuit ii) Restraining circuit	
xi	Min. Operating current	
xii	Is the slope setting variable.	
xiii	Setting ranges available	
xiv	Power consumption i) Operating circuit ii) Restraining circuit	
xv	2 nd and 5 th harmonic restrain provided or not.	
xvi	Whether internal angle and ratio correction is available.	
xvii	Operating time i) at 2 x I _n ii) At 10 x I _n iii) Time take to energize the trip coil of the break for initiation of fault current as in (I and II) above.	
xviii	Resetting ratio	
xix	Adjustable bias setting.	
xx	Three pole instantaneous high set units provided.	
xxi	Burden on purchaser's CT	
xxii	Output contacts and their ratings.	
xxiii	Shall have the following functions.	

	vi. Differential Protection vii. Restricted Earth Fault Protection viii. Thermal Over Load Detection ix. Over Fluxing Protection x. LBB	
xxvi	Details of Disturbance Recording facility.	
xv	Descriptive leaflet Ref. No.(to be enclosed)	
xvi	Communication a. Type of port (Front) b. Type of port (Rear) c. Comm. Protocol d. Time sync port	
T	<u>OVER FLUXING RELAYS</u>	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Static or Numerical	
v	Rating (V/Hz)	
vi	Operating principal	
vii	Setting range	
viii	No. of stages in relay	
ix	No. of timers provided and range of time settings available.	
x	Burden	
xi	Auxiliary relays as necessary to make scheme complete provided.	
xii	No. and rating of protective and auxiliary relay contacts.	
xiii	Write up on the relay enclosed.	
U	<u>RESTRICTED EARTH FAULT RELAYS:</u>	
i	Make	
ii	Type	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Maximum VA burden	
v	Operating time i) Minimum ii) Maximum	
vi	Description leaflet Ref. no.	
vii	No. of contacts make and carry for 0.5 sec and break type.	
viii	Whether contacts self reset or hand reset.	
ix	Contact ratings i) Make and carry continuously ii) Make and carry for 0.5 sec. iii) Break resistive load and inductive load with 40 m. sec. time current.	

x	Setting range.	
V	BUS DIFFERENTIAL RELAY	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Bus Bar Protection Functions: 1. Min fault current pick-up range (I_{kmin}) 2. Neutral current Detection range 3. Stabilizing factor (K) 4. Diff current Alarm setting range 5. Time Delay for (4) above 6. Isolator alarm time delay setting 7. Typical tripping time	
v	Check Zone: 1. Min fault current pick-up range (I_{kmin}) 2. Stabilizing factor (K) 3. CT Ratio matching range	
vi	Analog Inputs (Bay or Peripheral or Field Unit): 1. Maximum no. of Bays which can be connected with central unit 2. Current Rating 3. Thermal Ratings: - Continuous - For 10 s, Minimum $10 \times I_n$ - For 1 s, $100 \times I_n$ 4. Auxiliary Supply	
vii	Binary Inputs/ Outputs: 1. Operating Time 2. Max Operating Volt 3. Max Cont rating 4. Max make & Carry 5. Max making power 6. Whether Binary O/P Reset Programmable 7. Breaking Current: - Heavy Duty N/O Contact: - Signaling Contact: 8. No. of I/P per bay unit: 9. No. of I/P for central unit: 10. Pickup current for I/P: 11. Operating Time for I/P: 12. Nos of Output – Bay unit: 13. Nos of Output – Central Unit:	
viii	Auxiliary Supply: 1. Input Voltage: 2. Load: (Bay Unit) (Central Unit) 3. Front plate Signal	

	4. Switch	
ix	Optical Interface: 1. Number of Cores 2. Core/ sheath diameter 3. Max permissible attenuation 4. Connector:	
x	Event Recorder: It shall have event recording facility for minimum last 50 Operational/ fault events.	
xi	Disturbance Recorder: 1. Independent setting for pre-fault and post-fault period 2. Format	
xii	Local & Remote communication: 1. Serial interface for connecting a PC, either directly or via a modem. 2. System interface for connecting to a control system via IEC 61850. 3. System interfaces via IEC 61850 protocol for inter bay bus supports. 4. Time synchronization via IRIG-B / SNTP.	
xiii	Communication ports : • Front - RS232 / RJ45 / Optical • Rear - Fiber optic / RJ45	
xiv	Maximum fault current for which 100% stability can be achieved.	
xv	Impedance type and operating characteristic	
xvi	Continuous supervision of CT secondary against open circuit	
xvii	Architecture & Interconnection of Central unit and bay unit panel.	
xviii	Principle of CT ratio error matching	
xix	Measuring and tripping criterion	
xx	HMI details	
xxi	Self supervision and diagnostic facility.	
xxii	Measurements available	
xxiii	Whether bus bar image for each bay is formed and displayed in HMI	
xxvi	Redundant hardware available	
xxvii	Standard functions available	
	Optional functions available	
xxviii	Reset through a single push button	
xxix	Future configuration and activation of new bays should be possible	
xxx	Filtering and evaluation of Analogue qty at bay level	
xxxi	Tripping to trip coil directly from Bay units	
xxxii	Connection and communication between Bay unit	

	and Central unit	
xxxiii	Blocking of zone in case of communication failure and annunciation thereof	
xxxiv	Isolator integrity monitoring through software without any external relay and annunciation thereof	
xxxv	DR/Event function in CU as well as BU with non volatile buffer memory	
xxxvi	DR Sampling freq. And total duration	
xxxvii	Nos of events	
xxxviii	Availability of Blind zone detection & CB failure feature	
xxxix	Differential current display of each zone	
xxxx	Continuous DC supervision	
xxxxi	Central unit compatibility	
xxxxii	Availability of Current reversal technique for Bus Coupler bay	
xxxxiii	Any deviations	
xxxxiv	Any other details	
W	GENERAL	
i	Whether agreed for Testing & Commissioning of the panels at site.	
ii	Whether agreed for 24 Months Performance Guarantee.	
iii	Whether agreed for Demonstration of the offered panel or any loose item to be used in the panel, if asked before the opening of the price bid.	
iv	Whether agreed for Training if asked by the purchaser.	
v	Whether Schedule B and G dully sealed and signed attached.	
vi	TOOLS Whether Optional tools required for testing/ commissioning/ maintenance is listed and price for the same is given	
vii	SPARES: Whether list of recommended spares for normal maintenance for period of 5 years furnished.	

IOCL, PANIPAT REFINERY	Bill Of materials	Annexure-S-3/C-5/5
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LIST OF EQUIPMENT FOR CONTROL & PROTECTION PANELS
(TO BE FILLED IN BY THE BIDDER)

Sr.no.	Description	Quantity	Make and type designation

GUIDELINES FOR INSTALLATION OF METERING EQUIPMENTS AND ARRANGEMENTS AT THE PREMISES OF OPEN ACCESS CUSTOMERS.

- i) Open Access Customers injecting power in to HVPNL/DISCOM system shall provide separate line bay with line protection scheme at both ends to take care of any fault on line. At Sub Station end Supply should not be tapped from Bus PT. Exclusive line CTs and PTs are to be installed for at Sub Station end. The Meters are to be installed near line bay in Sub Station Yard
- ii) Meters are to be installed directly on line without any isolator in between line and metering CTs/PTs.
- iii) Metering CTs/PTs should be exclusively for interface metering. Customers may install any additional meter with separate CT/PT for their reference.
- iv) Customers who have interconnection with Inter- State Transmission System or Intra- State Transmission System / Distribution System and have been permitted Open Access shall be provided with interface meters.
- v) The scheme for location of meters shall be submitted to HVPNL or licensee by consumer in advance before installation of the Scheme.
- vi) The meter should be installed nearest to the CT/PT to reduce the potential drop in the secondary circuit with easy/ free access by HVPNL/DISCOM staff for installation, testing, commissioning reading and recording and maintenance of meters. The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organisation.
- vii) HVPNL/Licensee shall examine, test before installation and only correct meter shall be installed.
- viii) Meter is not to be installed in the control room of consumer's substation.
- ix) The operation, testing and maintenance of meter shall be carried out by the licensee.
- xi) Unique identification code of meter:- Every meter shall have a unique identification code, which shall be marked permanently on the front as well as in its memory. The series of unique identification code of meter shall be provided by HVPNL before installation & testing.
- xii) The calendar & clock of meter shall be correctly set at the manufacture's work.
- xiii) Microprocessor based 3 phase 4 wire meter (Model-A) shall conform to accuracy class 0.2S as per IS 14697 or IEC-62053-22. ~~As per HVPNL technical specification No. HVPNL/ST/INSTRUMENTATION/2010/01~~
~~modified~~ The meter is suitable for being connected through TTB to VT having secondary line to line voltage of 110V & to CT having a rated secondary current of 1A.
- xiv) Polarity:- As per HVPNL Technical specification.
- xv) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula, at respective sub-station & consumer PC. Suitable MRI be also procured.
- xvi) The meter shall be identical in all respect except for their unique identification codes. They shall also be totally sealed and tamper proof, with no possibility of adjustment at site except for a restricted clock correction.

- xvii) Each meter shall have a test output device (visual) for checking the accuracy of active energy and reactive energy (VARh) measurement using a suitable test equipment. The test output shall be software configurable for active energy import/ export & reactive energy import/ export.
 - xviii) All the CT/PT used in conjunction with metering shall also be of accuracy class not inferior to meter & conform to the relevant IEC/ IS & HVPNL/Discom specifications. The rating shall take into account the burdens imposed by lead wires and metering. The existing Consumers who have installed CT of 0.2 Accuracy class shall replaced the same with 0.2S accuracy class with in 60 day.
 - iv) CTs of 0.2S with CT output is 1A . However PTs of accuracy class 0.2 of secondary line to line voltage of 110 V shall be use. *(supply of CT & PT not in Bidden's scope)*
 - v) Metering CT/PT should be exclusive for metering purpose. These will not be allowed for protection purpose. The main meter & check meter shall be connected to the same core of CTs and VTs
 - vii) All connecting cables from CT/PT of 4Cx4 mm² to meters should be routed 2.5'dia HDD PVC pipe. *(Not in Bidden's scope)*
 - viii) Un-climbable fencing around metering, CT, PT area is to be provided which will be sealed by DISCOM/HVPNL as the case may be. *(Not in Bidden's scope)*
 - ix) Use of only single ratio metering CTs will be allowed. Multi ratio CTs are not to be used in any case.
 - x) Metering CTs/PTs, bottom plate needs to be welded after testing/installation at site.
 - xi) Open access customer (non-consumer of DISCOM) is required to provide communication channels at his own cost for communication of metering data to HVPNL if required so.
 - xii) Consumers who have already installed CT/PT without witness/checking of DISCOM/HVPNL shall get the same tested in the presence of DISCOM/HVPNL representative. The CT/PT may be got tested from NABL accredited lab.
 - xv) Data shall be collected from both the main and check metering schemes.
 - xvi) The meter shall operate with the power from the VT secondary circuits, without the need for any auxiliary power supply. The total burden imposed by a meter for measurement and operation shall not exceed 10 VA on any of the phase.
 - xvii) Inspection & testing:- The meter shall be fully type tested as per IS 14697 or IEC 62053-xviii). All routine test as per IS shall be carried out by manufacturer on the meters . The Type & Routine test report of Meter & CT/PT as per ISS or IEC shall be submitted by Open Access Customers after taking it from Manufacturer before deputing representative for witnessing site testing/witnessing test as per ISS/technical specification. The HVPNL shall ensure that all type, routine, & Acceptance test are carried out by the manufacturer on metering equipment as per ISS/IEC.
 - xix) At the time of commissioning, meter Testing & Commissioning of interface meters may be carried out in the presence of the representative of the parties at site.
 - xix) Sealing of meter shall be done at following points:-All meter shall be sealed by the manufacturer at its work. in addition to seal provided by the manufacturer at its work, the sealing of all meters shall be done as at following sealing points:- a) TTB- each Meter test terminal Block shall have the provision for two seal b) Meter body or cover c) meter terminal cover / meter terminal Block including each optical communication port.d) Meter cabinet. Suitable sealing of CT/PT may also be provided to ensure no tampering to made .Sealing of interface meters, shall be done by both the supplier & buyer.
- Meter reading & Recording:- HVPNL or Discom is responsible to take down the meter reading & EAC would verify the correctness of metered data & furnish the same to various agencies
- Removal of seals from meters:- When ever seals have to be removed advance notice be given to other party for witnessing the removal of seals and resealing of interface meter. The breaking & re-sealing of the meters shall be recorded by the party, who carried out the work, in meter register , mentioning the date of removal and resealing , serial number of the broken and new seals and the reason for removal of seals.
- xx) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula.

Suitable MRI be also procured. The test results duly witnessed by representative of concerned M&P Division of DHBVN and Haryana Vidyut Prasaran Nigam Limited may be submitted to this office for further analysis. A copy of Technical specifications of HVPN for SEM's be refereed

The other commercial terms & condition regarding warranty, etc shall be settled with supplier of equipment by Open Access Consumer.

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

(TECHNICAL SPECIFICATIONS)

S. No.	Relay Feature	Relay Feature Description	Confirm	Deviation s, if any
			Yes / No	
1	Application	The Numeric Feeder Protection Relay (hereafter referred to as the Relay) shall be suitable for use as a single comprehensive protective relay for HT/LT SWBD Incoming Feeders with at least the following protective function & features: Three-phase Instantaneous/ Definite Time Phase Over-current protection (50 - 50/2), three-phase IDMT Over-current protection (51), Instantaneous/ Definite-Time Earth Fault protection (50N – 50N/2), IDMT Earth Fault Protection (51N), Under voltage (27), Over voltage (59), Under frequency (81U), Over frequency (81O), Voltage dependent Over current (51V), Trip Circuit Supervision (95), Measurement & recording facilities, facility of logic programming		
2	Auxiliary Voltage	The offered Relay shall be suitable for working with auxiliary power supply for ~~220VAC~~ 220-240 VDC (+ 20%)		
3	Phase Current Input	1. The Relay shall be suitable for 1A & 5A CT secondary inputs selectable at site. 2- The relay shall have three phase CT input of both 1A and 5A (Selectable to either 1 or 5 A)		
4.1	Ground Current Input	1. The Relay shall be suitable for 1A & 5A CT secondary inputs selectable at site. 2. The Relay shall be suitable for residual as well as CBCT inputs. 3- The relay shall have minimum two earth fault CT input of both 1A and 5A (Selectable to either 1 or 5 A)		
4.2	PT input	The relay shall have at least one three phase PT input and one 2/3 phase PT input for synchronization. The nominal PT input voltage is 110 V AC. In case second independent 3 phase PT input are not available in one relay a combination of two relay can be offered.		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

5	Binary Inputs	1. The Relay shall have minimum twenty two (22) freely configurable binary inputs other than inputs used for Trip Circuit Supervision. Bidder to ensure 20% spare DIs after preparation of complete scheme.		
		2. All Binary Inputs shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.		
		3. All Binary Inputs including that for TCS shall work on the same voltage level as that of the relay auxiliary power supply. The Binary Inputs shall work only in the voltage range of the auxiliary power supply i.e., 110V DC $\pm$ 10% or 220 VDC $\pm$ 10% and shall not work in any other AC or DC Voltage range due to accidental occurrence of any voltage mixing, voltage superimposition or induced voltages in addition to the rated auxiliary supply mentioned above.		
6	Binary Output Relay Contacts	The Relay shall have atleast ten (10) freely configurable binary output relays for alarm and trip functions with at least four (04) relays having changeover contacts and an additional watchdog relay with changeover contacts for generating alarm contact in case of Internal Relay Fault. Provision shall be available in the relay to program the output relays for hand/ manual reset application. The output relay contacts shall be rated for at least 5A continuously at 220 V AC/DC. Bidder to ensure 20% spare DOs after preparation of complete scheme.		
7	Programming	1- The relay shall have facility of programming the total control scheme in soft through logic blocks (Programmable soft logic) inside the relay through communication software. The software should have necessary building blocks for the control scheme which can be used freely for implementation of desired scheme. Vendor shall develop the logics & drawing as per the IOCL requirement. 2- The relay shall have Programmable scheme logic to customise the protection and control functions by programming the functionality of the optically isolated inputs, relay outputs and LED indications. The programmable scheme logic shall comprises gate logic and general purpose timers with the ability to invert the inputs and outputs, and provide feedback. 3- Facility of blocking protection functions using digital/binary inputs		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		should be available.		
8	Protection Functions	1. The Relay shall have at least the following protective elements: a. Instantaneous/ Definite Time Over-Current: The relay shall possess an instantaneous/ definite time over-current feature for short circuit protection in case of phase faults. The time delay in the definite time setting shall be settable to a minimum of 0.00 sec. b. IDMT Over-Current: The relay shall possess at least three stages of IDMT over-current feature and shall be selectable to any of the IEC characteristic curves. Options shall be available for all type of IDMT IEC curves. c. Instantaneous/ Definite Time Earth Fault: The relay shall possess an instantaneous/ definite time Earth Fault protection feature for each EF CT input in residual, Neutral CT or CBCT connection. The time delay in the definite time setting shall be settable for a minimum of 0.00 sec. d. IDMT Earth Fault: The relay shall possess at least two stages of IDMT Earth Fault feature for each EF CT input and shall be selectable to any of the IEC characteristic curves. Options shall be available for all type of IDMT IEC curves.		
		e. U/Voltage protection – 1) Two stage undervoltage setting configurable to operate from either phase-phase or phase-neutral quantities for each PT input. 2) U/V Protection setting shall have option for actuation on all three phases voltage basis.		
		3) O/ Voltage -Two stage overvoltage setting configurable to operate from either phase-phase or phase-neutral quantities.		
		4) VT supervision- The relay should sense fuse failure and block all protections based on voltage.		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		5) The relay shall have a provision for second PT input of 2 or 3 phase for checking sync condition during Incomer and buscoupler closing.		
9	Setting Groups	The Relay shall have at least two (02) independent selectable setting groups for all protection features of the relay.		
10	Trip Circuit Supervision	The Relay shall possess Trip Circuit Supervision (TCS) feature to monitor the trip circuit both in ON & OFF conditions of Circuit Breaker. All necessary hardware and components required for hook up of Trip Circuit Supervision (TCS) to the relay shall be supplied as a part of the relay with each relay. The TCS connection diagram shall be submitted along with the offer. The TCS feature shall work on the same voltage as the relay auxiliary power supply level.		
11	Online monitoring / Measurements	The Relay shall monitor at least the following parameters online:		
		1. The true primary and secondary RMS currents of all three phases & neutral (earth)		
		2. Positive sequence current, Negative sequence current & Zero sequence current		
		3. Peak Current values		
		4. Status of Trip Circuit Supervision		
		5. Relay healthiness status		
12	Diagnostic Features	The Relay shall have following diagnostic features:		
	a) Fault Records	Relay shall be able to record minimum 5 fault records containing the details such as the nature of fault, fault current & faulted phase with date and time stamping.		
	b) Event Records	Relay shall be able to record minimum 50 events with date and time stamping. Events shall be time-stamped at a resolution of a maximum of 3 milliseconds.		
	c) Disturbance Records	1. The relay shall be capable of capturing fault waveforms for at least three (03) seconds. The relay shall be provided with at least 8 channels consisting of minimum 4 analog and 4 digital inputs for disturbance recording. The date and time stamping shall be available for each disturbance fault record.		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		2. All disturbances/ events shall be displayed with time stamp. Relay time shall be synchronized with plant clock through serial communication from data concentrator, from substation MMI or from SCADA RTU. The relay shall have the feature of capturing at least the following parameters at the instant of tripping inclusive of I0, IL1, IL2, IL3, I1 & I2, without the need of any external trigger in case of protection trips. 3. The relay should be capable of downloading the data to PC via serial link for further analysis. Fault recording Starting Signal can be either Instantaneous or time delayed tripping or activation of a logic input.		
13	Memory	The Relay shall be equipped for retention of data like parameter settings, programming, status, events and fault data information and shall not be lost on failure of Relay auxiliary power supply.		
14	Relay Front Display	The Relay shall have a backlit alphanumeric LCD display and shall be able to provide key information like settings, measurement, fault data and records. Side-lit LCD screens are not acceptable.		
15	LED Display	The Relay shall be provided with LEDs for indicating at least the Protection Trip and Relay Healthy indications. Additional minimum 4 nos of LEDs, to be provided, and shall be freely programmable separately at least for protection trips, status of Digital Inputs & status of Trip Circuit Supervision.		
16	Human Machine Interface (HMI)	The vendor shall provide a local portable HMI/ Laptop and shall be capable to carry out the complete settings and configuration of the relay online through the local HMI without disturbing or tripping the feeder. It shall also be possible to download the information from the relay and interrogate the relay from remote. The local HMI shall have latest MS Windows operating system, 9 pin port, 4GB RAM, 300GB Hard disk space, latest version setting and analysis software CD and necessary communication cables for programming the relay		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

17	Watchdog & Self Monitoring	The Relay shall monitor the healthiness of its circuits and components by a continuous self-monitoring system. In case of any problem, alarm shall be generated without tripping the feeder. An output relay with changeover contact shall be provided for remote annunciation of the Relay fault. This alarm shall also be communicable through the RS-485 port to the connected SCADA system.		
18	Other Relay Features and requirements	1. The Relay terminals shall not be plug-in type. The wires to the relay shall be able to be connected with the help of screws. Relay terminals shall be suitable for termination of 2.5/4 sq. mm. wires. All necessary hardware required for connection of the wires to all the relay terminals shall be supplied along with each relay as part of the relay. 2. The relevant software & hardware for relay setting, data downloading and waveform analysis shall be supplied along with the relay as a part of the relay. The licensed copy of software supplied shall be licensed in the name of IOCL. All future upgrades from time to time shall be provided immediately to IOCL free of cost. 3. At least five (05) sets of necessary tool kits for installation, connection and commissioning of the relay including standard communication cable at site shall be supplied along with this lot as part of the relays. 4. The Relay shall be flush mounting type. The enclosure shall be dust tight having degree of protection minimum as IP5X. All the PCBs in the Relay shall be suitable for corrosive environment (minimum G3) with a transparent coating for environment protection and tropicalisation. The relay terminals shall be easily accessible for testing and commissioning. 5. It shall be possible to program the relay or change the settings and configuration of the relay on-line when the feeder is ON and in service without disturbing or tripping the feeder. 6. A suitably designed Stabilizing Resistor shall be supplied with each relay for Earth Fault protection in residual connection of CTs as part of the Relay. 7. Relay shall be made immune to capacitance effect due to long length of cables. Any external hardware, if required for avoiding mal-operation of relay due to cable capacitance shall be included as a standard feature.		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		8. The setting and configuration of the relay shall have the feature to directly set from the menu of each feature in alphanumeric format and not indirectly through a set of binary digits and summation codes. The setting and configuration of the relay shall be user-friendly.		
		9. The warnings, alarms, faults & trips in the relay shall be displayed directly in alphanumeric format on the backlit LCD screen and not indirectly in the form of summation codes.		
19	Communication & Protocol	1. The relays should have a front port for local communication for relay settings, extraction and analysis of fault/event/disturbance records from a laptop . It shall also have a Rear RS485 for remote communication to SCADA/ ECS system on open protocols such as IEC 60870-5-103. It shall also have an IEC61850 protocol for communication to SCADA.. All hardware connectors and ports as well as port converters & associated power supply units required, if any, for this purpose shall be supplied with this lot of relay		
		2. The Relay shall be able to communicate with any type of SCADA or ECS. Vendor shall confirm it at the time of quoting. The vendor shall provide the inter operability table / memory map and all other details and data of the relay required for network communication along with the supply of relay for facilitating communication of the relay through any network.		
		3. It shall also be possible to synchronize the relay time with the network clock by connecting to the network through open protocol. The real time clock shall be settable through the network as governed by the connected SCADA or ECS system.		
		4. All three phase currents, fault currents of each phase and earth, fault alarms, status of binary inputs and output relays, event records & fault records in the relay with date and time stamping shall be accessible through the network in open protocol.		
19A	Conformity to Standards	1. The equipment shall comply with the requirements of latest revision of following standards, unless otherwise specified.		
		• IEC 60068-2-1/2 Temperature range in service, during transport and storage		
		• IEC 60068-2-3 Damp heat recycle test		
		• IEC 60255 DC and AC power interruption and short circuit test		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		• IEC 60255 Class 3 General performance requirement		
		• IEC 60255-5 Voltage withstand test, insulation resistance test, Dielectric impulse test, Impulse voltage withstand test		
		• IEC 60255-6 Measurement of accuracy, rated burden, thermal requirement		
		• IEC 60255-11 Auxiliary DC Power supply requirement		
		• IEC 60255-21-1/2/3 Mechanical performance requirement; vibration, shock, bump and Seismic test		
		• IEC 60255-22-1 High frequency disturbance test		
		• IEC 60255-22-2 Electrostatic discharge test		
		• IEC 60255-22-3 Radiated, radio frequency and electromagnetic field immunity test		
		• IEC 60255-22-4 Fast transient disturbance test		
		• IEC 60255-22-25 Conducted and radiated radio frequency emission tests		
		• IEC 60255-23 Contact performance requirement		
		• IEC 60529 Degree of protection by enclosure		
		• IEC 61000-4-5 Surge immunity test		
		• IEC 61000-4-6 Immunity to conducted disturbance induced by radio frequency field		
		• IEC 61000-4-8 Power frequency magnetic field immunity test		
		• IEC 61000-4-9 Pulse magnetic field immunity test		
		• IEC 61000-4-10 Damped oscillatory magnetic field immunity test		
		• IEC 61000-4-11 AC auxiliary supply requirement		
		• IEC 61000-4-16 Immunity to conducted, common mode disturbances		
		• ENV 50204 Radiated electromagnetic field disturbance test		
		• EN 55022 class A Radio interference test		
		2. In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.		
		3. The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.		

(TECHNICAL SPECIFICATIONS (NUMERIC PROTECTION RELAY FOR FEEDERS))

		4. In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.		
		5. In case of any contradiction between various referred standards/ specifications/ data sheet and statutory regulations the following order of priority shall govern:		
		• Statutory regulations		
		• Data sheets		
		• This specification		
		• Codes and standards		
20	Password Protection	The relays shall be provided with suitable security (password protection) against unauthorized WRITE ACCESS for change in relay setting. However it shall be possible to view metering, protection settings, and status and event data as READ ONLY without password protection. It shall also be possible to disable the password function.		
21	Operating Climatic conditions	The relays shall be suitable for satisfactory operation when installed in a panel located in a pressurized substation with restricted natural air ventilation, in tropical humid and corrosive atmosphere. The Relay shall be suitable for operation at a maximum ambient temperature of 55 degrees Celsius and at a relative humidity of 75% continuous and 93% intermittent.		
22	General Requirement	1. The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.		
		2. Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply.		
		3. After at least fifteen (15) years from the date of supply, Vendor shall give a notice of at least one (01) year to IOCL before phasing out the product/ spares to enable IOCL to take action for placement of order for spares and services.		