Relay Protection for Photovoltaic Power Stations

Overview

An Introduction to Protective Relays for Solar-Plus In this article, we'll explain how protective relays work, review some of the most common relay functio.

Key Takeaways

Relay protection in PV power stations ensures safe operation, fault isolation, and grid stability by using coordinated relays, inverters, and energy storage systems.

Overview of Relay Protection in PV Systems

Relay protection in photovoltaic power stations is essential to detect abnormal conditions such as overcurrent, overvoltage, undervoltage, frequency deviations, and ground faults, and to isolate affected sections to prevent damage to equipment and maintain grid stability.

Modern P

V plants typically generate electricity at low voltages (400–800V) and step it up to medium or high voltages (11kV–132kV) for grid integration, which introduces critical protection requirements.

Types of Relays and Their Functions

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Overcurrent and Ground Fault Relays: Protect feeders, transformers, and inverters from excessive current and earth faults. For example, AREVA Micom relays are commonly used on 10 kV feeders with overcurrent and ground fault protection. Voltage and Frequency Relays: Detect under/overvoltage and under/overfrequency conditions to prevent grid instability.

These relays are often set according to IEEE 1547 or local utility standards. Directional Power Relays: Monitor reverse power flow from the grid to prevent unintentional islanding. Photovoltaic Relays (PVRs): Solid-state relays with galvanic isolation, used for switching low- to medium-power loads in PV inverters and instrumentation, providing protection against high-voltage spikes and electrical shocks.

Protection Coordination

Relay coordination ensures that faults are cleared selectively, minimizing disruption to the PV plant and the grid. Coordination involves: Time-current curve analysis using software like EasyPower to determine relay settings and sequence of operation. Integration with inverters and energy storage systems to implement anti-islanding and ride-through strategies during tie-line faults.

Fuse and breaker placement at transformer secondary sides, PV switchboards, and inverter inputs to provide layered protection.

Anti-

Islanding and Fault Ride-ThroughPV stations are vulnerable to tie-line faults, which can cause unintentional islanding and inverter disconnection. Relay protection works in coordination with energy storage and inverter controllers to maintain voltage and frequency within safe limits, allowing the PV plant to ride through faults without disconnecting from the grid. Auto-islanding logic can be programmed in relays to trip breakers when voltage or frequency thresholds are exceeded.

Compliance and Monitoring

Relay protection systems must comply with national and international standards such as IEC, IEEE, and local grid codes.

SCAD

A systems are often used for centralized monitoring and control, enabling real-time fault detection, relay status monitoring, and remote operation.

Summary

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Effective relay protection in photovoltaic power stations combines overcurrent, voltage, frequency, directional, and solid-state relays with coordinated settings, anti-islanding logic, and SCADA monitoring. This ensures safe operation, fault isolation, and reliable grid integration, while minimizing equipment damage and operational losses. Proper design requires short-circuit studies, relay coordination, and plant-specific engineering to tailor protection schemes to the PV system and grid conditions.

Article Content

An Introduction to Protective Relays for Solar-Plus

In this article, we''ll explain how protective relays work, review some of the most common relay functions for solar and energy storage systems, and

GB/T 32900-2025: Technical requirements for (PDF English)

Relay protection technical requirements for photovoltaic power plants. This document specifies the general requirements, configuration requirements, setting requirements, and setting

Powering Protection: Relay Schemes, Grid Compliance

It elaborates on the types of protection relays used, relevant national and international compliance standards (including CEA, IEC, IEEE, and IS), and

Analysis and improvement of relay protection for photovoltaic power ...

Then analyze the characteristics and problems of typically existing relay protection configuration scheme for photovoltaic power station and its outgoing lines, and puts forward corresponding improvement

Relay Protection Configuration of High-voltage Plant Power System for ...

The relay protection system is widely used in power plants, substations, and transmission lines as an automatic device that can quickly and selectively remove faults when the power system fails or runs

Protection Relaying Practices in Solar PV Systems

With the increasing integration of Battery Energy Storage Systems (BESS) in solar PV projects, understanding protection relay practices for these systems is becoming more critical.

Complete Protection of Photovoltaic (PV) systems

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ABB effort to guarantee your photovoltaic (PV) system security Photovoltaic systems are the future of renewable energies, but they need a certain degree of protection according to the system installation

Powering Protection: Relay Schemes, Grid Compliance & Voltage ...

This document serves as a detailed guide to the protection systems employed in solar PV plants. It elaborates on the types of protection relays used, relevant national and international

Relay Protection Configuration of High-voltage Plant Power System for ...

This also puts forward higher requirements for the relay protection system of the high-voltage power plant of the photothermal power station, which requires that it can meet the requirements of

The Relay Protection Coordination for Photovoltaic Power Plant ...

Time-current relay curves will be computed and plotted for all protection devices in the network and the PV power plant.

Protection System of a Grid-connected PV System

Renewables Case Studies Solar Protection System of a Grid-connected PV System Photovoltaic (PV) generation is growing very fast to meet load demand, as its installation takes short

Effect of Photovoltaic Generation on Relay Protection of Distribution ...

This paper discusses the principle of relay protection based on traditional distribution network and the influence of photovoltaic on relay protection of distribution network. Then, the

Passive anti-Islanding protection for Three-Phase Grid-Connected ...

Abstract This paper presents the performances of a new passive anti-islanding protection with minimal switching losses for three-phase grid-connected photovoltaic power systems.

Fault Characteristics of Photovoltaic Power Station and Its Influence ...

To solve this problem, through theoretical analysis and simulation research, fault characteristics of PV power station and its influence on relay protection of transmission line are

Tie line fault ride-through method of photovoltaic station based on ...

In order to deal with the problem that the PV station cannot cooperate with the protection reclosing in case of tie line fault, a ride-through method of the PV station based on cooperative strategy of small

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GB/T 32900-2025: Technical requirements for (PDF English)

GB/T 14285-2023 Technical Specification for Relay Protection and Safety Automatic Devices GB/T 14598.24 Measuring relays and protective devices - Part 24.Transient data exchange

Relay Protection Coordination for Photovoltaic Power Plant ...

1. INTRODUCTION of relay protection coordination for a PV power plant connected to the distribution network is presented. In recent years, installation of PV power plants in the distribution network has

Full article: Reliability assessment of PV location based on a new ...

In energy indices calculation, a final study proposes new restrictions coordination between OC relay and PV in-feed current protection. A method for computing the energy not

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