

TECHNICAL BULLETIN

TB - 0195

Frame leakage busbar protection – Operating principles and inadvertent trip avoidance

Background

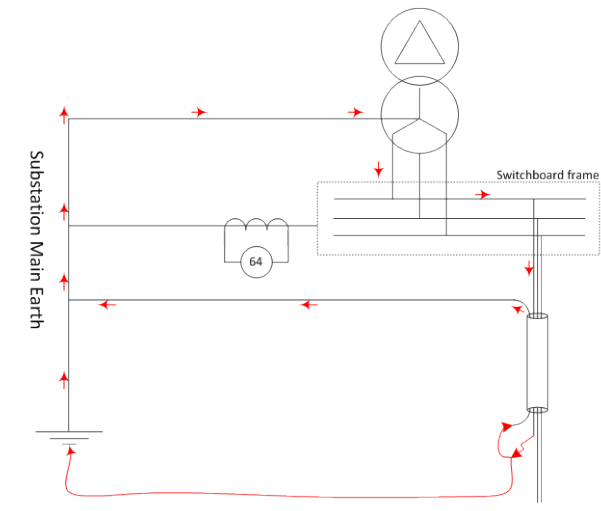
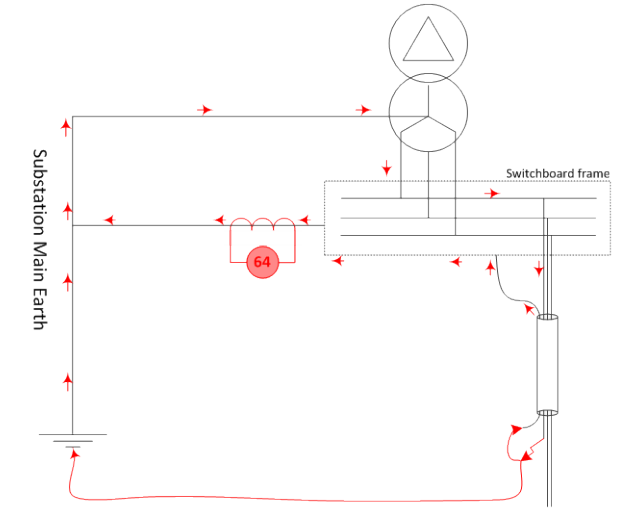
A number of *false* frame leakage busbar protection operations have occurred in recent years. The purpose of this technical bulletin is to describe the operation of frame leakage and highlight potential causes of mal-operation.

Where frame leakage protection is applied, the switchboard frame is entirely insulated from earth at all supporting points with the exception of a designated connection(s) between the frame and main substation earth through a CT connected to an instantaneous overcurrent relay.

For legitimate phase to earth busbar faults, fault current flows back to the main substation earth through this single earthing point, operating the busbar protection scheme.

For external faults (for example, a distribution cable fault) the frame leakage busbar scheme will remain stable. However if the scheme includes any inadvertent earth connections, the switchboard frame may become part of the fault current return path.

As a simple example, if a distribution cable screen is inadvertently bonded to the switchgear frame, part of the fault current will return through the switchgear frame, causing operation of the busbar scheme.

Cable bonding in accordance with earthing design	Inadvertent cable screen bonding to switchboard frame
	
Correct connection of cable screen to substation earth. Return fault path <i>does not</i> include the frame leakage busbar protection scheme.	Inadvertent connection of cable screen to frame. Fault path includes the switchboard frame and may operate the busbar protection.

Contact: Gavin de Hosson

Ph no: 9853 6417

Date: 22 July 2015

Authorised by: Stephen Lette

51 Huntingwood Drive, Huntingwood NSW 2148

Telephone: 131 081 Fax: (02) 9853 6000

Postal Address: PO Box 811 Seven Hills NSW 1730.

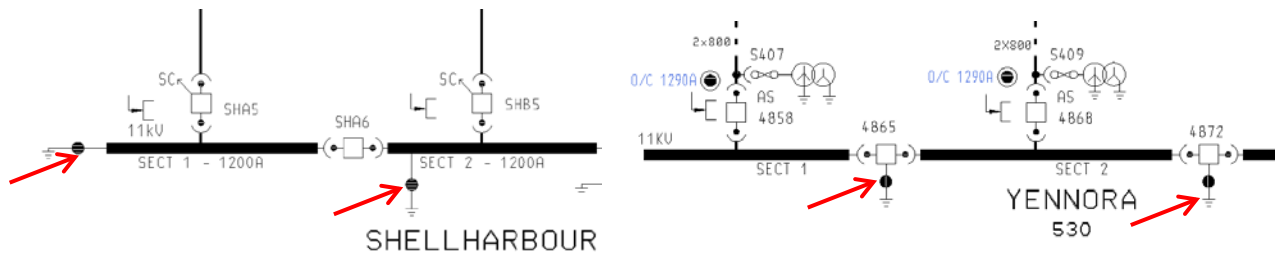
Page 1 of 3

Inadvertent earth connections also desensitise the busbar protection for genuine faults by providing a separate fault current path that is not through the busbar protection relay.

Inadvertent switchboard earth connections can arise in any number of ways. A few historical examples include:

- Distribution cable screen bonding to the switchboard frame;
- Switchboard 120V DC supply over a 2c+E conductor; earth conductor inadvertently bonded to switchboard DIN rail at one end, and; to the substation earth at the DC supply panel end;
- Measurement VT frame connected to substation earth.

Frame leakage busbar protection can be identified by the following symbol on SOPS diagrams.



Actions

All staff who work on or near frame leakage busbar protection schemes shall be aware of the operating principle (this includes project managers, project supervisors, technologist, and contractors).

All switchboard wiring shall be in accordance with approved substation, earthing and cable bonding designs. This includes any wiring for power cables, protection and control, or telecommunication purposes.

Earth connections to the frame of a switchboard protected by frame leakage should not be made unless part of an approved design.

Where practical, a frame leakage protection maintenance activity should be performed following any switchboard wiring modification to verify that no incorrect connections have been made.

Sites with frame leakage busbar protection schemes

11kV Busbars	33kV Busbars	66kV Busbars
Albion Park ZS	Bonnyrigg ZS	Ambarvale ZS
Castle Hill ZS	Bossley Park ZS	Blackmans Flat ZS
Corrimal ZS	Cabramatta ZS	Hazelbrook ZS
Dapto ZS	Cambridge Park ZS	Kandos ZS
Glenmore Park ZS	Canley Vale ZS	Lithgow ZS
Helensburgh ZS	Carramar ZS	Portland ZS
Inner Harbour ZS	Cranebrook ZS	West Pennant Hills ZS
Kembla Grange	Emu Plains ZS	
Kenny Street ZS	Glossodia ZS	
Kenthurst ZS	Greystanes ZS	
Kiama ZS	Homepride ZS	
Leabons Lane ZS *	Horsley Park ZS	
Lennox ZS *	Hoxton Park ZS	
Mittagong ZS	Jasper Road ZS	
North Wollongong ZS	Kellyville ZS	
Northmead ZS *	Kemps Creek ZS	
Parramatta ZS	Kingswood ZS	
Port Central ZS	Kurrajong ZS	
Port Kembla ZS	Leabons Lane ZS *	
Richmond ZS *	Lennox ZS *	
Rooty Hill ZS	Liverpool ZS	
Russell Vale ZS	Luddenham ZS	
Rydalmere ZS *	Marayong ZS	
Shellharbour ZS	Moorebank ZS	
South Granville ZS	Newton ZS	
South Wollongong ZS	North Rocks ZS	
St Marys ZS *	Northmead ZS *	
Ulladulla ZS	Plumpton ZS	
Unanderra ZS	Quakers Hill ZS	
Warilla ZS	Riverstone ZS	
West Wollongong ZS	Seven Hills ZS	
Yennora ZS	Sherwood ZS	
	Smithfield ZS	
	St Marys ZS *	
	Whalan ZS	
	Windsor ZS	
	Woodpark ZS	
	Yennora ZS	

* These location will have frame leakage protection decommissioned under future project works.