What to do about resonance in a 10kV unloaded busbar



Overview

Abstract: A 10kV bus PT breakdown accident caused by two-phase grounded is mainly introduced in this paper.

Key Takeaways

Resonance in a 10kV unloaded busbar can be mitigated by detuning capacitor banks, installing harmonic suppressors, or applying active filtering to prevent overvoltages and equipment damage.

Understanding the Problem

Resonance occurs when the inductance of the system and the capacitance of connected devices (like capacitor banks or voltage transformers) interact at a specific frequency, amplifying voltage or current. In an unloaded busbar, the lack of load can make the system more susceptible to ferroresonance, leading to overvoltages, insulation stress, and potential failure of voltage transformers or fuses . Symptoms include unusual voltage spikes, blown fuses, or erratic grounding indications.

Practical Mitigation Strategies

1. Detuning Capacitor Banks

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• If the busbar has capacitor banks, series reactors can be added to shift the natural frequency away from harmonic frequencies. This creates a detuned capacitor bank, preventing resonance at common harmonic orders (e.g., 5th or 7th) and reducing overcurrent through the capacitors .

2. Harmonic Suppressors / Neutral Point Absorbers

• Installing a neutral point harmonic absorber or detuning resistor at the neutral of transformers can dampen ferroresonance. These devices limit overvoltages, reduce current peaks, and stabilize the busbar voltage, protecting voltage transformers and extending equipment life .

3. Active Harmonic Filtering

• An Active Harmonic Filter (AHF) can detect harmonic currents and inject counter-phase currents to cancel them. This method is effective when resonance is caused by harmonic contamination from non-linear loads or long cable runs .

4. System Configuration Adjustments

• In some cases, changing transformer taps, regrouping loads, or avoiding certain switching operations can reduce the likelihood of resonance. However, these are often less effective than detuning or filtering .

Key Recommendations

• Conduct a power quality measurement and resonance analysis to identify the resonant frequency and affected harmonics.

• Avoid adding capacitors blindly, as this can exacerbate resonance.

• Ensure that any mitigation device (detuned reactors, harmonic suppressors) is properly rated for 10kV operation.

• Consider simulation studies for complex or newly designed busbars to predict resonance before installation.

By combining detuning, harmonic suppression, and careful system design, resonance in a 10kV unloaded busbar can be effectively controlled, preventing overvoltages, equipment damage, and operational disruptions .

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On the basis of theoretical analysis of the mechanism of ferromagnetic resonance, this paper uses electromagnetic transient

Parallel Resonance

Parallel resonances are associated with high impedances and the circulation of the harmonic currents in the parallel resonance

BUSBAR PROTECTION

Busbar protection may simultaneously trip a number of bus segments or even an entire busbar of a substation and the fast

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A second line of defence is considered good practice in most schemes of busbar protection, not to give security

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