Underground Distribution Substation
Self-healing vault switchgear automation with peer-to-peer communication

Safety, reliability and resiliency are top priorities for electric utilities. Working on or near electrical equipment in underground vaults can be very dangerous as field personnel are exposed to hazardous voltages. However, work in the vault is essential to quickly restore power after failure, or recover from severe weather conditions. Vault modernization and automation can significantly increase reliability indices by improving fault identification and restoration times, lifting system average interruption duration and frequency indexes (SAIDI and SAIFI) defined in IEEE 1366. ABB’s Fault Location Isolation and Service Restoration (FLISR) system and vault switchgear automation keep utility personnel secure with remote monitoring, protection and control solutions that deliver network visibility without requiring vault entry.

Challenges for underground distribution networks

Many underground utility networks were installed decades ago, and typical practice is to replace equipment only when it fails. Underground primary equipment – switchgear, transformers and isolators – was originally designed with open air electrical connections posing a huge safety risk for utility personnel. As primary equipment reaches end-of-life, there is an increased need to enter the vaults in these dangerous conditions. Lack of automation and network visibility means personnel have to physically enter the outdated vault to diagnose the type of failure. When every customer minute without power affects utility reliability metrics, aging equipment and the need to isolate equipment vault-to-vault is a recipe for lengthy outages before the electric power is restored.

ABB solution

Vault revitalization and automation

An ABB team will help you assess the present state of your vault network and provide comprehensive solutions, including primary equipment replacement with modern switchgear and control systems, such as dead-front switchgear design that improves the safety of personnel in a fully energized system.

ABB’s control and automation solution also improves safety by enabling the visibility of vault equipment from street level and network control center. Reliability and resiliency are improved by ABB’s fault identification and automatic transfer switching solutions, which utilize state-of-the-art control technology based on IEC 61850 communication standards. ABB utility vault solutions are supported by robust technologies and enhanced automation that provide total visibility, and minimal customer outages.

Features

- Scalable and flexible vault switchgear automation for fast restoration and control
- Remote monitoring of internal or external faults from street level or network control center, with added telemetry for vault condition information, i.e., water level in the vault
- Wired and wireless communications integrates vault switchgear into SCADA and Distribution Management System (DMS)
- Fast fault isolation and restoration to minimize the duration and scale of network outage
- Advanced data analysis and reporting

Benefits

- Improved safety: switchgear can be controlled from outside the vault, limiting risk to personnel working in a restrictive space, according to NFPA70E standard for electrical safety in the workplace.
- Lower operational costs: improved vault reliability leads to lower outage times.
- Improved visibility and accessibility: simple operation of the switchgear from street level or network control center.
- Cost effective solution: maintenance-free switchgear suitable for use in submersible applications.
- Advanced automation: IEC 61850 global standard, scalable control, modular switchgear, for easy system extension.
Solution description
Monitoring and SCADA control: The compact remote terminal unit, RTU540, with its proven gateway functionality enables remote control from street level via wired and wireless communications with the switchgear vault, minimizing the need for personnel to enter dangerous vault environments.

Protection and control: All control and protection devices utilize IEC 61850 communications with Generic Object Oriented Substation Events (GOOSE) messaging for flexible and fast peer-to-peer vault control.

In the event the fault cannot be cleared in the local vault, the REC670’s flexible logic sends GOOSE messages to both neighboring and adjacent vaults to isolate the electric source to the affected vault, thanks to Fault Detection Isolation and Restoration (FDIR) and Automatic Transfer Switching (ATS) functionality.

Vault status, information and supervision of FDIR are monitored by the SCADA/network control center via wired or wireless communication solutions. At the network control center, the DMS can additionally enable centralized FLISR functionality to further enhance service restoration.

Enabling products
• Remote Terminal Unit – RTU540
• Control and protection IED – ABB Relion REC670 or REF615
• Wired communication – FOX605, AFS650
• Wireless communication – TropOS wireless radios
• Distribution Management System – DMS600
• Submersible transformer and secondary distribution connectors - Homac Connectors
• Separable connectors, splices, and fuses - Elastimold
• Faulted circuit indicators - Fisher-Pierce

Points to consider
• Does your system have underground vault networks?
• Is the equipment more than 20 years old?
• Are exposed conductors inside the vault?
• Is personnel safety important to your company?
• Do dangerous vaults increase risks to personnel?
• Does your existing equipment lead to poor reliability indices?
• Are automation and communication systems installed in your underground distribution network?
• Are you considering to install or an upgrade to a DMS?
• Is storm hardening receiving increased priority?