Working principle of distribution network automation terminal

Overview

The installation of distribution automation terminal can significantly improve the power supply reliability of the distribution network.

Key Takeaways

A distribution network automation terminal monitors, controls, and communicates the operational status of the distribution network, enabling fault detection, isolation, and service restoration.Overview

A distribution automation (DA) terminal is a key field device in a distribution automation system, responsible for real-time monitoring and control of the distribution network. It interacts with the master station and other field devices through a communication network to ensure efficient, reliable, and automated management of electricity distribution . The terminal collects data from switches, transformers, and sensors, and executes control commands to maintain network stability and optimize performance .

Core Functions
• Monitoring and Data Acquisition The terminal continuously measures electrical parameters such as voltage, current, and power flow. It also monitors the status of switches, circuit breakers, and distributed energy resources (DERs), providing real-time data to the master station .

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• Fault Detection and Handling Distribution terminals support self-healing and fault management. Depending on the control logic, they can operate in:
• Centralized control type: The terminal sends fault information to the master station, which determines the fault zone and issues commands for isolation and restoration. This can be fully automatic or semi-automatic .

• Local control type: The terminal autonomously executes fault handling based on pre-set logic, such as voltage-time, current-voltage, or level-difference protection schemes .

• Simple mode: Basic fault detection and reporting without complex automation.

• Control and Switching Operations The terminal can remotely operate switches and circuit breakers to reroute power, isolate faults, or balance loads. It supports applications like Volt/VAR control to manage voltage and reactive power, and Direct Transfer Trip for coordinated protection between substations .

• Communication and Integration Terminals communicate with the master station and other field devices via secure communication networks, including cellular, VPN, or fiber-optic links. This enables integration with SCADA, distribution management systems (DMS), and advanced metering infrastructure (AMI) for coordinated control and data analysis .
Operational Principle

The working principle of a DA terminal can be summarized as follows:

• Data Acquisition: Sensors and measurement devices feed real-time electrical data to the terminal.

• Processing and Decision Making: The terminal analyzes the data locally or forwards it to the master station for fault detection, load analysis, or voltage regulation.

• Control Execution: Based on the analysis, the terminal executes switching operations or sends control commands to other devices.

• Communication Feedback: Status updates and alarms are transmitted back to the master station for monitoring, logging, and further decision-making .
Benefits
• Improved Reliability: Rapid fault detection and automated restoration reduce outage duration.

• Operational Efficiency: Remote control and monitoring minimize manual interventions and operational costs.

• Scalability and Flexibility: Terminals can be deployed across various network topologies and integrated with DERs and microgrids . In essence, the distribution network automation terminal acts as the intelligent interface between the field devices and the control center, enabling automated, reliable, and efficient operation of the distribution network.

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