

It's time to build extra grid resilience into substation strategy

by **Sami Raitakoski**

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As the switch to electrification across the world continues to grow, the US government is prioritizing grid resilience like never before. With nearly 70 percent of the nation's grid more than 25 years old, the White House is making historic investments that will strengthen the transmission and distribution grid to drive down energy costs, generate good-paying jobs, and help keep the lights on during increasingly extreme weather events.



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The Department of Energy estimate that outages alone cost the US economy \$70 billion annually and this is only set to worsen without modernizing and expanding the domestic power grid.

But it's not just about building bigger and better to resolve the issue of energy security and reliability. To operate in an ever changing and volatile environment, utilities should develop effective resilience strategies, with greater system flexibility, delivered through digital and emerging technologies.

Electric grids need to become more robust and allow a quicker response to outages through better use of fault detection, isolation and restoration. Additionally, monitoring systems that perform complex functions, such as asset management, can greatly reduce capital costs and provide optimal grid efficiency.

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Substation hardening

Consequently, there needs to be a shift from traditional and often reactive crisis planning to more proactive resiliency planning – preparing the grid ahead of time to prevent a crisis – and this starts with substation hardening and improving the use of existing asset capacity through a predictive servicing approach.

There is an unheralded, but nimble and adaptable technology at the edge of the grid that allows for two-way communication between the power source and the user, and that can quickly respond to changes in the power system in real time. Enter the humble circuit breaker, which protects electrical systems from damage by interrupting and safely re-establishing a disrupted current flow. If a short circuit occurs, a breaker isolates the section of the network at risk within milliseconds – which is 10 times faster than the blink of an eye – to safeguard the energy flow.

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Aging infrastructure certainly makes the network more susceptible to outages and Entergy New Orleans is a great example of a company undertaking upgrades as part of a proactive retrofit plan





Photo: ABB

(including multiple circuit breaker replacements) to improve resilience. Improvements at its 300 MW Derbigny substation have brought a stronger and more reliable grid to the downtown area and are helping deliver more consistent energy supplies to nearly 10,000 customers in the Central Business District of New Orleans.

Magnetic actuation technology

Plus, in the case of primary MV substation applications there's magnetic actuation circuit breaker technology, which delivers an even safer alternative by lengthening the time period between maintenance cycles and eliminating the problems traditionally associated with complex spring charge mechanisms.

The magnetic actuator is that rare maintenance-free mechanism, because only one moving part makes for minimal wear and tear. This is pretty unique, as spring-based alternatives with open compartments expose technicians to the danger of mechanical components, plus multiple gears and chains require a lot of regular cleaning/lubrication and spare parts - and are far less reliable when it comes to maintaining critical power supply.

Additionally, it allows for monitoring of the operating mechanism prior to an operation - for an ultra-reliable solution. We have helped hundreds of utilities (including Oncor, the largest transmission and distribution electric utility in the state of Texas and the fifth largest utility company in the US) make tangible savings by increasing product reliability and decreasing operation and maintenance costs by improved breaker performance.

It's rigorously tested with built-in safety features and from a physical security perspective installed inside substations that are fenced, gated and locked, with only authorized personnel allowed access and who have gone undergone utility specific training.

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Strengthen grid resiliency

Digitalization of this substation circuit breaker is imminent and this will further strengthen grid resiliency because it will sit independently within the network and allow for even quicker and easier storm restoration (via remote access) and absolute minimum downtime.

Meanwhile, natural disasters caused by extreme weather, including flooding, heat and drought continue to affect energy security and impact millions of people and businesses each year, costing billions. In response to these challenges and to meet utility demand for power safety and reliability, there is a next generation extreme weather

resistant housing cabinet for the magnetically actuated dead tank breakers that secure medium-voltage primary substations.

The housing has been designed to the stringent NEMA 4 rating standards, offering unparalleled protection against even the most severe water and dust ingress – up to 65Gal/min from any direction. Featuring seamless roof-to-wall joints and external self-sealing bolts that prevent any gaps, the housing is completely secure and watertight. A new roof overhang also helps limit water exposure, plus the bushings-to-roof interface is secured by a superior aerospace-grade UV-resistant and more robust gasket.

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Even better for Original Equipment Manufacturers (OEMs), a three-point latch and self-aligning hinges help ensure a smooth and uniform door fit, while the enhanced position indicator window design also repels excess water levels.





Even better for Original Equipment Manufacturers (OEMs), a three-point latch and self-aligning hinges help ensure a smooth and uniform door fit, while the enhanced position indicator window design also repels excess water levels. The footprints can even be reduced from 60 in. width down to 52 in. width, offering space and resource savings in some of the R-MAG ratings.

Increased protection for substation personnel

There's also an option for Internal Arc Resistant housing (tested as per IEEE C37.20.7, Type 2B, 0.5s) and this new enclosure ensures any fire and gases are expelled in a controlled manner in the event of an internal arc fault. This means increased protection for substation personnel on all sides of the equipment, much lower risk of failure and downtime, plus faster overall restoration of the system.

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The primary equipment, such as circuit breakers, protection relays, busbars and switchgear, can employ new materials and construction – and advance through digitalization – but essentially stays the same. The evolution enabling a changing power grid perhaps comes more from the intelligent secondary equipment.

Centralized protection and control (CPC) is a digital and software-oriented solution, which brings scalability and flexibility by moving substation P&C from multiple bay level devices to a single central processing unit. It typically comprises managed Ethernet switches, a time synchronization clock and merging units to digitalize the analog information from instrument transformers/sensors and interact with each breaker/contactors being protected. A CPC system unlocks benefits that could not be achieved earlier using multifunctional protection relays.

Substation automation

With CPC, the flexibility and performance of the whole automation system increases substantially, allowing for new ways to manage substation automation. It offers convenient station-wide visibility, minimal engineering, and cost-efficient system management, which in turn delivers enhanced reliability, availability and flexibility, plus reduced overall life cycle costs.

A single device can handle the tasks of 30 protection relays – centralizing this functionality in the substation reduces network complexity – while also carrying out real-time monitoring and control of distributed energy resources.

What's more, the first ever virtualized CPC has just been launched to help substation owners maximize asset utilization. They can further enhance automation by simply installing standalone software on the hardware of their choice to optimize their IT infrastructure. This approach means operators can have multiple CPC instances on a single computer for even bigger systems.

With virtualized functionality, a substation owner can also replace different kinds of old equipment with the same type of new equipment. This considerably reduces the amount of knowledge required to maintain the substation because of the smaller amount of hardware variants.

Optimizing assets

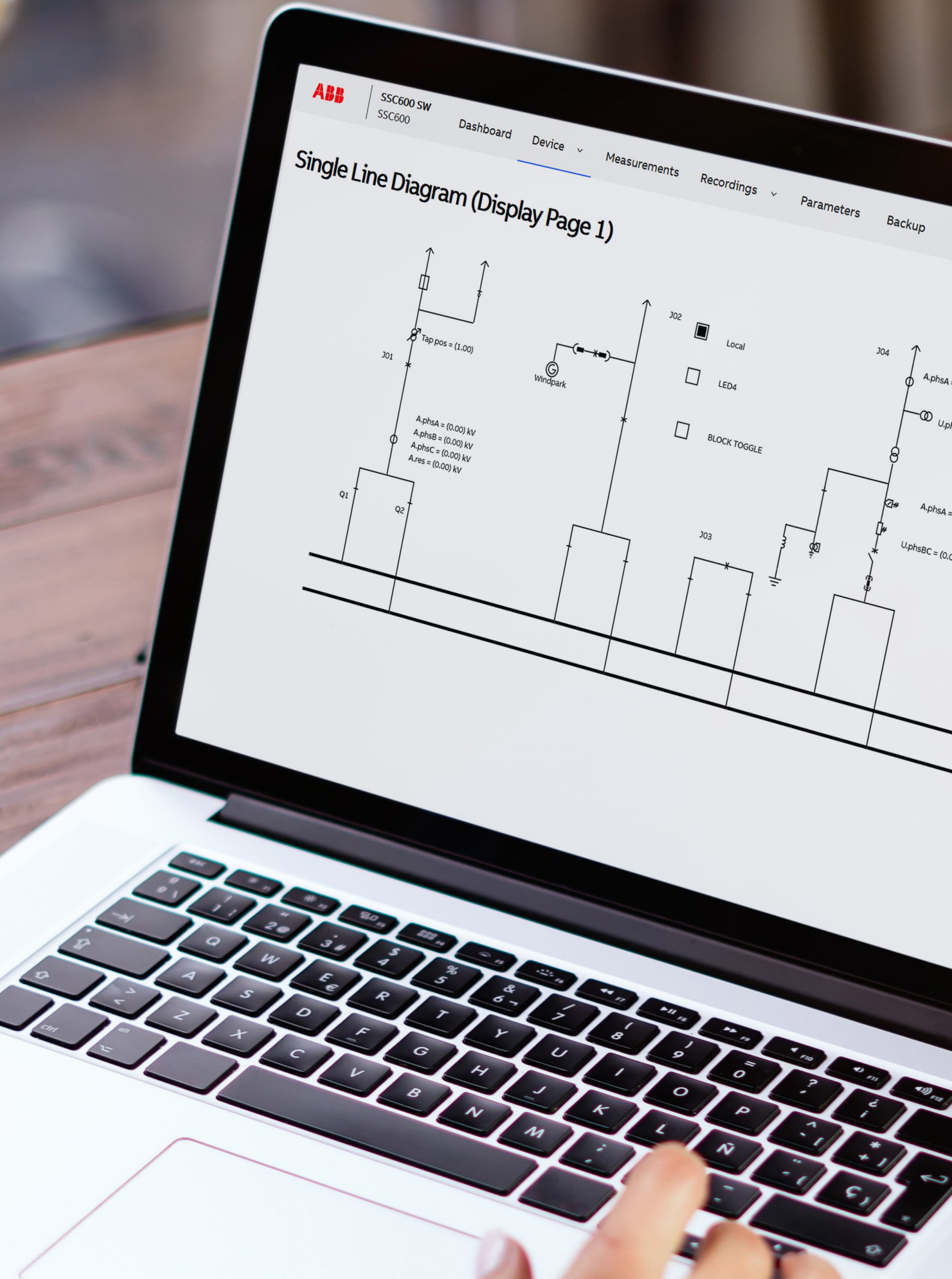
Utilities are facing an unprecedented pressure to ensure grid resiliency today while also preparing for the environmental challenges of tomorrow. Substation strategy must electrify the grid with more resiliency against extreme weather and include optimizing assets, because the most sustainable and cost-effective solution is assessing existing equipment.

Smarter and well-planned investment will improve distribution security, while it's also a case of achieving much more with much less, while continuing to use the existing and limited power grid infrastructure and simultaneously transitioning to a new one.

However, by also leveraging new technologies, such as the industry's very first virtualised protection and control solution for substations, utilities can achieve improved grid stability with greater ease and speed.

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SSC600 SW
SSC600

Dashboard

Device

Measurements

Recordings

Parameters

Backup

Single Line Diagram (Display Page 1)

