German Single-Sequence Current Protection

AI Overview

German single-sequence current protection relies on negative-sequence current (I2) injection proportional to negative-sequence voltage (V2) during unbalanced faults, as mandated by the German Grid Code.Overview of Single-Sequence ProtectionSingle-sequence protection, also known as negative-sequence current protection, is designed to detect unbalanced faults such as single-line-to-ground, line-to-line, or double-line-to-ground faults. It operates by measuring the negative-sequence current (I2), which arises only during asymmetrical faults, and comparing it to the negative-sequence voltage (V2) to determine fault type and location. This method is widely used in distance relays, directional relays, and single-pole tripping schemes to ensure selective and reliable fault clearance.German Grid Code RequirementsThe German Grid Code (VDE-AR-N 4120, 4110, 4105) mandates that inverter-based resources (IBRs) connected to the bulk power system must inject negative-sequence current proportional to the negative-sequence voltage during unbalanced faults . For synchronous generators, I2 typically leads V2 by 90°–100°, which ensures proper operation of existing protection schemes. However, some Type III wind turbine generators (WTGs) inject I2 leading V2 by 135°–150°, which can affect fault detection and impedance-based protection functions .Impact of IBRs on ProtectionIBRs differ from synchronous generators in their fault response because their current injection is controlled by converter logic rather than physical machine dynamics . Key impacts include:Reduced or unconventional I2 magnitude: Some IBRs may inject little or no negative-sequence current, potentially delaying fault detection.Phase angle deviations: I2 leading V2 outside the 90°–100° range can cause misoperation of distance and directional relays.Limited fault current contribution: IBRs often have lo...

Article Content

Impact of IBR Negative Sequence Current Characteristic on Distance ...

Relay vendors utilize phase comparators and/or impedance-based methods to implement impedance-based protection functions. The impact of IBR with no or proper negative sequence

Protection of systems containing IBR from asymetrical ground faults ...

This paper presents a novel method to allow the sub-cycle detection, and determination of the relative location, of asymmetrical ground faults (single line to ground and double line to ground) in systems

System Protection Guidelines for Systems with Inverter

System Protection Guidelines for Systems with Inverter Based Resources: Performance of Line Current Differential, Phase Comparison, Negative Sequence, Communication-Assisted, and

Principles, Functions, and Classification of Zero

Principle and function of current transformers The basic principle of zero sequence current protection is based on Kirchhoff''s current law: the algebraic sum of the

Protection of systems containing IBR from asymmetrical

The relatively low fault current of inverter-based resources presents difficulties in differentiating faults from increased loads. Additionally negative

An adaptive protection scheme for multiple single-phase grounding ...

Abstract Conventional zero-sequence current (ZSC) protection relays for low-resistance grounded systems (LGSs) are confronting challenges due to the risk of multiple single-phase

Zero-Sequence vs. Standard CTs: Your Guide to Power

Understand the crucial differences between zero-sequence and standard current transformers for enhanced power system safety. Learn how

Zero-Sequence Differential Current Protection Scheme

Through the analysis of the recovery inrush current generated by the external fault removal of the converter transformer, it is pointed out that the zero

IBR Protection Challenges in Power Systems

The DSC scheme improves the operation of protection systems by independently controlling positive and negative sequence currents, which provides better

Transmission line protection challenges influenced by ...

High penetration of renewable energy sources (RES) leads to new challenges for protection devices. Protection schemes are typically designed according to the dynamic behavior of

Advanced control strategies for grid-following inverter fault response ...

Understanding the behavior of IIDGs during faults, considering the fault response models of inverters, is crucial to mitigating adverse effects such as protection blindness, bidirectional current

A New Paradigm in IBR Modeling for Power Flow and Short Circuit

To limit the positive sequence fault current, must be adjusted according to the output positive sequence fault current. The X/R ratio of virtual impedance is key to balancing stability, current limitation, and

System Protection Guidelines for Systems with Inverter

As a potential solution to these challenges, the report studies the effectiveness of WTG negative sequence current injection based on the recent German grid code VDE-AR-N 4120 technical...

Negative sequence quantities-based protection under inverter-based ...

Abstract Inverter-based Resources (IBRs), including Wind Turbine Generators (WTGs), exhibit different negative-sequence fault current characteristics compared to conventional synchronous generators

SENTRON Residual Current Protective Devices

To protect against fires caused by ground-fault currents, the use of residual current protective devices with a rated residual current of up to 300 mA has proven itself to be effective.

Protection of systems containing IBR from asymmetrical ground faults ...

Negative sequence protection has an advantage over zero sequence relays in that negative sequence protection needs only the three-phase currents, and not the neutral line current which zero

Zero-Sequence Current and Voltage Control Strategy of Multiple

The ac/dc hybrid distribution network (HDN) is facing great challenges under single-phase ground (SPG) fault. To ensure the continuous and stable operation of ac/dc HDNs, it is essential that the converters

Understanding Zero-Sequence Current Protection and Differential ...

Among these technologies, zero-sequence current protection and differential protection stand out as two essential methods for ensuring the safe and stable operation of transformers and

Impact of Inverter-Based Resources on Protection Schemes

The focus of this paper is to analyze and demonstrate the potential impact of IBRs on protection schemes relying on negative sequence voltages (V2) and currents (I2). There are a number of

Negative Sequence Current as a Breaker Failure Protection for

Situation in our grids before implementing the current negative sequence protection relay was as follows: • Backup was handled only by a HV/MV transformer''s overcurrent relay.

Sequence Impedances of Land Single-Core Insulated

The paper deals with the sequence impedances (positive/negative and zero sequences) of high- and extra-high-voltage land single-core insulated

Negative sequence quantities-based protection under inverter-based ...

This paper discusses two critical topics in detail: (1) wind farm IBR model development and validation against vendor PSCAD model, and (2) IBR impacts on distance and current differential...

Contact Us

For more information, pricing, or custom solutions, please contact us:

Website: https://www.sphplantsales.co.za
Email: info@sphplantsales.co.za
Phone: +27 64 827 3915
Address: Unit 9, Highveld Technopark, 43 Atlas Road, Johannesburg, 2196, South Africa

This document is for informational purposes only. Specifications subject to change without notice.