Technical Bulletin

TB 0217A Cable screen passing through current transformer

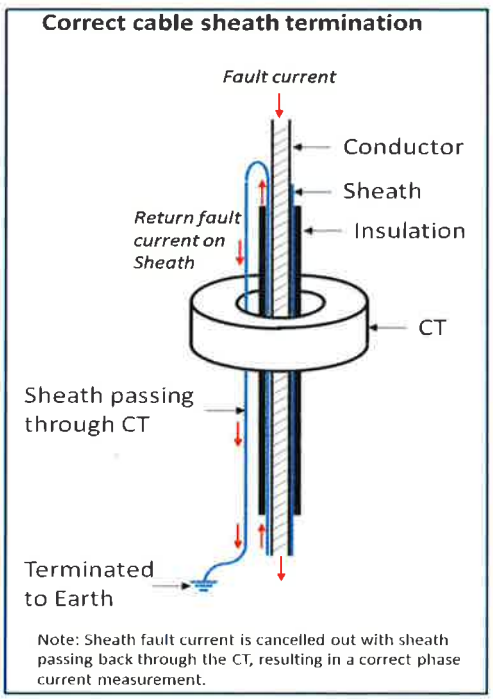
The purpose of this technical bulletin is to notify Endeavour Energy staff and ASP's about the correct method of passing the cable screen through a current transformer (CT) before earthing it. This is to ensure the correct operation of earth fault protection systems.

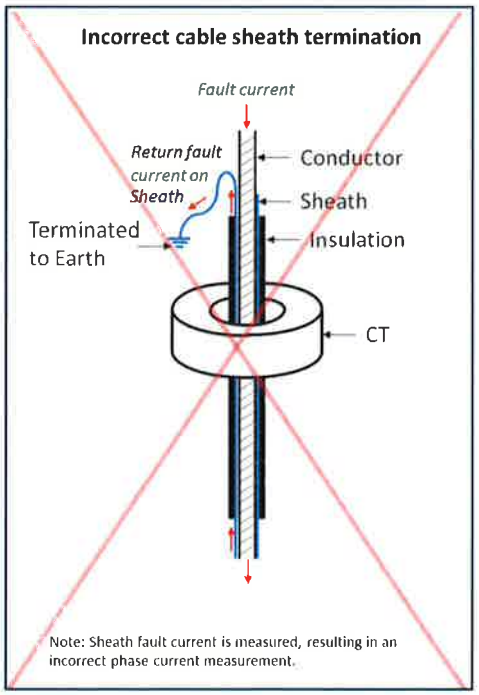
Background

Whenever a cable screen passes through a CT, the cable screen must be taken back through the CT before being earthed such that the sheath current is cancelled out and the CT measures the actual earth fault current.

If the cable screen is incorrectly earthed, the protection:

- **May not detect an earth fault on the circuit being measured.** This occurs because the earth fault current through the cable may fully or partly return via the sheath, and these two currents (phase and sheath) will cancel each other out resulting in a reduction in the net current being measured.
- **May operate unintentionally for faults on another item of plant or feeder.** This occurs because some of the earth fault current from another fault can return via this cable screen, and is incorrectly measured as earth fault current on the un-faulted feeder.





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18.4.18

Endeavour Energy

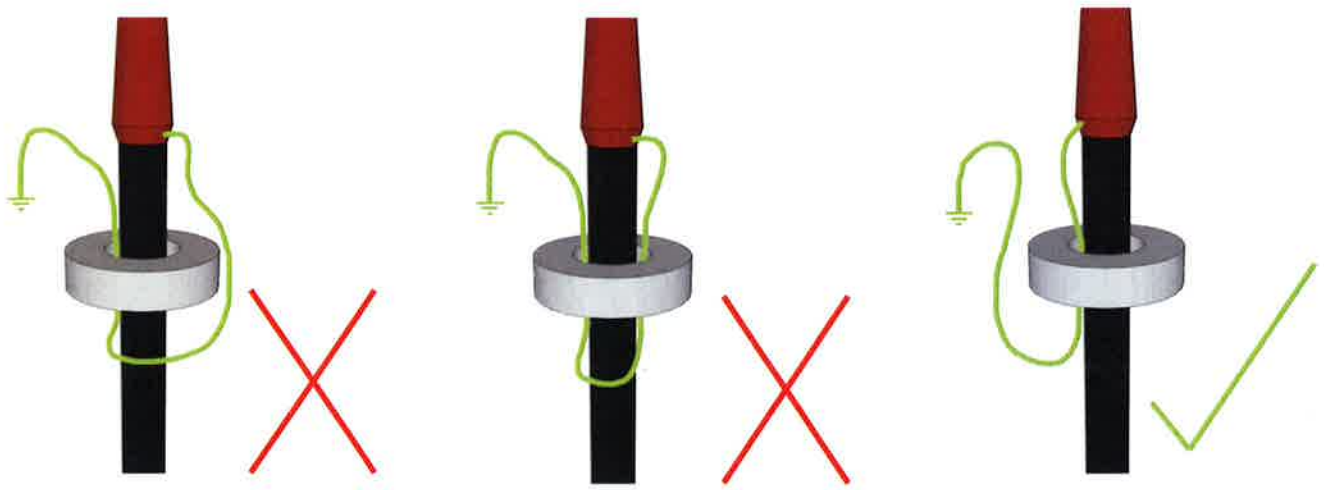
Protection Maloperations

Incorrect cable screen termination has caused several protection maloperations:

- In one incident an earth fault was undetected by the feeder protection as the feeder cable had its screen incorrectly terminated. The fault was cleared by back-up protection which unnecessarily resulted in complete loss of all zone substation load.
- In the second case, the transformer protection tripped for a feeder fault due to incorrect termination of the cable screens on the transformer cables. A small portion of earth fault current from the feeder returned through the sheath of the transformer cables. Because the screen of the transformer cables was not taken back through the CT, the fault current present on the screen was measured. The transformer protection saw this as differential current and tripped.
- In another incident the Sensitive Earth Fault (SEF) protection on a feeder operated incorrectly for a small amount of induced current flowing through the sheath. Since the circuit breaker was racked out, the relay initiated a CB Fail trip causing the entire bus section to trip unnecessarily. The investigation concluded that the SEF maloperation was caused by current induced in the CT due to incorrect earthing of the cable screen.

Actions

Whenever a cable screen (inside or outside of the cable) passes through a CT, the cable screen must be taken back through the CT, in the opposite direction, before being earthed, so that the current in the sheath is cancelled and is not measured by the CT. Refer to the figures below for examples of correct and incorrect terminations.



Incorrect cable screen terminations

Correct cable screen termination

Design drawings should detail the cable screen earthing arrangement for these scenarios.

When breaking screen connections, be sure to bridge across before breaking the connection to avoid hazardous voltages.

Safety Reminder
If part of an earthing system is broken, dangerous voltages may appear. When it is necessary to open circuit a part of an earthing system, temporary bridging conductors of equivalent current carrying capacity are used to create an equipotential bond before making or breaking neutral or earth connections. (Safety Rules 6.35.4) This applies to cable screens even if the cable is not energised, as the cable screen can still introduce remote potentials and be subject to induction and hazardous voltages can result.

Core Balance CT

Core Balance current transformers (CBCTs) are designed for sensitive measurement of earth fault currents and are now being used on some 11kV and 22kV distribution feeders. They are installed around the outside of the distribution cable.

The requirements for CBCTs and cable screens are the same as those listed above for traditional CTs. Where a CBCT is installed around a screened section of cable, the cable screen must be passed back through the CBCT from the cable termination before being bonded to earth.

The main objective is to have the CBCT observing or 'seeing' only the current in the phase conductors. This is achieved by having any cable screen or earth return path that is already within the CBCT window brought back through the CT prior to bonding to earth (to cancel each other out).

Cable screen earth conductor passed back through CBCT before bonding to earth.