NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

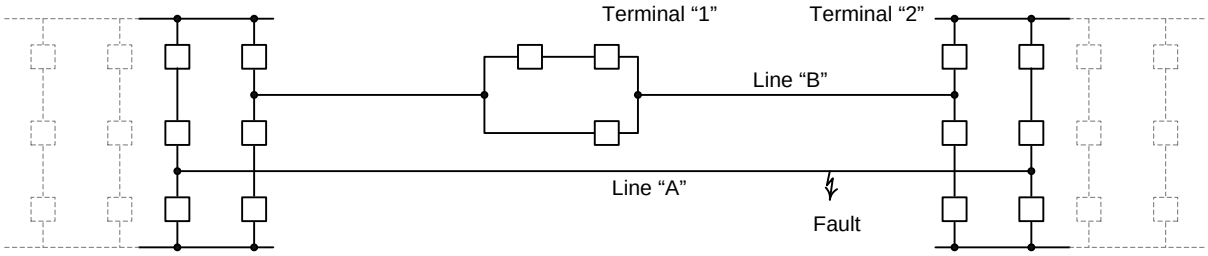
Lesson Learned

Transmission Relaying – Removing Unused Components

Primary Interest Groups
Transmission Owners
Generation Owners
Distribution Providers

Problem Statement
Auxiliary potential transformers (PTs) from a previous relay scheme were left in service after the relay equipment was replaced. The unused equipment contributed to the false tripping of another line during a normal relay operation to clear a fault on another line.

Details
A high impedance phase to ground fault occurred on line "A." The fault was cleared with high speed relaying. During the fault, terminal "1" of line "B" upstream from the faulted line tripped. Analysis indicated that the Primary relay at terminal "1" properly sent the permissive overreaching transfer trip (POTT) signal. However, the Primary relay at terminal "2" at the opposite end of line "B" did not properly sense the fault in the reverse direction, so it echoed the POTT signal back to terminal "1." Upon receiving the signal, terminal "1" of line "B" tripped.



Inspection found a blown potential fuse (on the same phase as the fault) feeding the line "B" Primary relay at terminal "2." The blown fuse should have been sensed as a loss of potential condition and caused a station alarm but this did not occur. Further analysis determined that a backfeed condition was occurring on the relay potential, keeping the relay potential at normal voltage even when the fuse was removed. The source of the backfeed was from an unneeded set of "wye - broken delta" auxiliary potential transformers (PT). The broken delta PTs had been used to supply an overvoltage relay used to detect a loss of potential condition. This relay was no longer required because the loss of potential logic was accomplished in the digital relay. When the digital relays were put in service, the overvoltage relay was removed. However, the auxiliary PTs were not

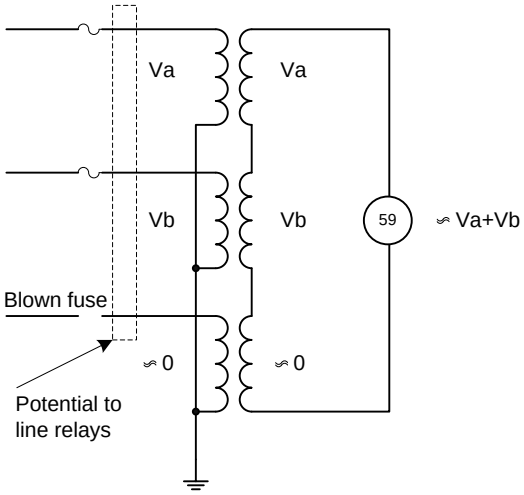
removed and the broken delta side of the auxiliary PTs was incorrectly shorted. The shorted broken delta winding was the source of the undesired backfeed. This backfeed combined with the blown PT secondary phase fuse, caused the "B" line Primary relay at terminal "2" to sense the fault improperly. Refer to the figures below showing the auxiliary PTs.

Corrective Actions

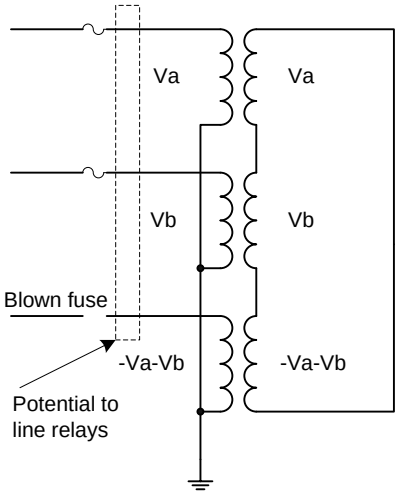
The auxiliary PTs were removed from the circuit. The entity then performed random spot checks to ascertain that this design problem was an isolated incident. They later reviewed their AC schematics for all recently replaced line relaying to ensure this problem did not exist anywhere else on the system.

Lesson Learned

Leaving energized unneeded components in a protection scheme, such as auxiliary PTs in this example, can adversely affect the functioning of Protection Systems. When replacing relays, care should be taken to remove unneeded circuitry and components. These unneeded components can influence whether relaying will operate properly.



Original circuit – when a fuse blows, the overvoltage relay would see a voltage across it and alarm



Potential circuit with aux. PTs shorted – when a fuse blows, voltage backfeeds to the line relays

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