

State Grid Corporation Relay Protection Enhancement Plan



AI Overview

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 Plan

The 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.

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.

AI 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 si...

Article Content

State-of-the-art in the industrial implementation of protective relay ...

Ideally, a protective relay system should be capable of responding to an infinite number of abnormalities that may occur in the power grid. However, in practice, some compromises must be

Relay protection for power-electronics-dominated power grids:

However, this transformation introduces significant challenges to grid stability, especially for relay protection technologies. Traditional relay protection often falls ineffective in power-electronics

New development in relay protection for smart grid

Abstract This series of papers report on relay protection strategies that satisfy the demands of a strong smart grid. These strategies include ultra-high-speed transient-based fault discrimination, new co

Enhancing Grid Resiliency in High Fire or Flood Risk Areas ...

The issue of extreme weather events has become a significant concern for transmission and distribution protection systems, leading to increased scrutiny of traditional protective relay

Development Status and Prospects of Relay Protection Technology in ...

This paper explores the development of relay protection technology in smart grids, analyzing its applications in intelligent algorithms, digital devices, and automated coordination.

Relay protection and safety technology for intelligent substation ...

To achieve information sharing and interoperability among intelligent electrical equipment in intelligent substations, the author proposes research on relay protection and security technology

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

PSRC WG C2

This section describes the design of a typical comprehensive transformer protection relay for protecting two and three winding transformers (including autotransformers), with multiple sets of three-phase

CASE 24-E-0140

The Enhanced Vegetation Management Program is having a positive effect on reliability for those circuits that are being trimmed under the increased distribution line clearance specification.

A state evaluation and fault diagnosis strategy for substation relay ...

Abstract Ensuring the operational reliability of substation relay protection systems through rapid defect diagnosis and state assessment is crucial for maintaining power system stability.

Investigation of smart grid technologies deployment for energy ...

This study investigates the deployment of smart grid technologies in electricity distribution networks for possible improvement of energy reliability

Integration and Coordination Strategy of Relay Protection System in ...

Abstract: The purpose of this paper is to discuss the integration and coordination strategy of relay protection system in smart grid, focusing on analyzing the main problems existing in the

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This work was financially supported by the State Grid Technology project of "Evaluation and test of the effect of core components on the performance of relay protection device".

Latest advancements in smart grid technologies and

The State Grid Corporation of China has earmarked a total of USD 77 billion for transmission investments in 2022, and a cumulative amount of

2025 Power Trends Report

supply, load, and transmission projects are seeking to interconnect to the grid at record levels.

Societal and technology trend report

Next, this framework is applied to two representative line-protection schemes – line distance protection and line differential protection – for quantitative evaluation under PEDG conditions.

Research on Relay Protection Technology Based on Smart Grid

Relay protection, as the first line of defense to ensure the safe operation of the power grid, needs to actively adapt to the power grid reform. The thesis first introduces the related technologies of relay

The first batch of new power system series relay

The widespread integration of new energy into the grid has increased the likelihood of faults with characteristics such as rising harmonic content in the

A state evaluation and fault diagnosis strategy for

The article proposes a comprehensive fault diagnosis and prediction model for the state of the relay protection system using the support vector

Basic protection relay knowledge

On the other hand, unselective protection operation in the extra high voltage network – i.e. at the national grid level- may endanger the stability of the whole power system, possibly leading to a

The first batch of new power system series relay protection devices of ...

Conducted research on fault mechanisms, fault characteristics, relay protection algorithms, etc., and proposed a new relay protection algorithm that does not rely on power supply

Relay protection for power-electronics-dominated power grids:

Recognizing the dire need for advanced relay protection, this report presents a comprehensive analysis of the evolving landscape. It outlines technical challenges, potential innovative solutions, equipment

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Research on State Grid's technical specification system of relay ...

To the challenge relay protection faced during the process of smart substation development, State Grid Corporation of China has set a series of standards to lead its fast and normal development.

The Adaptability and Challenges of Protection Relays in Distributed ...

This paper proposes a relay protection scheme based on random forest algorithm, combined with IoT technology for real-time data collection and processing, to improve the sensitivity

Latest Progress in Theory and Technology of Relay

With the emergence of AC/DC hybrid power grids and the large-scale incorporation of new energy to the power grid, modern power systems have put forward more

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