Relay Protection Technology for Photovoltaic Power Stations



Overview

The paper studies a photovoltaic power plant dynamic modeling for relay protection performance analysis.

Key Takeaways

Relay protection in PV power stations ensures safe operation, fault isolation, anti-islanding, and grid compliance through coordinated protective relays and control strategies.

Overview of Relay Protection in PV Systems

Photovoltaic power stations generate electricity at low voltages (typically 400–800V) and step it up to medium or high voltages (11kV–132kV) for grid integration. This voltage transformation necessitates robust relay protection systems to safeguard equipment, maintain grid stability, and comply with national and international standards such as IEC, IEEE, and GB/T 32900-2025.

Key Types of Protective Relays

Overcurrent Relays (OCR) – Detect excessive current due to short circuits or overloads and isolate affected sections to prevent equipment damage. Undervoltage and Overvoltage Relays (27/59) – Monitor voltage deviations and disconnect the PV system during abnormal voltage conditions. Frequency Relays (81U/81O) – Detect underfrequency or overfrequency events to protect the grid and PV inverters.

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Directional Power Relays (32) – Identify reverse power flow, which is critical for preventing unintentional islanding. Ground Fault and Small Current Protection – Protect against earth faults, especially in systems with neutral point grounding via arc suppression coils.

Anti-

Islanding Protection – Ensures PV inverters disconnect during grid outages to prevent unintentional island operation.

Fault Ride-

Through and Islanding ControlTie line faults between the PV station and the grid can cause unintentional islanding, leading to inverter disconnection and potential grid instability.

Modern P

V stations implement cooperative strategies combining small-capacity energy storage, relay protection, and inverter control to maintain stable operation during faults and enable controlled reconnection to the grid.

Protection Coordination and SCADA Integration

Relay protection systems are coordinated to ensure selective tripping, minimizing disruption to the plant.

SCAD

A systems provide centralized monitoring, control, and real-time fault management, allowing operators to respond quickly to abnormal conditions. Compliance and StandardsPV relay protection must comply with technical standards such as GB/T 32900-2025, which specifies configuration, setting, and performance requirements for relays, current transformers, inverters, and energy storage converters. These standards cover protection for collection lines, step-up transformers, busbars, reactive power compensation, and grounding transformers.

Additional Considerations

Lightning and Surge Protection – Direct and indirect lightning strikes require surge protection devices to prevent damage to PV arrays and inverters.

Short-

Circuit Current Considerations – PV systems can produce short-circuit currents higher than the maximum power point current, necessitating specialized overcurrent protection. Dynamic Reclosing and Fault Information Management – Modern protection schemes include reclosing functions for transmission lines and fault data management for rapid diagnostics.

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Conclusion

Effective relay protection in photovoltaic power stations combines overcurrent, voltage, frequency, directional, grounding, and anti-islanding relays with coordinated control strategies and SCADA integration. Compliance with standards like GB/T 32900-2025 ensures safe, reliable, and grid-compliant operation, while advanced fault ride-through and energy storage strategies enhance resilience against grid disturbances.

Article Content

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

Photovoltaic Power Plant Dynamic Modeling for Relay Protection ...

The paper studies a photovoltaic power plant dynamic modeling for relay protection performance analysis. The photovoltaic power plant topology and operation are briefly discussed with a focus on

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 pho-tovoltaic on relay protection of distribution network. Then, the positioning method of

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

As solar plants scale up in capacity and voltage levels, the complexity of protection and monitoring systems increases. This document presents a comprehensive overview to guide protection...

The value and development of relay protection technology in modern ...

The study aims to provide an in-depth exploration of the value of relay protection technologies in modern power systems and to offer references for related research and practical applications.

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

Relay Protection Coordination for Photovoltaic Power Plant ...

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ll be computed and plotted for all protection devices in the network and the PV power plant. Protection relay AREVA Micom is pl. ced on the secondary side of a 10 kV feeder and has overcurrent and

Relay protection for power-electronics-dominated power grids:

Protection technology is closely tied to the development of power systems, and its importance becomes even more pronounced in PEDGs, where the demands are more critical and complex.

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

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

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

Photovoltaic power technology is developing rapidly all over the world. The photo-voltaic power system in distributed photovoltaic power grid development trend, challenges of relay protection induced the

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

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.

The Performance and Robustness of Power Protection Schemes for

The OMICRON-256 system is utilized to carry out real-time testing on a SIPROTEC 7SJ62 multifunction protection relay, which validates the effectiveness of the proposed method in

What is the relay protection of photovoltaic power station?

The relay protection of the photovoltaic power station is equipped with different protection devices according to the voltage level and the voltage level of the step-up transformer, but the basic

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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

Countermeasures for Distributed Photovoltaic Grid Integration

In this paper, the impact of distributed photovoltaic power generation on the low-voltage power grid during the grid connection is analyzed, and related countermeasures for relay protection are ...

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

This paper discusses transient fault current characteristics of photovoltaic system with the help of photovoltaic power system simulation model built in the PSCAD/EMTDC. Then analyze the

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