Relay protection longitudinal differential



Overview

Zero-sequence longitudinal differential protection of transmission. By establishing communication between the relays on the opposite ends of a line using.

Key Takeaways

Longitudinal differential protection provides fast, selective protection by comparing currents at the ends of a protected zone to detect internal faults.

Principle of Operation

Longitudinal differential protection works by comparing the currents entering and leaving a defined zone, such as a transmission line, generator winding, or transformer. Current transformers (CTs) are installed at the boundaries of the protected zone. Under normal conditions or during external faults, the vector sum of currents entering and leaving the zone is zero, so the differential relay does not operate.

When an internal fault occurs, part of the current flows into the fault, creating a difference between incoming and outgoing currents, which triggers the relay to trip the associated breaker.

Applications

Transmission Lines: The relay compares currents at both ends of the line. For short lines, pilot wires can connect CTs directly. For longer lines, Optical Ground Wire (OPGW) communication allows the relay to operate over extended distances without pilot wire limitations.

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Generators and Alternators: Longitudinal differential relays protect stator windings by comparing currents at the line and neutral sides. Percentage biasing is used to prevent maloperation due to CT mismatches or external faults. Transformers, Busbars, and Motors: Differential protection ensures fast and selective tripping, minimizing equipment damage during internal faults.

Key Components and Considerations

Current Transformers (CTs): Must have matched characteristics and correct polarity to ensure accurate differential measurement.

Dedicated C

Ts are preferred for differential protection. Restraint and Biasing: Stabilizing resistors and percentage biasing prevent relay operation due to CT saturation, inrush currents, or minor mismatches. Communication Links: Pilot wires or OPGWs transmit CT signals between relay ends.

OPG

Ws allow protection over long transmission lines and can carry additional data. Digital Algorithms: Modern relays use phasor comparison, zero-sequence detection, or traveling-wave methods to improve sensitivity and reliability, especially in radial or low-impedance networks.

Advantages

Fast and Selective: Only trips for faults within the defined zone. High Sensitivity: Detects even low-magnitude internal faults. Adaptable: Can be applied to short or long lines using pilot wires or OPGWs.

Versatile: Protects lines, generators, transformers, and busbars effectively.

Summary

Longitudinal differential protection is a unit protection scheme that ensures rapid and reliable disconnection of faulted equipment by comparing currents at the boundaries of a protected zone. Its effectiveness depends on accurate CT placement, proper biasing, and reliable communication between relay ends. Modern implementations leverage digital relays and OPGW links to extend protection to long transmission lines while maintaining high sensitivity and selectivity.

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Article Content

Zero-sequence longitudinal differential protection of transmission ...

By establishing communication between the relays on the opposite ends of a line using OPGW, the use of differential protection becomes a feasible option. The longitudinal differential

An algorithm for longitudinal differential protection of transmission ...

The paper presented an algorithm for longitudinal differential protection of transmission lines. An electric power model was formed and various algorithms were tested.

Longitudinal Differential Protection of Power Systems Transmission ...

Abstract This chapter describes using optical waveguide for communication between two relays on the opposite ends of the power systems transmission line (or transmission line). Transmission lines are a

Longitudinal Differential Protection of Power Systems Transmission ...

The longitudinal diferential protection principle is based on the comparison of the currents located at the beginning and at the end of the line, resulting in a quick, sensitive and simple protection concept that

Differential Protection of Generator or Alternator

Differential protection is primarily used to clear any internal faults in the stator winding of a generator or alternator. The differential protection is provided in the generator by using longitudinal

US4855861A

The present invention comprises a longitudinal differential protective relay for protection and supervision of power line zones in a distribution system. The protective relays are located at each end of the

Proposing a new method to improve the longitudinal differential relay ...

Longitudinal differential protection is among the most important protection mechanisms in the short transmission lines. During energization, some factors might disrupt the performance, and

Three basic principles of differential protection you SHOULD properly ...

Current differential relays are connected at both terminals in the differential core which, in the event of an internal fault, trip the circuit breakers in their respective stations.

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IEC 60255-187-1:2021

IEC 60255-187-1:2021 specifies the minimum requirements for functional and performance evaluation of (longitudinal) differential protection designed for the detection of faults in ac motors, generators and

(PDF) Longitudinal Differential Protection of Power Systems ...

Power differential relay was proposed recently as a practical relaying scheme for transmission systems. In this paper, the dynamic behaviour of the power differential relay is

Three basic principles of differential protection you

Generators, motors, transformers & lines The three basic principles of differential protection explained in this article, which has been known for

(PDF) Longitudinal Differential Protection of Power Systems ...

This paper describes a new algorithm for longitudinal differential protection of transmission lines. Classic stabilization is an unreliable method for avoiding unnecessary relay tripping in case ...

An algorithm for longitudinal differential protection of transmission ...

Analogue longitudinal differential protection is used for shorter, single-circuit transmission lines in double-fed networks. If optical ground wires (OPGW) are used, the length of the line ceases

(PDF) An algorithm for longitudinal differential protection of ...

This paper describes a new algorithm for longitudinal differential protection of transmission lines. Classic stabilization is an unreliable method for avoiding unnecessary relay tripping in case of current

Increase of sensitivity of current longitudinal differential protection ...

Current longitudinal differential protection is the main protection of overhead power lines. In the classic version of this protection, the tripping algorithm is based on a comparison of phase currents

Pilot Wire Protection Relay | Transverse Differential Protection

Pilot Wire Protection Relay: In this case the auxiliary Pilot Wire Protection Relay are provided to carry the information signals from one end to the other. Protective systems requiring the use of pilot wires

Line differential protection and control RED615 IEC

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RED615 is a phase-segregated, two-end, line differential protection and control IED harmonized for overhead line and cable feeders.

A study of algorithms of longitudinal differential protection of ...

A comparative analysis of two principal algorithms of operation of differential protection of generators and transformers is presented. The behavior of relay protection devices based on the

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