		1. With Start / Stop Push Buttons. 2. With Start / Stop Push Buttons & Local/OFF/Remote Selector Switch. 3. With Start / Stop Push Buttons, Local/OFF/Remote Selector Switch & Ammeter. 4. With Start / Stop Push Buttons & Ammeter.
19	**Numerical Relays**	1. All Numerical relays shall be draw out type, proven for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. 2. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach, and other characteristics to provide required sensitivity to the satisfaction of the Employer. 3. All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying, and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays. 4. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage. 5. One-minute power frequency withstand test voltage for all numerical relays shall at least be 2kV (rms). 6. All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts, the minimum quantity of which is as follows. 7. Motor feeder – 10 BI + 8 BO 8. Transformer feeder – 12 BI + 6 BO 9. Incomer, Bus-coupler, Tie feeder – 14BI + 8 BO 10. Board IED (Switchgear Control Unit) – 32 BI + 32 BO 11. The above quantities are only indicative and shall be finalized during detailed engineering. In case the offered IED does not have the required number of I/Os, the same can be achieved through external I/O device of same make complying with the requirement stated elsewhere in this specification. 12. Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker vacuum contactor operation. Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.

		13. All the numerical relays shall have communications on two ports, local front port for communication to laptop and one RJ45 port on IEC 61850. All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power-factor, and energy parameters. 14. Relays shall have event recording feature, recording of abnormalities, and operating parameters with time stamping. Master trip (86) and non-86 trips shall be software configurable to output contacts and no separate master trip relay shall be used. 15. All numerical relays shall have provision of both current (CT) and voltage (VT) inputs. Relays shall be suitable for both residually connected neutral CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1A. Relays for transformer feeders without differential shall have 5 CT inputs (3 – Phase, 1 – CBCT, 1 – REF). Relays for transformer feeders with differential protection shall have 9 CT inputs (6 – Phase, 1 – CBCT, 1 – REF, 1 – Standby Earth Fault). Motor relays shall have 4 & 7 CT inputs for non-differential & differential application respectively. Relays for Incomers, Bus-couplers & Ties shall have 4 CT inputs. 16. All relays except incomers, ties and bus-couplers shall have 3Nos of VT inputs. Relays used in incomers, ties and bus couplers shall have provision of two sets of voltage inputs (3Nos for bus voltage & 1No. for line voltage) for the purpose of synchronization. 17. All CT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT open-circuit. In no circumstances Plug in type connectors shall be used for CT / VT connections. 18. All numerical relays shall have keypad / keys to allow relay setting from relay front. Pre-programmed or programmable key for Master trip (86) reset shall be provided on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote. Relays shall have suitable output contact for circuit breaker failure protection (CBFP). Relays shall have self-diagnostic feature with continuous self-check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure. Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI / user programmable characteristics. All cards/ hardware of numerical relays shall be suitable for operation in Harsh Environmental conditions with respect to high temperature, humidity & dust. 19. Protections for Incomers, Bus-couplers, and Tie feeders (Module Type DC/DE/DD)

		20. Three Phase Over current and Earth Fault protection (50 & 50N) 21. The over current element should have the minimum setting adjustable between 250- 2000% of CT secondary rated current. The earth fault element should be suitable for residually connected CT input. The relay shall be suitable for detection of earth fault currents in the range of 5% to 10% of the CT rated current. 22. Synchronizing Check (25) 23. Synchronizing check feature as a part of manual live change over and dead bus closing feature shall be provided. 24. Bus No-volt 25. Bus no volt signal shall be configured in the relay for use in control logics. 26. Transformer Feeder Protections (Module Type DB/DBF): The Transformer protection relay shall be suitable for providing the following protections. 27. Three Phase Over current and Earth Fault protection (50 & 50N) 28. The relay shall have instantaneous as well as time delayed over current and earth fault protections. The over current element should have the minimum setting adjustable between 250- 2000% of CT secondary rated current. The short circuit protection shall also have cold load pick up (doubling) / group-changeover feature to allow higher setting during transformer charging (inrush) and lower setting during normal operating condition. With CBCT the relay shall be suitable for detection of earth fault currents in the range of 10mA secondary. 29. Restricted Earth Fault protection (64R) 30. Restricted earth fault protection (64R) shall be provided with high stability circulating current principle having pick up setting range of 10 to 40 % of CT secondary. Necessary stabilizing resistors shall be provided. 31. Stand by earth fault protection (51N) 32. For transformers of rating 5MVA and above, definite time delayed Stand by earth fault protection shall be provided having a pickup setting range of 10% to 40% with a timer delay of 0.3 to 3 sec. 33. Transformer Differential protection (87T) Z 34. Differential protection for transformers (87T) of rating 5MVA and above shall be provided with stabilized biased differential relay. The differential protection shall be provided with harmonic restraint during switching and over fluxing condition. No ICT shall be provided either for ratio correction or for transformer primary and secondary correction. The necessary correction shall be programmable at offered numerical relay. Sensitive phase current and phase angle displays should be available to facilitate the