

Distribution Network Automation Residual Voltage Protection Setting



Overview

The recommended setting of the overvoltage relay energized by the neutral-point displacement voltage is about 3% of the voltage obtained at a single phase-to-earth fault with zero-fault resistance.

Key Takeaways

Residual voltage protection (ANSI 59N) in distribution networks is set based on zero-sequence voltage thresholds and definite or inverse time characteristics to detect ground faults effectively.

Overview of Residual Voltage Protection

Residual voltage protection, often implemented as the 59N function, is designed to detect phase-to-ground faults by monitoring the zero-sequence voltage ($U_N = 3U_0$) in medium- and high-voltage networks. It serves as a backup ground fault protection in networks where phase-to-ground currents are low, such as in ineffectively grounded star points, and complements primary overcurrent or differential protection schemes.

Setting Principles

Zero-Sequence Voltage Measurement

The protection relay calculates the zero-sequence voltage either through internal software using phase voltage vectors or via direct measurement from broken-delta windings of voltage transformers.

The RM

S value of the fundamental Fourier component of the residual voltage is used to determine the operating condition. Voltage Threshold (Start Voltage)The start voltage (TOV59N_StCurr_IPar_) is set above the normal operating residual voltage to avoid false tripping due to load imbalance or inherent residual currents. Typical low-voltage networks may experience residual currents below 20 mA under normal operation, which should be considered when defining the threshold.

Time Delay Settings

Residual voltage protection can operate with definite time characteristics, where the relay trips after a fixed delay once the voltage exceeds the set threshold. Time delays are critical to ensure selectivity with upstream or downstream protection devices, preventing unnecessary disconnection of healthy feeders. Coordination with Other Protection DevicesIn automated distribution networks, residual voltage protection is coordinated with overcurrent relays, differential protection, and sectionalizing switches to form a cascading protection scheme.

Multi-stage protection may use residual voltage lockout principles to overcome current transformer saturation and ensure near-zone fault detection.

Practical Considerations

Network Configuration: TN, TT, and TN-C-S systems require different closed-surface definitions for residual current measurement to avoid repeated neutral grounding points affecting sensitivity. Load and Line Effects: Residual voltage protection must account for line capacitance, load fluctuations, and asymmetric loads, which can generate inherent residual currents and create a protection dead zone if not properly set. Digital Relays: Modern digital relays allow flexible software-based calculation of zero-sequence voltage, adjustable time delays, and integration with SCADA or IoT platforms for enhanced monitoring and automation.

Summary

To set residual voltage protection effectively in distribution network automation: Measure zero-sequence voltage accurately using phase vectors or transformer windings. Define a start voltage threshold above normal residual currents. Apply definite or inverse time delays to ensure selectivity.

Coordinate with other protection devices in a multi-stage scheme. Consider network type, load conditions, and inherent residual currents to avoid false trips and maintain sensitivity. This approach ensures reliable detection of ground faults, enhances network safety, and supports automated fault isolation in modern distribution systems.

Article Content

A Multi-level Current Protection Technology for Distribution Networks ...

This paper proposes a multi-stage current protection technology for distribution networks based on the residual voltage lockout principle, which overcomes the limitations imposed by the saturation of

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The recommended setting of the overvoltage relay energized by the neutral-point displacement voltage is about 3% of the voltage obtained at a single phase-to-earth fault with zero-fault resistance.

Residual Overvoltage Protection 59N Study of Settings Across

This paper presents a study focusing on the settings for residual overvoltage protection 59N within distribution networks MV and transmission networks HV. The research examines the practices

Enhancing Low-Voltage Distribution Network Safety ...

This paper systematically analyzes the operating characteristics of low-voltage distribution networks and proposes a distributed residual current protection method based on closed sections.

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When the protection is implemented using a voltage relay, the selected setting must be equal to or exceed the calculated stabilizing voltage. The value of the stabilizing resistor is determined according

Residual overvoltage protection ROVPTOV (ANSI 59G/ 59N)

Residual overvoltage protection ROVPTOV (ANSI 59G/ 59N) - Arc protection - Auto synchronization - Bay control and measurement - Merging unit - Transformer protection - 2 winding - Feeder protection

Two step residual overvoltage protection (ROV2PTOV) _ Setting ...

The “Two step residual overvoltage protection (ROV2PTOV)” function calculates the residual voltage from the three-phase voltage input transformers or measures it from a single voltage input

Paper Title (use style: paper title)

Abstract— This paper presents a study focusing on the settings for residual overvoltage protection 59N within distribution networks MV and transmission networks HV. The research examines the practices

Protection and Fault Isolation Scheme for DC Distribution Network

Aiming at the problems of high peak value fault current, fast rising speed, and being unable to ensure the reliability of the power supply in the non-fault zone in a multi-terminal DC

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The distributed power supply is gradually connected to the distribution network, the original single power source radiant network pattern of the distribution network no longer exists. The

Overvoltage, Undervoltage and Residual Voltage Relay

Application The voltage relay SPAU 330 C is intended for overvoltage and undervoltage supervision of the substation busbar phase-to-phase voltage and for supervision of the residual

Overvoltage, Undervoltage and Residual Voltage Relay

The voltage relay forms an integrated protection scheme which includes a residual over-voltage relay module and two combined overvoltage and undervoltage relay modules.

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It is not possible to set non-directional residual overcurrent relays so that they provide a selective protection of the feeders. If a solid single phase-to-earth fault occurs close to the load bus L at F as

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Distribution Control Overview

DNA® (Distribution Network Automation), and automation controllers. You can reconfigure and optimize networks based on a complex combination of load,

The Development of System for Automatic Adaptive Change of Relay ...

At present, problems in the implementation of relay protection can arise due to the integration of distributed energy resources into the distribution network. With the integration of distributed energy

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The limitation of hazard voltages in accordance with the applied safety regulations forms the basis for the design and setting value selection of the earth-fault protection of network components. This

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