

Lesson Learned

Circuit Breaker Modification Leads to Inadvertent Trips

Primary Interest Groups

Transmission Owners (TOs)
Transmission Operators (TOPs)
Generation Owners (GOs)
Generation Operators (GOPs)

Problem Statement

Sulfur hexafluoride (SF6) gas circuit breaker controls were field modified to trip on low gas and air pressure. This field modification resulted in the breakers tripping when direct current (DC) power was removed and then re-applied to the SF6 Gas circuit breaker.

Details

This model of SF6 circuit breaker comes prewired from the manufacturer to lock-on-bus (disable tripping) for falling SF6 gas pressure and for falling air pressure. This is necessary to prevent operation of the circuit breaker when there is not enough stored energy (air pressure) for the operating mechanism or if there is not sufficient SF6 pressure in the interrupter chamber to interrupt a fault. The Entity determined that the risk of locking circuit breakers on the bus had a greater impact to the grid than tripping a circuit breaker under these conditions and reconfigured the circuit breaker to trip on falling SF6 gas pressure or falling air pressure. The modification made to this model of circuit breaker involved connecting manufacturer-provided low-pressure auxiliary relay contacts labeled for use in the primary and secondary trip circuits in parallel with the control switch trip contact.

This scheme worked correctly as long as the DC to the trip circuit was not disconnected. However, when the DC was removed, the low-pressure auxiliary relay coils became de-energized, closing the contacts ("b" contacts) connected to the trip circuits. This set up a trip signal to the trip coils which was initiated as soon as the DC source was turned back on because the operating time of the low-pressure auxiliary relay to re-open the tripping contacts is several cycles.

During construction activities, the DC secondary power source (DC #2) to multiple SF6 gas circuit breakers in a station was temporarily removed to facilitate relocation of a DC disconnect box. The DC #2 source fed the low gas and low air pressure trip circuits. When the DC circuits were re-energized, this resulted in multiple SF6 gas circuit breakers opening upon restoration of the DC power. This action open ended multiple transmission lines and resulted in a generation facility being disconnected from the system.

Corrective Actions

The entity reconfigured/redesigned the pressure switch and auxiliary relay circuit. The pressure switch was changed to energize the auxiliary relay on falling/low pressure. Consequently, the tripping of the circuit breaker is accomplished through an auxiliary relay "a" contact. This alleviated a standing trip on the circuit breaker when DC supply power was removed from the gas circuit breaker. (See attached schematic)

Lesson Learned

When making changes to original factory equipment schemes, entities should analyze the scheme change to ensure that the removal/restoration of DC power to the scheme does not cause an undesirable operation.

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