Plant-wide relay protection setting calculation

Article Overview

Plant-wide relay protection requires calculating pickup currents, time multiplier settings, operating times, and coordination intervals to ensure selective fault isolation and reliable backup protection.

Key Principles of Relay Setting

Relay setting is the process of defining the current threshold and time delay at which a relay trips a circuit breaker during a fault. The main goal is selective fault clearing: downstream relays closest to the fault operate first, while upstream relays provide backup protection if downstream devices fail, preventing widespread outages and localizing disturbances . Modern overcurrent relays use inverse time-current characteristics based on thermal damage curves of protected equipment. IEC 60255 defines four primary curve families: Standard Inverse (SI), Very Inverse (VI), Extremely Inverse (EI), and Long Time Inverse (LTI), each with unique constants to achieve different coordination characteristics .

Essential Calculations
o Pickup Current (Ip)
o The minimum current at which the relay starts to operate.
o Typically set above the maximum load current to avoid nuisance tripping.
o Formula: Ip=Plug Setting Multiplier (PSM)xICT secondary where CT secondary is the current seen by the relay .

o Time Multiplier Setting (TMS)
o Adjusts the operating time of the relay according to the selected inverse curve.
o Determines how long the relay waits before tripping once the fault exceeds the pickup current.
o Calculated using the desired operating time and the relay's time-current characteristic constants .

o Operating Time (t)
o The actual time the relay takes to trip for a given fault current.
o Calculated using the IEC 60255 equation for the selected curve type.
o Ensures coordination with downstream relays by maintaining a Coordination Time Interval (CTI), typically 0.2-0.5 seconds between relays .

o Plug Setting Multiplier (PSM)
o Ratio of fault current to relay pickup current.
o Helps determine the relay's sensitivity and ensures proper discrimination between normal load and fault conditions .

o Coordination with Downstream Relays
o Ensure that relays closer to the fault trip first.
o Upstream relays are set with slightly longer operating times to act as backup.
o Coordination involves calculating CTI and adjusting TMS accordingly .

Additional Considerations

o Fault Level Calculations: Determine maximum and minimum fault currents for different fault types (single line-to-ground, line-to-line, three-phase) to set relay thresholds accurately .
o Transformer Differential Protection: Requires calculations for differential current thresholds, through-fault stability, inrush restraint, and harmonic filtering .
o Distance Protection: For long transmission lines, impedance relays require zone reach and impedance settings to avoid overreaching .
o Primary and Secondary Ratios: Correct CT and VT ratios ensure the relay receives signals proportional to actual system conditions .

Practical Tools

Interactive calculators, such as the FIRGELLI Protection Relay Setting Calculator, allow engineers to input load current, CT ratio, fault current, plug setting, TMS, and relay curve type to compute pickup current, operating time, PSM, and CTI efficiently . These tools are particularly useful for plant-wide coordination across multiple feeders and substations.

Summary

Effective plant-wide relay protection requires a systematic approach:

o Calculate pickup currents above maximum load.
o Select appropriate inverse time-current curves.
o Determine TMS and operating times to maintain coordination.
o Ensure CTI between upstream and downstream relays.
o Consider fault levels, transformer protection, and distance protection requirements.
o Use simulation or interactive calculators to verify settings and coordination. By following these steps, engineers can achieve reliable, selective, and coordinated protection across the entire plant electrical system, minimizing equipment damage and operational disruptions .

These standards outline criteria for gens to stay on -line (without damaging equipment) to provide system support and avoid a wider

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Abstract. This article deals with the issue of protective relays in terms of protecting high voltage lines. At the beginning of the article it

Relay setting plays an important role in maintaining the reliability of a Power System. Read this blog to find out more

To avoid relay mal-operation, set Slope 2 as high as possible. Normally, a high Slope 2 setting causes slow tripping for evolving

Introduction This technical report refers to the electrical protections of all 132kV switchgear. All calculations are based on the

Abstract Nuclear power plants have a complex structure and changeable operation mode, which induces low setting

Protective relay functions and data This technical article will cover the gathering of information needed to calculate

The relay protection setting calculation work of oilfield power plant is so difficult for its heavy work load, long working period and

This paper describes the experiences of Energinet.dk in the administration of relay settings, test documents and their management,

The document provides calculations for relay settings for different components in a power system network. It calculates the fault

Development of new methods of automated coordination of traditional step-type protection and multidimensional

Abstract. The conventional relay protection setting calculation method considers the internal interference of the transformer and

Effective relay protection in HV/MV substations requires a thorough approach encompassing calculations, precise

This document outlines relay setting calculations for a 100 MW / 150 MWp solar power plant at Bhadla, Rajasthan, detailing

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Getting overcurrent relay settings right matters. If you misjudge the coordination between zones, a basic equipment

This comprehensive article delves into the key aspects of relay protection in HV/MV substations, including calculations,

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