Relay protection at the grid connection point of photovoltaic power station

Overview

Powering Protection: Relay Schemes, Grid Compliance & Voltage. It elaborates on the types of protection relays used, relevant national and international.

Key Takeaways

Relay protection in photovoltaic grid connection ensures safe operation, fault isolation, and compliance with grid codes, using specialized relays for overcurrent, anti-islanding, reverse power, and surge protection.

Overview of PV Grid Protection

Photovoltaic (PV) systems generate electricity at low voltages (typically 400–800V) and require step-up transformers to connect to medium or high-voltage grids (11kV–132kV) depending on plant size and grid requirements. Relay protection is critical to safeguard both the PV plant and the utility grid, ensuring fault detection, isolation, and compliance with standards such as IEC, IEEE, and national regulations like AS/NZS 4777.

Key Protection Functions

Overcurrent Protection P

V systems have non-linear characteristics, and short-circuit currents can exceed the maximum power point (MPP) current. Standard overcurrent devices may fail to trip, so specialized overcurrent relays are used to detect and isolate faults.

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Anti-

Islanding Protection Anti-islanding relays prevent the PV system from feeding electricity into a de-energized grid, which could endanger personnel and equipment. Loss-of-mains detection is a standard requirement for grid-tied systems. Reverse Power Protection Relays monitor power flow direction to prevent reverse power from damaging inverters or the grid.

This is particularly important when export limitation is required. Voltage and Frequency Protection Relays monitor grid voltage and frequency. Thresholds are set for undervoltage, overvoltage, underfrequency, and overfrequency to detect abnormal conditions and trigger disconnection if necessary.

Surge and Lightning Protection Direct or indirect lightning strikes can damage PV equipment. Surge protection devices and proper grounding are integrated with relay systems to mitigate these risks.

Relay Types and Technologies

Electromechanical Relays: Traditional relays with moving parts, less common in modern PV systems. Static/Static-State Relays: Solid-state relays with faster response and higher reliability, widely used in PV plants.

Digital/

Intelligent Relays: Programmable relays capable of complex logic, communication with SCADA, and integration with inverter controls. Compliance and StandardsPV protection schemes must comply with international and national standards: IEC 61850 for communication and protection interoperability.

IE

C 60364-7-71 for PV system installation and protection. AS/NZS 4777 for anti-islanding, export limitation, and grid connection requirements.

Implementation Considerations

Coordination with Inverters: Relay settings must consider inverter trip characteristics to avoid nuisance tripping.

SCAD

A Integration: Supervisory Control and Data Acquisition systems allow centralized monitoring, remote control, and data logging of relay operations.

Plant-

Specific Studies: Short-circuit analysis, relay setting calculations, and protection coordination studies are essential for each PV plant to ensure reliability and safety.

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Conclusion

A robust relay protection scheme for PV grid connection combines overcurrent, anti-islanding, reverse power, voltage/frequency, and surge protection using modern digital relays integrated with SCADA systems. Compliance with standards like IEC 61850, IEC 60364-7-71, and AS/NZS 4777 ensures safe, reliable, and grid-compliant operation, while plant-specific engineering studies optimize protection coordination and fault response.

Article Content

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

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

Grid and Installation Protection (NA Protection) – Why is it crucial ...

Protection against islanding: The Ziehl relay ensures that in the event of a grid failure, the PV farm will not maintain voltage on a disconnected section, protecting service personnel and

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.

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 ...

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

Research on relay protection of grid

This paper concentrates on the protection of distribution system in the light of recent developments of photovoltaic generator (PV) in Qinghai. When PV is connected to the distribution

IEC homepage

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IEC everywhere for a safer and more efficient world. The IEC is a global, not-for-profit membership organization that brings together more than 170 countries and

Cascaded H-bridge multilevel converter for grid connection of ...

Use cascaded H-bridge multilevel converter instead of ordinary inverter, we can get a photovoltaic power generation system which has a multilevel output voltage.

Research on the Influence of Photovoltaic Grid-connected on the Relay ...

Research on the Influence of Photovoltaic Grid-connected on the Relay Protection of Distribution Network Abstract: First of all, this paper makes a theoretical analysis of three-section current

Electrical protection for the grid-interconnection of photovoltaic ...

Abstract Distribution network and transmission system operators (DNOs and TSOs) who are obliged to connect photovoltaic-distributed generation (PV-DG) to their respective distribution

Complete Protection of Photovoltaic (PV) systems

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

The Relay Protection Coordination for Photovoltaic Power Plant ...

Abstract This paper presents a procedure and computation of relay protection coordination for a PV power plant connected to the distribution network.

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

An Introduction to Protective Relays for Solar-Plus

Electrical relays, protective devices used to switch power on or off for parts of a circuit, have been integrated into circuits for nearly two hundred years.

Reactive Power Control Strategy of Grid-connected Point Voltage

When the photovoltaic power supply is connected to the power grid, the grid connection point will face the risk of voltage exceeding the limit. In this paper, the working principle of a single-stage voltage

Protection System of a Grid-connected PV System

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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

Research on relay protection issues of grid-connected photovoltaic ...

Abstract The connection of the photovoltaic power plants which have capability of low voltage ride-through (LVRT) brings the grid protection a series of challenge.

Optimizing Grid-Connected Photovoltaic Systems through Reactive Power ...

When distributed PV is connected to the grid, the grid connection point may encounter the issue of voltage exceeding the limit. This study aims to tackle a particular challenge by exploring the working

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