

Lesson Learned

System Protection Review Prior to Disabling Protective Relays

Primary Interest Groups

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

Problem Statement

An internal failure of 345 kV Gas Circuit Breaker (GCB) occurred during initial energization, and was followed by remote-end tripping due to disabled relay protection.

Details

Construction work for the installation of a new GCB on an existing capacitor bank was nearing completion when workers closed a bus-side disconnect to the GCB (breaker was in the open position) to test switch indication. They did not intend to fully commission the new GCB even though the GCB had been site-acceptance tested and was properly filled with SF6 gas. The GCB was verified open and the single-phase breaker disconnect switches were closed. When they closed a second breaker disconnect switch, the open GCB flashed internally.

Relay technicians had previously disabled the trip outputs of the secondary protective distance relaying for 345 kV bus 1, which included the failed GCB in its zone of protection prior to the closing of the disconnect switches by a separate work group. The trip outputs of the 345kV bus 1 secondary protective distance relaying had been disabled to minimize the risk of unwanted tripping during related construction wiring in a control panel. A systematic review of the protection system had not been performed prior to disabling the protective relay. The work groups did not adequately communicate their actions, so the relay technicians incorrectly thought that the primary protective differential relaying was adequate for the equipment that was energized. The primary protective relaying for 345kV bus 1 was in service, but the new GCB was not in its zone of protection (see figure 1). As a result, remote-end tripping was needed to clear the fault.

Corrective Actions

- The failed GCB was sent to the manufacturer for analysis to determine the root cause of the failure. The manufacturer's final report indicates that the failure was due to transient recovery voltage when the breaker disconnect switch was closed.
- A process was in place to review proper protection for maintenance activity but not for construction activity. This process was expanded to include a systematic review of the protection system during construction activity.
- A team was formed to review all current commissioning practices from an equipment and safety point of view. Recommendations from this group will be added to the current commissioning process.

- A memo was attached in the asset management system to denote that for any work order on the secondary protective distance protective relay on the 345kV bus, the 345 kV bus needs to be removed from service. This will alert relay technicians to request a 345kV bus outage prior to disabling the secondary protective distance relay.
- A specific switching order was created for maintaining the 345kV bus 1 secondary protective distance relay that requires the removal of the 345kV bus from service. This switching order is indexed to the memo that is attached to the asset management system for the 345kV bus secondary protective distance relay.
- A review of the current protection scheme is being undertaken to determine if additional relay protection is required for the protected facility.

Lessons Learned

Entities should review their current commissioning practices and procedures to ensure that, when energizing equipment, adequate system protection is in service prior to energization. In addition, a thorough review process should be established to ensure adequate system protection exists prior to the disabling of system protection equipment. If adequate system protection does not exist, the protected equipment should be removed from service prior to disabling the system protection. These practices should align with maintenance practices and procedures. Roles and responsibilities also need to be defined among all the work groups involved in the construction activity so that, prior to any switching activity taking place, it is verified that adequate system protection is in service.

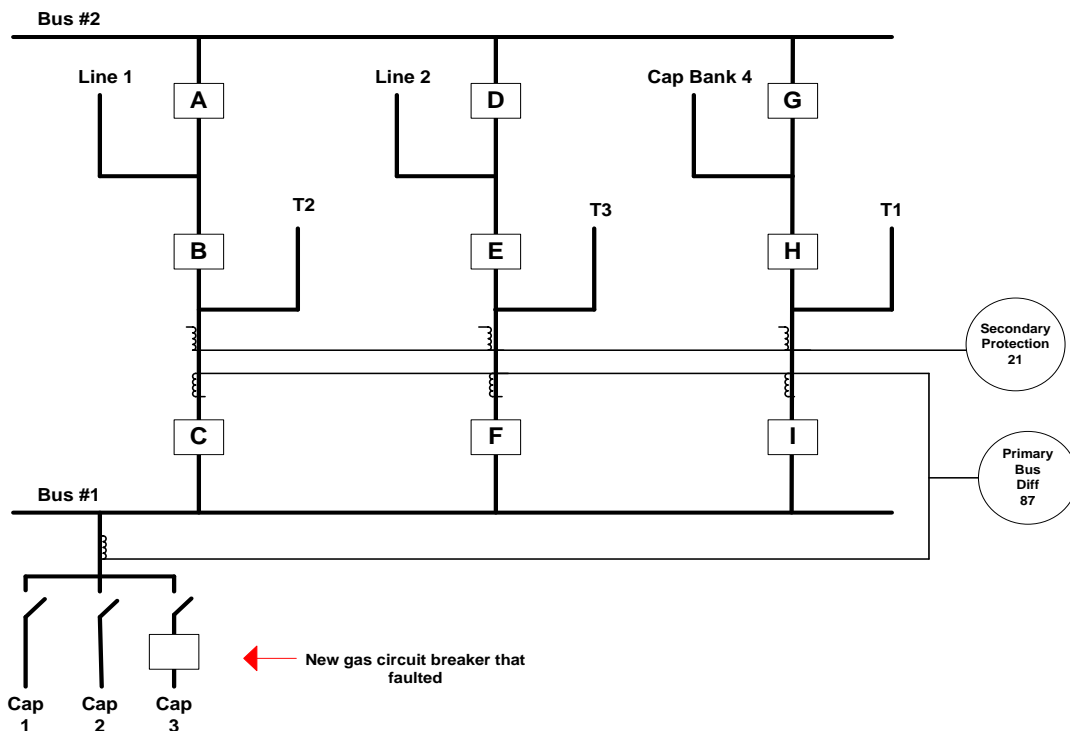


Figure 1: Zones of Protection

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