Underground Distribution Substation

Vault modernization improves reliability, safety and resiliency

The need for reliability, safety and resiliency in our power networks is driving grid modernization, and forms the basis of every utility’s key performance indicators. Outdated, aging equipment increases the risk of failure, while the lack of modern control and automation puts field personnel at risk and exposes customers to wider outages during equipment failure and severe storms. Fortunately, the rapid evolution of power equipment, monitoring and automation technologies is improving the capabilities of equipment and automation in critical areas, such as underground utility vaults.

Challenges for underground distribution networks

Many underground utility networks were installed decades ago, and equipment in them is replaced only when it fails. Primary underground equipment - switchgear, transformers and isolators - was usually installed with open air electrical connections that pose huge safety risks for utility personnel.

As your underground vault exceed their expected life, there are many challenges driving your maintain or replace decision. Vault designs and networks that worked in the past are becoming increasingly problematic obstacles to safe and efficient operation. For example:

- entry of field personnel entry into confined vault space requires extreme safety precautions;
- manual operation of load switches and coordination with adjacent vaults;
- zero visibility of vault switchgear status, or telemetry of proper working pump and drainage system;
- low availability of spare parts for aging equipment;
- utilization of pole top transformers for underground applications;
- poor reliability and delayed outage responses.

Vault entries under hazardous conditions will increase as primary equipment reaches end-of-life, and equipment failures multiply. Lack of automation and visibility means personnel have no choice but to bodily enter the vault network to diagnose failures. In today’s environment where every minute without power hits the utility reliability metric, aging equipment and the need to isolate vault to vault can result in lengthy outages before a power system is restored.

The ABB solution

Vault revitalization and distribution automation

Your ABB team will help assess the present state of your vault network and provide comprehensive solutions, including primary equipment replacement with modern switchgear and control systems, including dead front switchgear designed to improve personnel safety in a fully energized system.

ABB’s control and automation solution also improves personnel safety by enabling vault visibility from the street and allows your network control center to dispatch crews to the identified vault. Reliability and resiliency are improved with ABB’s fault identification and automatic transfer switching solutions, which utilize state-of-the-art control technology based on the IEC 61850 communication standards.

ABB utility vault solutions are built on robust technologies, enhanced automation to provide total underground distribution network visibility that minimizes customer outages.
Features

- Submersible ABB switchgear, transformers, and connectors allow for full operability if vault is flooded.
- Submersible ABB control and monitoring equipment provide vault control and condition status to field operators and network control center.
- Remote capacity monitors for internal or external faults from the network control center, with added telemetry for condition information, i.e., water level in the vault.
- Integration of the vault switchgear into SCADA and Distribution Management System (DMS) utilizing wired and wireless communications.
- Fast fault isolation and restoration to minimize the duration and scale of the network outage.

Benefits

- Improved reliability: submersible switchgear, transformer, and connectors able to withstand flooded.
- Improved resiliency: submersible control system's ability to operate and report telemetry during severe storm flooding.
- Improved personnel safety: switchgear control from outside the vault, limiting risk to personnel working in a restrictive space, according to NFPA70E standard for Electrical Safety in the workplace.
- Reduce labor costs: coated connector greatly reduce the need from taping at transform bushing.
- Lower operational costs: improved vault reliability leads to lower outage times.
- Improved visibility and accessibility: simple operation of switchgear from street level.
- Cost effective solution: maintenance-free switchgear suitable for use in submersible applications.
- Advanced automation system: IEC 61850 international standard, scalable control and modular switchgear, enabling easy system extension.
- Full line of connector solutions configurable to meet the needs of any application.

Solutions summary

<table>
<thead>
<tr>
<th>Design for Submersible Operations and Safety SAS-004-01</th>
<th>Vault automation for system visibility and resiliency SAS-004-02</th>
<th>Turnkey services for vault design, package and procurement SAS-004-03</th>
<th>Wireless communication infrastructure field area network SAS-004-04</th>
<th>Network control of vault system with ABB Distribution Management System SAS-004-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB vault modernization solutions provide a safe environment for field personnel during maintenance and operation. ABB vault solutions are designed to be submersible and to operate under severe weather conditions.</td>
<td>State-of-the-art ABB control and monitoring solutions provide SCADA visibility of vault equipment under extreme conditions. Fault detection, isolation and adjacent vault restoration capability ensures and protects grid improving resiliency.</td>
<td>ABB electrical and automation solutions, design and packaging services are a turnkey one-stop shop. Engineering services support your grid modernization planning, engineering design and consultation, including packaging and delivery services.</td>
<td>ABB wireless systems are the backbone of network control, automation and vault visibility. High performance and a secure field area network is the conduit for improving vault network visibility and management.</td>
<td>ABB Distribution Management System (DMS) provides complete vault network control and outage management under severe weather or normal maintenance conditions.</td>
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</table>

Solution description

ABB’s modernization solution for vaults begins with compact and submersible switchgear design, incorporating Elastimold Switches and Interrupters with dead front technology for enhanced personnel safety. The switchgear, transformer and interconnections are compact, modular and scalable, permitting easy entrance in confined spaces and maximum flexibility in underground vault design. Switchgear control utilizes ABB’s bay control solution. The comprehensive multi-object REC670 controller can integrate 4, 5, and 6-way bay control of underground vault switches and interrupters. The switchgear controller is accessed by the remote terminal unit RTUS40 and TropOs wireless radio. The underground vault interface enables both local field access and remote access from the network control center. A key feature of the submersible control cabinet is its capacity to operate during vault de-energization and under flooded vault conditions. ABB’s wireless communication solution and extensible Distribution Management System provides complete network visibility, essential for vault electrical control and outage management.

Enabling products

- Submersible switchgear – Elastimold Switches and Interrupters
- Submersible underground commercial transformers
- Switchgear control – ABB Relion REC670 or Ref615
- Remote Terminal Unit – ABB RTU540
- Wireless communication – ABB TropOs radio and network management
- ABB-designed submersible control cabinet and backup battery system
- Distribution Management System – ADMS and 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?

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