

Virtualisation & grid stability

In a world where the uptake of new energy sources and increasing electrification are pushing existing grid infrastructure to the edge, modern substations must continue to become smarter, more secure, and easier to manage to allow utilities to redefine how we approach fluctuating demand and generation imbalances. The virtualisation of protection and control forms a key part of this journey, offering new possibilities to optimise the supply of renewable generation and achieve flexibility and scale

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According to the International Energy Agency, the world is set to add as much renewable power in the next five years as it did in the past 20, as countries seek to strengthen energy security and decarbonise.

But while this emerging new energy economy may be critical to our low carbon future, integrating these new energy sources is having a fundamental impact on the electrical grid.

Put simply, most of the world's aged grid infrastructure was built to serve non-renewable energy sources such as coal, oil, and natural gas. And, constructed under the understanding that the power generated must always be equal to the power consumed, this made it relatively simple to ensure grid stability easily most of the time. The inherent variability of wind and solar, including potential imbalances in supply and demand and changes in transmission flow patterns, make balancing of the existing grid problematic.

Add to the mix a changing grid profile as electricity needs evolve, with rapid electrification driven by electric mobility, heating and ventilation, datacentres and emerging industries, and it becomes clear that the world needs innovative approaches to balance the grid – and fast.

Enter virtualisation, which is set to become a key enabler in efficient supply and demand management, optimisation and, in turn, grid stability management.

What is virtualisation?

Virtualisation, in simple terms, separating software from dedicated computer hardware, has become standard practice in IT architecture for businesses. One server becomes many 'virtual machines', replacing the traditional 'one computer, one application model.' This can help to stabilise the electrical grid in several ways.

But to understand how, we must first look at the typical modern substation. As the power grid needs to evolve, substation technology is also changing. The primary equipment, such as circuit breakers, busbars and switchgear, employs new materials and construction but essentially stays the same. The evolution enabling a changing power grid comes from the intelligent secondary equipment. From communication components and operator terminals through to SCADA (supervisory control and data acquisition) systems, most substations today have multiple computing devices, both legacy and newer assets, running specific applications and working in isolation. These allow more automation and control but devices proliferate in the substation.

This can make maintenance a minefield for the typical operator, tasked with keeping track of an



SSC600 SW is the virtualised version of ABB's SSC600 smart substation control and protection device, pictured here

ever-growing list of automation, communication and computing equipment. In most cases too, because individual computing devices are usually vendor-specific, it can mean any modifications involve a specialist skillset to be outsourced at a cost. This requirement will continue to grow as more functionalities are added.

Further, more computing devices mean more space required in a substation, making the task of physically installing and maintaining each electronic asset a challenge in itself. Additional considerations include the expenditure associated with power supply, cooling, heating and ventilation requirements, maintenance and whole lifecycle management.

Through virtualisation, however, it becomes possible to address many of these challenges by consolidating multiple workloads arising from various pieces of computing equipment into one single, easy-to-use platform. This includes not only the IT software like engineering tools, but now also OT software like protection and control.

As the first major benefit, virtualisation drastically reduces the number and type of computing devices in substations, meaning there are fewer devices to replace, test, commission and maintain. As there is only one kind of hardware running all the different tasks it effectively eliminates the need for users to learn the specifics for each device and reduces the amount of knowledge required to maintain the substation. It also enables most key activities to be performed remotely, in real-time, anywhere in the world, negating the need for a physical presence. The result is faster, less expensive operations.

But the benefits do not end there. What is equally appealing about virtualisation is the ability to aggregate all the data from various computing devices in the substation into one single location. For the utility, the wide-reaching visibility afforded by this approach can empower better decision making in such areas as power quality, renewable integration, asset management.

Virtualised protection and control

One clear example of the wide-reaching benefits of virtualisation can be found in the

realm of protection and control in distribution substations.

As most utility operators will already know only too well, the increasing penetration of large-scale renewables brings a number of new protection and control considerations – from generation imbalances to voltage and frequency anomalies, and more. To deal with this, many substation owners face the need to increase automation, which often leads to an increased amount of computing devices used in the substation – which in parallel means increased footprint, increased installation and maintenance requirements and, in turn, increased complexity.

Therefore, the market recently welcomed the introduction of ABB's SSC600 SW – the world's very first virtualised protection and control solution for substations, which – in short – can enable operators to enhance automation by simply installing standalone software on the hardware of their choice.

SSC600 SW is the virtualised version of the SSC600 smart substation control and protection device. ABB introduced the SSC600 in 2018, an innovative approach to protection and control in distribution networks in which all the protection and control functionality is centralised into one single device.

One SSC600 device can handle the tasks of 30 protection relays, whereas with a virtualised approach, operators can have multiple SSC600 SW instances on a single computer for even bigger systems.

Through this new ability to virtualise, it becomes possible to upgrade, maintain and operate the protection and control arrangement in real-time with ease. Working via one central platform also makes it easier to analyse and act upon the data obtained from the assets, individually and collectively, to identify and address any issues ahead of time management.

Journey to improved grid stability

Ultimately, the journey to improved grid stability will not be an easy one. It will require greater innovation and ingenuity in order to achieve much more with much less, all while continuing to use the existing power grid infrastructure and simultaneously transitioning to a new one. However, by 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. ●