

Phenomenon of 10kV bus voltage resonance



Overview

Impedance-frequency characteristic curve of 10kV bus Due to the 34th resonance at the 35kV bus at the distance of 26.3km from the main transformer, the 34th.

Key Takeaways

10kV bus resonance occurs when the bus system interacts with nonlinear inductances and capacitances, leading to voltage fluctuations, harmonic amplification, and potential equipment damage.

Overview

The 10kV bus resonance phenomenon is primarily associated with ferroresonance and harmonic resonance in medium-voltage power systems. It typically arises when a voltage transformer (VT/PT) or a capacitor bank is connected to a bus with certain inductive and capacitive characteristics, creating conditions for series or parallel resonance. This can result in voltage spikes, irregular fluctuations, and abnormal currents, which may damage transformers, fuses, or other connected equipment.

Causes

Ferroresonance: Occurs when a nonlinear inductance, such as the excitation winding of a voltage transformer, interacts with the bus capacitance. Common in neutral ungrounded systems or when a bus is lightly loaded or de-energized. Can be triggered by switching operations, lightning strikes, or single-phase-to-ground faults, causing high-voltage oscillations in the transformer secondary.



Harmonic Resonance: Arises when capacitor banks or other reactive components resonate with harmonic currents generated by loads like VFDs or industrial drives. Unequal capacitor bank ratings or switching operations can shift the resonance frequency into the range of dominant harmonics (e.g., 9th–10th harmonic), causing audible humming, vibration, and voltage distortion. **Equipment Malfunction:** Faulty PT fuses or poor internal contacts can intermittently disconnect the voltage transformer, leading to irregular bus voltage fluctuations between high and low values, which may trigger alarms or reactive power device switching.

Effects

Voltage Fluctuations: Bus voltage may swing significantly, sometimes exceeding rated limits (e.g., 6.5 kV to 11.3 kV on a 10 kV bus),.

Harmonic Amplification: Certain harmonics are amplified, potentially causing overheating, insulation stress, and equipment failure. **Audible and Mechanical Effects:** Capacitor banks may hum or vibrate due to electromagnetic forces during resonance. **Protection Tripping:** Protective devices may operate unexpectedly, leading to system instability.

Mitigation Strategies

System Design: Proper sizing and coordination of capacitor banks and voltage transformers to avoid resonance at dominant harmonic frequencies. Use of neutral grounding resistors or damping resistors to limit ferroresonance amplitude.

Monitoring and Maintenance: Regular inspection of PT fuses, harmonic elimination devices, and bus protection systems.

Continuous monitoring of zero-sequence voltage in ungrounded systems to detect early signs of resonance. **Operational Measures:** Avoid energizing empty buses with voltage transformers connected. Sequential switching of capacitor banks to prevent sudden resonance conditions.

Use of series reactors or detuning filters to shift resonance frequencies away from harmonic sources.

Conclusion

Bus resonance is a complex phenomenon resulting from the interaction of nonlinear inductances, bus capacitances, and harmonic currents. It can lead to voltage instability, equipment damage, and operational hazards. Understanding the system configuration, monitoring key parameters, and implementing proper design and operational measures are essential to prevent or mitigate resonance events in medium-voltage distribution systems.

Article Content

Impedance-frequency characteristic curve of 10kV bus

Due to the 34th resonance at the 35kV bus at the distance of 26.3km from the main transformer, the 34th harmonic current and voltage amplification phenomenon in the 10kV bus and...

Ferroresonance in Distribution Systems – State of the Art

The voltage levels resulted from ferroresonance phenomenon are extremely high. The abnormal switching action and the unexpected conductor failure may cause harmful damage to the

Research on the mechanism and restraining measures of

The results show that when eliminating the single-phase ground fault, it is easy to cause the frequency division resonance of the system, and the use of these two measures can effectively

Analysis of Ferromagnetic Resonance Influencing Factors of 10kV ...

Abstract: Aiming at the existing ferromagnetic resonance protection measures have the disadvantage of after-the-fact remediation, this paper analyses the influence factors of ferromagnetic resonance,

Examples of Ferroresonance in a High Voltage Power System

The phenomenon of ferroresonance is of particular concern during capacitor voltage transformer (CVT) or coupling capacitor voltage transformer (CCVT) transients, and can cause noticeable deviation of

Analysis and Measures of 10kV Bus PT Breakdown Accident

Abstract: A 10kV bus PT breakdown accident caused by two-phase grounded is mainly introduced in this paper. Firstly, the bus voltage variation is analyzed when two-phase grounded occurs.

Ferroresonance in electricity networks

Ferroresonant circuits exhibit a highly distorted waveform, and voltage and current at transitions in and out of the saturated mode typically show discontinuities or first-order singularities.

Ferroresonant Phenomena on 6 to 10kV Substation Buses

Procedures for limiting and nonadmission of ferroresonance overvoltages and overloads of the equipment are proposed.

Ferroresonance in Distribution Systems – State of the Art

The investigation of ferroresonance in the radial distribution system and the effect of integrating Distributed Generation (DG) into the distribution zone on this phenomenon are presented.

Research on the mechanism and restraining measures of

In this paper, the mechanism and the main suppression measures of ferroresonance were described. A typical substation was taken as the research object, and the simulation models were

An Overview on Overvoltage Phenomena in Power Systems

This paper is discussed about overvoltage phenomenon including causes and effects of overvoltage and overvoltage protection towards power system.

Paper Title (use style: paper title)

In 10kV distribution system, VT (voltage transformer) frequently blown phenomenon. VT high voltage fuse blown cause various effects on the grid. VT generated resonance over-voltage may damage the

Study of Transformer Resonant Overvoltages Caused by Cable

Power transformers can fail from dielectric stresses caused by electromagnetic transients. In this paper, we focus on a special phenomenon where excessive overvoltages arise due

Harmonic Resonance in Power Systems – Voltage Disturbance

This could a large industrial facility where multiple low voltage substations inject harmonic current in to the medium voltage facility bus. A potential parallel resonant condition can

Ferro-Resonance Analysis of Capacitor Voltage Transformer with

The frequency spectrum analysis, and the measurements of resonance bus voltage and line voltage, were carried out to find the design method of a fast saturation damper (FSD) and its

Research on the mechanism and restraining measures of

Abstract In order to monitor the three-phase voltage of the busbar to ground, the substation bus is usually connected to the electromagnetic voltage transformer by YN connection in

PT 10kV high-voltage fuse bus causes and solutions

Neutral systems to 10kV high voltage fuse of Bus PT analyze the causes of possible causes for a variety of solutions were discussed. And Phoenix Zhengzhou 220KV substation power company actually

The voltage of the 10kV bus fluctuates between high and low, and the ...

A strange phenomenon occurred in a 35kV substation for several consecutive days: the 10kV bus voltage fluctuated irregularly between 6.5kV and 11.3kV, causing the reactive power

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