ABB generation protection and control systems
100% stator and rotor earth fault detection through high frequency injection principle

As the owner/operator of critical generation assets, your generator protection system needs to ensure maximum protection. ABB generation protection solutions can cost-effectively protect 100% of your generator’s stator and rotor windings from earth faults, safeguarding your assets.

Challenges
Your unit was delivered more than 10 years ago and is approaching its first, or perhaps second, protection upgrade. Regulatory requirements, grid modernization phenomena such as subsynchronous oscillations, operational and footprint challenges are all driving the requirements for your next upgrade decision. Your current system has served you well, but aspects of its design will become increasingly problematic:

• It is based on electromechanical or first generation microprocessor generator protection relays deploying antiquated protection philosophies, exposing generation assets to greater risk.
• It shuts down when the frequency is less than 55 Hz, leaving your unit unprotected.
• It does not offer protection against stator or rotor winding earth faults.
• NERC/PRC regulations have significantly increased your disturbance reporting obligations and maintenance efforts.
• It cannot detect and respond to subsynchronous oscillations and subsynchronous resonance coming from your grid connection.
• It is not compatible with the latest protection and control technologies available in the digital world.

Situational analysis/background
To meet the challenges of today, and tomorrow, aging generation assets must continue to operate efficiently and with minimal downtime, under increasing regulatory reliability pressure. Unfortunately, many generation owners deploy systems operating on outdated protection technologies exposing the generator asset to risk of damage due to legacy protection philosophies. ABB can deliver the power of one solution for protection and control, offering improved reliability and system performance essential to asset dependability and security.

Injection based, 100% stator earth fault protection solutions have been used for many years. Traditional injection methods utilize frequencies between 10 Hz and 25 Hz applied into the stator winding. These solutions require either a dedicated grounding transformer with a secondary grounding resistor, or injection on primary side of the grounding circuit – both of which are cumbersome and costly.

Unreliable earth fault detection in both stator and rotor windings can result in significant damage to the generator. Winding damage will require the rotor extraction, winding replacement or repair, and result in a lengthy downtime with associated loss of revenue.
Traditional injection systems perform best during steady-state operation, either at generator standstill or full engagement. During startup and shutdown, activities occur that pose additional challenges to the traditional protection methods, such as varying rotational speed, closing of breakers and stop operations using electrical braking.

For example, a rotor that weighs approximately 500 tons can take more than 30 minutes to stop. Electrical braking is initiated by making an intentional three-phase short circuit at the generator terminals, creating braking torque to slow the rotor. Harmonics produced during the braking process can interfere with the injection frequencies and cause nuisance operations.

**Points to consider**
- What components of your generator protection and control system are original equipment?
- Which components have previously been upgraded? When were the upgrades performed?
- When is your next planned generator outage? Upgrade outage?
- Do you operate as a base load unit or as a peaking unit? If peaking, roughly how many starts per year?
- Do your existing generation assets utilize advanced protection solutions capable of protecting 100% of the stator and rotor windings from earth faults?
- Have you been impacted by subsynchronous oscillations or sub-synchronous resonance?
- Are you in proximity to:
  - HVDC devices
  - Series capacitance, STATCOM, SVC or other active devices
  - Wind farms
- Are you able to comply with all the requirements of NERC/PRC as it pertains to generators?

**The solution**
ABB protection and control solutions allow for increased capability with a significantly smaller footprint while smoothly interfacing with your existing primary system to monitor and protect 100% of the stator and rotor windings from earth faults.

ABB’s REG670 protection and control solution utilizes high and adjustable higher frequency injection at 87 Hz for maximum asset protection of the critical generator windings. The advanced solution addresses the operational concerns during startup and shutdown where the braking harmonics are automatically detected, and the solution blocks relay trips avoiding unwanted operation during the braking sequence.

**Advanced applications**
- Generator and unit transformer protection in one protection device
- ABB’s patented turn-to-turn winding detection for ultrafast fault detection and clearance
- ABB’s patented frequency tracking algorithm to protect the asset during generator startup and shutdown
- Smaller footprint, reduced control system wiring and integrated control for flexible automation
- NERC/PRC compliant trending, reporting and display
- Synchronizing and excitation systems for automatic voltage regulation for synchronous generators

**Next steps**
Arrange a visit from our technical team to discuss
- The latest technological advances in generator protection and control
- Stator and rotor earth fault protection solutions and the impact of antiquated technology on your system
- Requirements for your next generator protection and control upgrade and a budgetary estimate for ABB solutions

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