Underground Distribution Substation
Submersible apparatus and control for utility vaults

Safety, reliability and resiliency are top priorities for electrical utilities. In many cases, utility personnel working in underground electrical vaults face a variety of potential hazards, including electric shock resulting from air insulated equipment, unsafe air quality and extreme flooding from severe storms. ABB delivers safe, reliable and resilient distribution substation solutions that protect personnel and equipment, and provide superior performance at the height of a storm or flood using robust technologies that can withstand extreme conditions.

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 designed with open air electrical connections that can pose huge safety risks for utility personnel. An underground vault containing multiple electric circuits means personnel may find themselves working on a de-energized circuit adjacent to energized ones – a real potential hazard.

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 its 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 is going to result in lengthy outages before a power system is restored.

The ABB solution

Submersible apparatus and control systems for utility vaults

ABB will assess the current state of your vault network and develop comprehensive solutions, which includes replacing primary equipment with modern switchgear, transformers and control systems. ABB underground vault solution incorporates a submersible switchgear, transformer and control enclosure. The solution also monitors...
water level in the vault and verifies a working pump and drainage system. ABB’s switchgear, transformer, control system and interconnections are designed to operate in floods. A submersible solution enables fast restoration and improved personnel safety both during and after severe weather events, while a local battery system maintains vault operations if source power is lost. This control capability is essential during power restoration in order to reconfigure the vault network.

**ABB solution features**

- Submersible ABB switchgear and transformers fully operable if vault is flooded
- Submersible ABB control and monitoring equipment provide vault control and condition status to field operators and network control
- Additional telemetry provides condition information, like vault water level
- Equipment isolation during restoration supports network outage management
- Battery backup system operates switchgear during outage conditions

**ABB solution benefits**

- Increased reliability: submersible switchgear and transformer can operate despite vault flooding
- Increased resiliency: submersible control system can operate and transmit data despite vault flooding
- Improved personnel safety: switchgear control from outside the vault reduces risk to utility personnel
- Improved operation: battery backup ensures report and control functions if source power is lost
- Better visibility of vault water levels: ensures pump and drainage systems are working

**ABB Solution description**

Submersible apparatus: ABB’s compact, submersible underground vault design utilizes Elastimold switches, interrupters with a dead-front safety features that help personnel safety able to operate after severe weather has passed. Modular switchgear, transformer and interconnection designs provide easier access to confined spaces, and scalability to make underground vault design more flexible.

Submersible control: ABB Relion REC670 bay controller protects and controls vital switchgear assets. 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 RTU540 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.

**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 wireless radios
- ABB-designed submersible control cabinet and backup battery system
- Sumbersible 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?
- Is storm hardening receiving increased priority?