

Modern Substations

Distribution substations have been a key part of the U.S. power grid since its beginning, with the primary function of reducing sub-transmission voltage for safe use by nearby homes and businesses. Today, advances in things like digitalization, automation, renewables integration, cybersecurity and energy storage have transformed the modern substation with a host of new devices and technologies aimed at improving safety, efficiency and reliability.

Transformer Monitoring

- Tracks loading, oil condition, temperature and gas levels.

Substation Automation System

Communicates with digital relays and controllers to monitor the grid and isolate faults.

Control Building

Houses servers and communications infrastructure that run multiple software systems.

DERMS

Monitors and coordinates distributed energy resources.

Microgrid management

Enables islanding during major outages.

Advanced voltage regulation

Maintains steady power quality as DERs fluctuate.

Power quality monitoring

Tracks harmonics, flicker, voltage sags/swells and other issues.

Cybersecurity

Protects substation control networks, relays and communications equipment.

Digitalization

Interoperability protocols and fiber optics enable secure, high-speed communications between devices and control center.

Transformer

Busbars

Maintenance Sensor

Monitors equipment health.

Switchgear

Advanced Feeder Automation

Detects and isolates faults and automatically reroutes power.

Remote Monitoring

Allows operators to see and address substation status remotely.

Battery Storage

Supports peak shaving, voltage support and backup power.

Source: NRECA; Design: Kevin Kepple