State Grid Relay Protection Enhancement Action

Overview

of real-time monitoring data, potential protection system risks can be identified in advance, enabling strategic optimization and enhancing grid resilience, thus ensuring secure and stable power supply.

Key Takeaways

The State Grid Corporation of China is enhancing relay protection through adaptive, AI-driven, and power-electronics-compatible devices to improve fault detection, grid stability, and renewable energy integration. Overview of the Enhancement PlanThe enhancement plan focuses on upgrading traditional relay protection systems to address challenges posed by modern power grids, especially those dominated by renewable energy and power electronics. Traditional protection schemes often fail in low-inertia, power-electronics-dominated grids due to reduced fault currents, high-frequency transients, and complex fault characteristics, which can compromise grid reliability.

Key Technological Measures

Deployment of Advanced Relay Protection Devices The first batch of new power system series relay protection devices has been implemented in East China, including transformer protection devices and line protection devices. These devices are designed to handle “double-high” characteristics of modern grids, such as high harmonic content and voltage phase mutations, ensuring accurate fault identification and rapid isolation.

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Adaptive and Model-

Based Protection The new devices utilize adaptive distance protection and fast time-domain distance protection based on transient information. Transformer protection devices improve internal fault detection, while line protection devices prevent malfunctions in flexible DC transmission and renewable energy-connected grids.

A

I and Machine Learning Integration Algorithms like XGBoost have been applied to enhance fault detection accuracy, achieving detection rates above 95% for various fault types, with low false alarm and missed alarm rates. This improves both the speed and reliability of protection actions in complex grid environments.

Digital Twin and Simulation-

Based Coordination Digital twin technology is being used to simulate grid conditions and optimize relay protection coordination. This allows predictive fault analysis and scenario-based testing, improving overall system resilience.

Strategic Goals

Enhance Grid Stability and Safety: By improving fault detection and isolation, the plan reduces the risk of cascading failures in renewable-heavy grids. Support Renewable Integration: Adaptive protection ensures reliable operation despite the variability of wind and solar generation. Standardization and Interoperability: Efforts include updating standards like IEC 61850 and developing verification protocols for AI-based protection to ensure reliability and compatibility across devices.

Industry Collaboration: The plan emphasizes cooperation across manufacturers, utilities, and research institutions to foster innovation and accelerate deployment of advanced protection technologies.

Conclusion

The State Grid Corporation's relay protection enhancement plan represents a comprehensive modernization of grid protection, combining adaptive devices, AI-driven fault detection, and digital twin simulations. These measures aim to ensure rapid, accurate, and reliable fault management, particularly in grids with high renewable penetration and power-electronics-dominated infrastructure, supporting China's broader goals of energy transition and carbon neutrality.

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Article Content

A review on adaptive power system protection schemes for future

Enhanced solutions for unlimited scenarios and network topologies: To achieve boundless adaptive relay protection schemes, it is necessary to develop enhanced solutions that can handle

Societal and technology trend report

of real-time monitoring data, potential protection system risks can be identified in advance, enabling strategic optimization and enhancing grid resilience, thus ensuring secure and stable power supply.

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This article mainly proposes a fault detection method based on XGBoost algorithm, which significantly improves the performance of relay protection systems in smart grids by optimizing

Remedial Action Schemes for Power System Performance

The concept of power system protection consists of protection components, and their functionality is illustrated. Furthermore, several types of protective relays, and their general operating and design

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Based on the operation specifications of relay protection devices and practical operation and maintenance experience, the evaluation level boundary standards of relay protection state

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Anti Interference Technology of Relay Protection System in Large

Abstract: Relay protection plays an important role in the safe and stable operation of the large power grid, which can prevent the collapse of the power grid caused by the failure of the power system and

Applications of Protection Relays in the 21st Century in Smart Grid

1. INTRODUCTION Concept of Smart Grid is primarily an approach and implementation of state of the art technological advancement into Electrical power system. In the same vein, advancement in

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Increasing renewable penetration and grid modernization initiatives are having a significant impact on the operating and fault characteristics of distribution systems. As a result, protection

New development in relay protection for smart grid

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In the context of global energy transformation, the construction of smart grids is becoming a novel vogue in the evolution of power systems. As the core node of the smart grid, the

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