Substation physical security and resiliency
Checklist for hardening your substation

In March 2014, the North American Electric Reliability Corporation (NERC) implemented Order CIP-014-1 requiring transmission owners to assess the vulnerability of critical substations and develop and implement security plans. Once the vulnerabilities have been identified, the next step is to create a prioritized plan for addressing these

When planning how to harden your substation, hardening can be broken down into three categories: operational measures, substation design modifications and new equipment/substation hardening.

Operational measures

Operationally there are several elements that can make your substation more secure; perimeter fencing, alarm systems, remote surveillance, lighting, and communication redundancies are all activities that server to deter and detect would-be attackers.

Perimeter fencing

- Opaque bullet proof walls
- New ballistic proof and cut proof fencing
- Multiple fencing layers
- Electronic motion sensors on fencing with multiple system triggers
- Removal of vegetation around substations

Enhanced lighting systems and remote surveillance

- Motion activated lighting
- Proper lighting to give clear pictures of potential threats
- Perimeter lighting outside of substation
- Motion activated regular and infrared camera systems to capture activity on sites

Communications infrastructure

- Wireless mesh networks provide a redundant communication path for critical applications, allows for communication configuration, and provides reliable, enhanced security for system robustness.

Design modifications

Substation design modifications, most commonly applied in greenfield applications, can range from reconfiguring your substation to limit impact of an event or even camouflaging or undergrounding substations.

Underground cables

Combined with an enclosed or underground substation, transitioning from overhead lines to underground cables remotely from the substation disguises its location.

Utilization of GIS to camouflage critical substations

A gas insulated switchgear (GIS) substation can occupy as little as 10 percent of the space required by a conventional substation. In recent years there has been an industry shift to indoor GIS substations. Not only do GIS substations blend into surrounding architecture, but they also require smaller space requirements which provides more protection from attacks and allows for bullet resistant enclosures.

IEC 61850 utilization for improved resiliency

Another opportunity to reduce cabling and substation footprint is through the use of IEC 61850 to provide functional consolidation of the substation protection and control. Learn more about IEC 61850 standard, here.

Physical separation of A&B set protection

The separation of A&B systems improves the single point of failure from physical attack on the control house. Smaller standardized with fiber connections allows for rip & replace and quick reconnect of fiber interface.

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Equipment/substation hardening

Most importantly, any layered approach calls for equipment hardening activities. Equipment hardening such as ballistic shielding, dry bushings, redundant transformer cooling, and hardened control houses are often your last line of defense from would-be attackers.

Ballistic technology

ABB's AssetShield™ is an optimized combination of coating and steel that is designed to protect power equipment such as transformers, switchgear, circuit breakers, reclosers, and capacitors from extreme events. AssetShield™ reduces the kinetic energy of the bullets and spalling (or fragmentation) after impact which can help lower the amount of collateral damage in your substation.

Cooling resiliency

Cooling is vital to a transformer. A transformer can only operate for a short time with damaged or reduced cooling. In order to prevent equipment damage in the case of a ballistic events, ABB offers various cooling resiliency solutions to better protect the cooling capabilities to the transformer.

Dry bushings

Bushings are vital to a transformer, and when porcelain bushing's are compromised, fatal events can occur. ABB's dry bushings are oil and paper free which eliminates the risk of a fire. Dry bushings do not contain porcelain thus eliminating possible potential collateral damage to other equipment and personnel in the substation from broken shards of porcelain. ABB's dry bushings are available in many voltage and current ratings and are high-seismic zone rated.

Accessory protection

Many of a transformer's critical components can be fortified using the AssetShield™ system, including: tap changers, control cabinets, relays, oil level indicators, valves, entry points, gas collection relays, temperature indicators, oil expansion systems, nitrogen systems, rapid pressure relays, gas monitors, silica gel breathers, and current transformers.

Hardened control houses

ABB's precast control enclosures will keep your assets safe with a Seismic Category "D" (Seismic zone 4) rating, resistance up to 150 MPH wind loads, 2-hr fire rated walls, and a bullet resistant finish.

Summary

Our nation's critical infrastructure has over 200,000 miles of high-voltage transmission lines and thousands of exposed substations and large electric power transformers. Every utility's approach to enhancing the resiliency of their substation will of necessity be different from others because of budget, system differences, existing design and operating practices, and regulatory oversight.

ABB's philosophy on physical security and resiliency consists of a layered approach which allows utilities to protect against attacks and quickly recover when an incident occurs. When you are ready to assess and/or harden your system, ABB is ready to help.

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