State Grid s automated operation and maintenance of distribution networks

Overview

2024_BOOKLETS_PIP_Rev1 The PSRP evaluates and prioritizes maintenance and replacement of major power infrastructure components to maintain reliable 2025-26.

Key Takeaways

State Grid leverages advanced digital technologies, IoT, and automation to enable real-time monitoring, intelligent control, and predictive maintenance of its distribution networks, enhancing reliability, efficiency, and integration of distributed energy resources.Overview of Distribution Automation

Distribution automation involves using smart sensors, remote-controlled switches, communication networks, and control centers to monitor and manage power distribution in real time . This approach allows grid operators to detect faults, isolate issues, and restore service automatically, reducing downtime and improving reliability. Automation also supports the integration of renewable energy sources, electric vehicles, and distributed generation, which require flexible and intelligent grid management .

State Grid Shaanxi Case Study

State Grid Shaanxi has implemented a distribution network monitoring platform covering over 136,000 transformer districts, 1,220 power supply stations, and 7,183 10 kV lines across 11 cities . Key features include:

• Real-time sensing of line and transformer status to detect faults and monitor low-voltage distributed energy.

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• IoT-based management platforms for flexible application development and edge computing units (ECUs) that act as intelligent nodes in transformer districts.

• Cloud-edge synergy enabling rapid online upgrades and orchestration of edge devices.

• High-precision transformer identification for accurate household-to-transformer mapping, supporting line loss analysis and fault location.

• HPLC dual-mode power carrier communication ensuring 99.9% reliability and second-level control for low-voltage transparency . These technologies allow State Grid to observe, measure, adjust, control, and trace power distribution operations, improving operational efficiency and enabling predictive maintenance.
Advanced Distribution Management Systems (ADMS)

ADMS serves as the central nervous system for automated distribution networks, integrating functions such as:

• Automated fault detection, isolation, and service restoration

• Voltage optimization and power flow analysis

• Predictive maintenance and load balancing

• Seamless integration of distributed energy resources (DERs) By processing vast amounts of real-time data from sensors and SCADA systems, ADMS converts information into actionable intelligence, allowing operators to manage complex grids efficiently and reduce outage times.
Digitalisation and Service-Oriented Architectures

Modern approaches, such as the SOGNO and PLATONE projects in Europe, demonstrate the use of microservice-based, cloud-enabled architectures for distribution grid automation . These architectures allow:

• Modular deployment of intelligence in distribution management systems

• Integration of machine learning analytics for predictive maintenance

• Extension of legacy systems without large upfront investments

• Flexible, service-oriented management of grid operations State Grid's initiatives mirror these principles, emphasizing digital transformation, IoT integration, and edge-cloud orchestration to achieve a clean, low-carbon, secure, and intelligent power system .
Benefits

Automated operation and maintenance of distribution networks provide:

• Enhanced reliability and reduced outage duration

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• Improved integration of renewable and distributed energy

• Real-time monitoring and predictive maintenance

• Operational efficiency and cost-effectiveness

• Support for flexible, low-voltage, and high-demand scenarios State Grid's deployment demonstrates how digitalisation and automation transform traditional distribution networks into intelligent, responsive systems capable of meeting modern energy demands.

Article Content

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IEEE Distribution Automation Working Group White Paper v3

This White Paper, “Smart Grid for Distribution Systems” addresses the benefits and challenges of implementing the many different

Distribution Automation

The realization of distribution automation can improve the reliability of power supply, enhance customer satisfaction, and reduce the

How It Works: Electric Transmission & Distribution and Protective

Distribution grids are managed by IOUs, Public Power Utilities (municipals), and Cooperatives (co-ops) that operate both inter- and

Digital Operation and Maintenance Management System of

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On this basis, this paper studies the problems and core technologies in the construction of smart grid, and explores the operation and

Advanced Distribution Management Systems | Grid Modernization | NLR

The architecture features an ADMS operation, with synergistic ADMS and grid-edge operations, the inclusion of PV

The Distribution Network Operation Online Monitoring and

The design of the online monitoring and analysis system of the State Grid Corporation''s distribution network operation follows the

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This paper reviews the current state of AI applications in distributed energy systems, highlighting their transformative

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Improve the reliability and availability of power distribution grids. Siemens Distribution Automation

Artificial intelligence-driven dynamic optimization for predictive ...

This study reduces cyber risks, schedules maintenance more efficiently, and increases grid dependability. This study

Optimizing Grid Operation: Automation and Management

This article explores strategies for optimizing grid operation through automation and advanced management techniques. By

Design Distribution Automation Systems With a Unified Architecture to ...

Approaching the automation question with a unified operations and information technology (IT) architecture will

Asset management and maintenance programming for

Security and continuous proper functioning of the power system is a vital issue for supplying

Digitalization Processes in Distribution Grids: A Comprehensive

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This systematic review meticulously explores the transformative impact of digital technologies on the grid planning,

The Optimal Operation of Active Distribution Networks with Smart ...

In this chapter, a special attention is given to the management of databases built with the help of information provided

A Novel Power Grid Operation and Maintenance Strategy Based on ...

In this paper, a RL framework for optimal operation and maintenance of power grid under uncertain conditions is

Smart Grid Protection, Automation and Control: Challenges and

This article focuses on redefining the features of traditional and modern P&C systems, Centralized Protection

Introduction to Smart Operation Centers | Springer Nature Link

This chapter presents an overview of technologies associated with smart grids, the automation and smart operation of

Development of Intelligent Operation and Maintenance and

The distribution network intelligent operation and maintenance and communication device developed in this paper has been installed

Front Matter

Live-Line Operation and Maintenance of Power Distribution Networks Live-Line Operation and Maintenance of Power Distribution

Distribution Automation

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Designing digitally enabled proactive maintenance systems in power ...

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Distribution network automation equipment has been widely installed and used in the power grid, which plays a very

Operational planning steps in smart electric power delivery system

The traditional Distribution Network Service Provider (DNSP) is required to evolve into a flexible Distribution System

A comprehensive review of AI-driven approaches for smart grid

Abstract The stability and reliability of smart grids are essential for ensuring efficient and secure electricity delivery,

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Distribution Automation: Results from the Smart Grid Investment

Advanced grid devices and power electronics, such as solid-state distribution transformers, offer enhanced functionality and flexibility

The Role of Advanced Distribution Automation in Smart Grid

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The most important application of the Advanced Distribution Automation is fault diagnosis by monitoring the faults in the grid, then

Microsoft Word

To solve the challenges and support the trends associated with ensuring a seamless transition to the future grid, technology

Smart Grid 101: System Operations

As a Business Architect, Dr. Vadari has been delivering solutions focusing on Transmission/ Distribution/ generation operations,

Asset management and maintenance programming for power distribution ...

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