CORE BALANCE CURRENT TRANSFORMERS

Core Balance Current Transformers (CBCT's) are employed for providing earth leakage protection in a power system. **They are different from normal protective & metering current transformers due to their performance requirement.**

In insulated or compensated neutral networks, earth leakage currents are small and are, generally, much smaller than nominal load currents. Such earth leakage currents should not be allowed to exist for long periods of time, since they eventually cause insulation failure on healthy phases and subsequently develop into phase-to-phase or double phase to earth faults. To protect cable circuits and overhead transmission lines with cable terminations, core balance current transformers are commonly employed.

Generally, it is sufficient to incorporate insulation monitoring only to indicate appearance of earth leakage, and not for disconnection. The operating staff in such cases will be able to take measures to switch the load over to other feeders and switch out the faulted circuits for repairs. Exception to this rule are circuits which supply power to peat pits, ore mines, and similar loads where, in view of safety considerations, the protection system is designed to switch out the circuit in the event of occurrence of earth leakage.

CBCT's are manufactured with one core and one secondary winding. **The number of secondary turns does not need to be related to the cable/feeder rated current because no secondary current would flow under normal balanced conditions.** This allows the number of secondary turns to be chosen such as to optimize the effective primary pick up current. The choice of ratio should therefore be left to the manufacture to obtain the best possible results.

When mounted on insulated cables, irrespective of the voltage ratings of the cables, the insulation level of CBCT shall be 0.66/3 KV.

CBCT's are used with suitable relays for earth leakage protection purposes. A CBCT encircles 3 Phases, 3-core cable or 3 single core cables.
During healthy conditions i.e. when there is no earth leakage current, the secondary of CBCT does not carry any current, as there is no net magnetic flux in the core. In case an Earth Leakage occurs, a net unbalanced current sets up flux in the core of the CBCT and current flows through the secondary winding, causing the relay to operate.

If more than one 3-phase cable are used in parallel, it is recommended that a separate CBCT on each cable be connected across a common relay or a separate relay be provided for each CBCT.

The purchaser should provide the following information while ordering a CBCT

1.) Cable size or minimum I.D. require for CBCT
2.) Minimum earth leakage current to be detected by CBCT + Relay combination.
3.) Specifications of the relay to be used including relay burden & relay setting range available.

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4.) Distance between relay and CBCT (if greater than 10 metres).

(The choice of Relay setting to be used should be left to the CBCT designer).

(5) CHOICE OF RATIO.

There is always some confusion about the nominal ratio to be chosen for CBCTs. Actually there is no need for such confusion.

The cable on which the CBCT mounted acts as the primary conductor of the CBCT. Under normal operating conditions, the three line currents are almost 120 degree apart in phase and balance each other. The resultant secondary current is zero.

Upon occurrence of an earth-fault, the faulted phase is the only one experiencing earth fault current in the primary. The maximum value of the current is decided by the system earthing conditions.

Thus, it can be seen that the cable circuit has nothing to do with the earth-fault detection scheme.

The nominal ratio of CBCT chosen in such a way that, upon occurrence of an earth-fault with lowest value to be detected, the current on the CBCT secondary has a value near to the relay setting chosen for fault detection.

The secondary rated current of the CBCT is chosen as 1 amp (occasionally 5 amp) for sake of convenience and ease of co-ordination.

Common values of nominal ratio of CBCTs are 50/1, 100/1 while 200/1 is also chosen occasionally. Sometimes, ratios lowers than 50/1 (such as 40/1, 25/1 etc.) are required to be chosen due to the Relay & value of Earth Fault Current to be detected.

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HOW TO SPECIFY CBCTs

One can specify the parameters of CBCTs as under :-

(a)	Insulation level	:	0.66 / 3.0 KV.
(b)	Nominal ratio	:	To be chosen by manufacturer.
(c)	Accuracy class	:	'PS' as per IS 2705.
(d)	Relay to be used	:	To be specified by customer.
(e)	Relay setting range	:	To be specified by customer.
(f)	Relay setting used	:	To be chosen by manufacturer of CBCT.
(g)	Minimum primary E/F Current (Ip)to be detected by the CBCT+Relay Combination.	:	To be specified by customer
(h)	No. of cables in Parallel, if any.	:	To be specified by customer
(i)	Knee-point voltage (VK) and secondary resistance of CBCT (Rs.).	:	To be specified by the manufacturer of CBCT.
(j)	Cable opening in The CBCT.	:	To be specified by the customer

A correctly chosen CBCT + Relay combination is a very effective method of detecting incipient earth-faults. Severity of damages to cables and /or connected apparatus due to the earth-faults is subsequently reduced, not to mention the reduction in down –time after the damages. The investment made for providing such a protection scheme, thus, is more than recovered.