Lesson Learned
DC Offset For Relays

**Primary Interest Groups**
Transmission Owners
Generation Owners
Distribution Providers

**Problem Statement**
A relay setting did not consider the DC offset current which led to an improper trip after a fault.

**Details**
After a lightning arrester failure on a Balancing Area’s (BA) 69 kV system, a subsequent breaker failure and relay misoperation resulted in the loss of over 200 MW of load and 70,000 customers. Two breakers on one end of the faulted 69 kV line operated correctly, but the breaker furthest from the fault failed to operate due to a bad trip coil. Since the fault was on the remote end of the line, the breaker failure and a relay misoperation caused four of the BA’s tie lines to trip since there was no other zone of protection.

Investigation revealed that three of the tie lines tripped on over-current and the fourth on a trip signal received from the remote end. Analysis of the event recorder showed that the remote end relay issued a “Phase B Trip – Weak Feed” trip command.

The event reports and the settings were reviewed by the relay manufacturer’s application engineer and it was determined that the settings on the relay were too sensitive. The analysis revealed that the actual fault current was above the relay setting threshold because the DC offset current had not been considered.

**Corrective Actions**
Once the BA and the adjacent BA became aware of the situation, personnel from both entities reviewed the relay settings, the minimum fault currents, and the manufacturer’s Setting Guidelines and Application Notes to recalculate the settings.

**Lesson Learned**
This event highlights the need for Protection Engineers to understand the proper way to calculate a relay’s asymmetrical fault current setting. The instantaneous asymmetrical fault current is a total of the AC current and the DC off-set current. \( I(t) = I_{ac}(t) + I_{dc}(t) \).

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This Lesson Learned was prepared by the SPP Registered Entity that experienced the event. Company specific identifiers were removed to maintain confidentiality.