Paper 16: Point-on-wave vs Pre Insertion Resistor techniques in capacitor bank switching

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Abstract:

Modern power distribution networks are increasingly challenged by the integration of renewable energy sources which introduce variability and reduce grid stability. Capacitor banks play a crucial role in voltage regulation and reactive power compensation, particularly in solar and wind applications. However, frequent switching operations, necessary for dynamic grid support, can produce harmful transients that stress equipment and compromise system reliability. Conventional circuit breakers often worsen these effects. To mitigate such issues, advanced methods like Pre-Insertion Resistors (PIR) and Point-on-Wave (PoW) switching are being adopted. This paper investigates both approaches through electromagnetic transient simulations applied to a real-world scenario, analyzing energization and de-energization phases. The study aims to identify the most effective strategy for minimizing electrical stress and enabling safer, smarter capacitor bank operations in next-generation power grids.