Directional Ground Fault
Simulation Example
Using BricsCAD InPower Ver. 0.97.28 to Simulate
Electrical Ground Faults
July 2021

Grounded WYE DELTA transformers can provide a path for zero sequence currents due to voltage being present at the transformer terminals during a fault. The transformer terminal voltage drives the zero sequence current to the fault. Protective relay devices, set for current magnitude only, can open the transformer circuits causing nuisance power outages. BriscCAD InPower is used to solve this problem. The one line diagram is created and the network simulation is run in BriscCAD InPower.

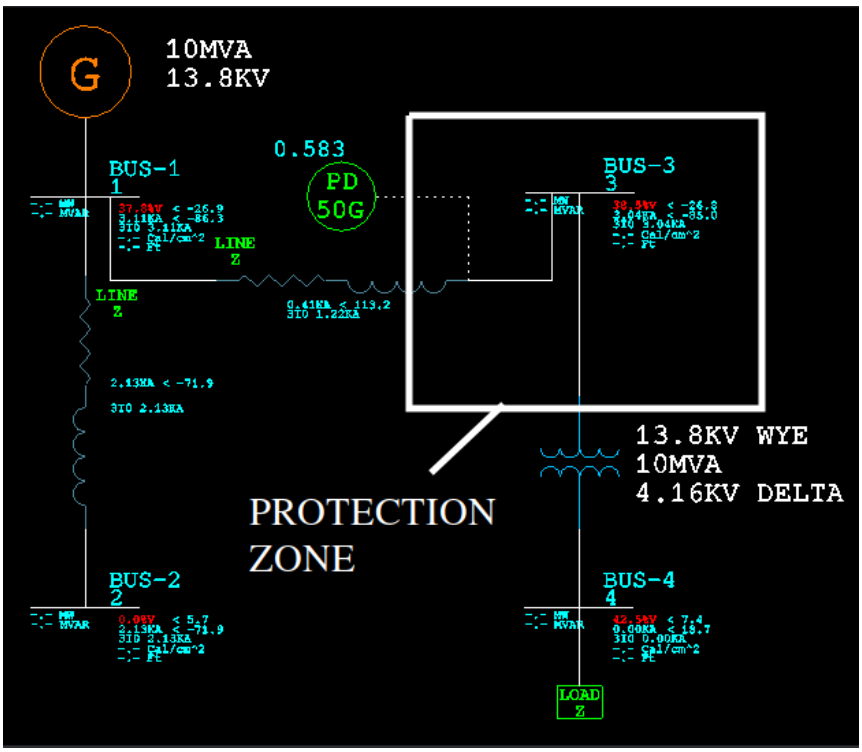

Figure 1. Ground Fault At Bus–2

The one line diagram in figure 1 shows the BicsCAD InPower simulation and the Line “Bus-1 to Bus-3” branch currents with a ground fault at Bus-2. Reference the inpower.out file for additional information. Zero sequence current is flowing from the 10MVA transformer to the fault at Bus-2.

Zero Sequence Data: Branch Current Bus-1->3 = 3.0 * If0 = 1215.0 Amps < 113.170 Deg.

The ground fault protective device, PD 50G, shown in figure 1, has a pick up current value of 250 amps and an operation time of 0.583 seconds with a fault at Bus-2. PD 50G is set to pick up on current magnitude only. This causes an outage at LOAD Z for a fault at Bus-2. The fault is outside of the desired protection zone shown in Figure 1.

One solution for this out of zone outage is to provide a directional ground over-current element that considers both magnitude and the phase of the fault current flowing from Bus-1 to Bus-3.

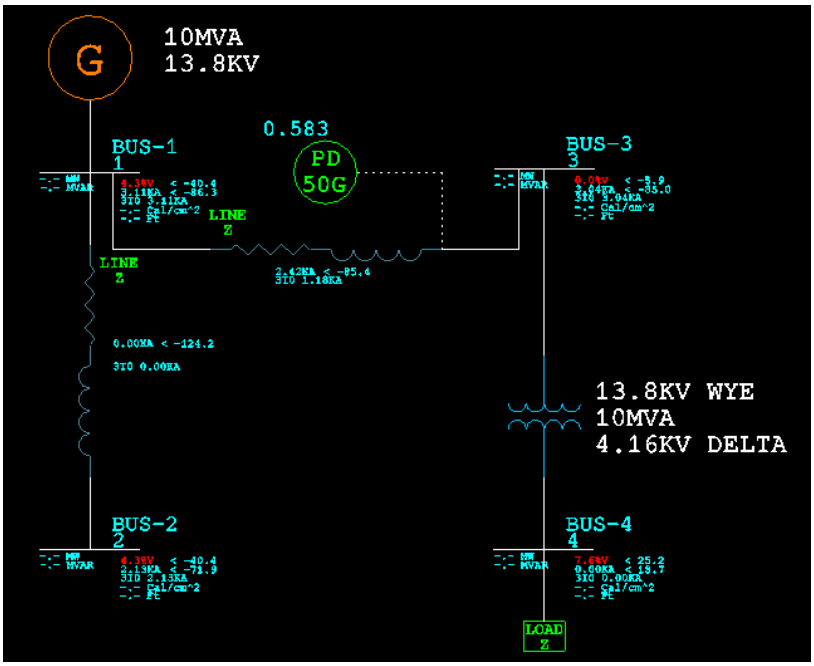

Figure 2. Ground Fault At Bus-3

Figure 2 shows the BicsCAD InPower simulation branch currents for a ground fault at Bus-3 inside the protection zone.

Data: Branch Current Bus-1->3 = 3.0 * If0 = 1173.0 < -87.5 degrees. This is current flowing towards the 10MVA transformer.

The angle of the current is -87.5 degrees. The relay fault directional element is set to pick up on any fault with an angle of -87.5 plus or minus 90.0 degrees. Or -87.5 + 90 = 2.5 to -87.5 - 90 = -177.5

Figure 3 shows the BicsCAD InPower simulation after setting the directional attributes. “NO OP“ no operation is displayed at the PD 50G device. The directional relay prevents the loss of power to LOAD Z for a fault at Bus-2. Problem solved with BricsCAD InPower.

Data: Branch Current Bus-1->3 = 3.0 * If0 = 1215.0 Amps < 113.170 Deg.

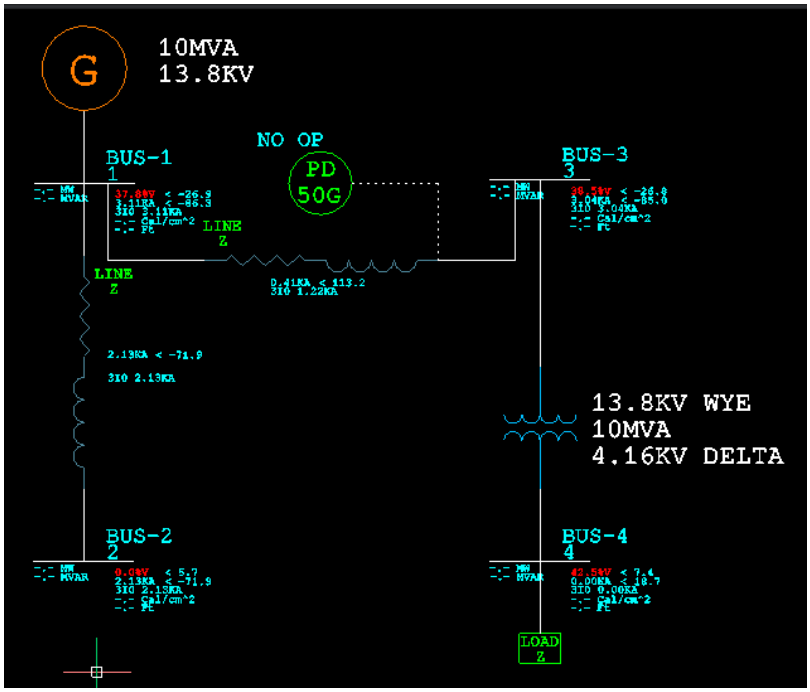

Figure 3. Ground Fault At Bus-2 Directional Relay Setting

Figure 4 shows the settings attributes for the protective relay device PD 50G.

Misc	
Name	INPOWER_PD_GROUND50
Path	
Annotative	No
Rotation	0
Block unit	Inches
Unit factor	1
Explodable	Yes
Attributes	
BUS1	1
BUS2	3
PDPICKUP	250.0
PDDELAY	0.5
PDNAME	P-1
PDEQUOP	0.083
PDOPTIME	NO OP
PDANGLE1	2.5
PDANGLE2	-177.5

Figure 4. P-1 Relay Settings

BricsCAD InPower is used to solve real world electrical engineering problems. BricsCAD is used to draw the one line and document the electrical network. InPower is used to for the electrical short circuit, power flow and arc flash simulations.