TECHNICAL PAPER

Less complexity means more space and reliability with digital switchgear

In most digital versus analog matchups, the benefits of digital make it the clear winner. When it comes to switchgear, there are four key aspects of digital technology that make it the right choice.

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While there are some audio enthusiasts who insist that vinyl recordings are superior, most listeners opt for the many benefits offered by digital audio. In fact, in almost every instance where there are analog and digital options, the digital technology is superior and preferred.

That is increasingly the case in electric-power distribution and control systems. As one example, digital switchgear is gaining ground on traditional analog solutions. When you review the long list of advantages delivered by digital technology, it's easy to see why.

Lower, safer outputs

The alternatives to digital measurement devices are traditional current and potential instrument transformers. The digital versions are typically referred to as non-traditional instrument transformers or NCITs. IEC designates them as passive current or voltage transformers. Whatever you call them, one of their biggest benefits is that they operate at far safer output voltage levels.

The secondary outputs on an analog instrument transformer are proportional to the high primary current and voltage being measured. Digital devices, on the other hand, use low-power output signals in the millivolt range, from current and voltage sensors. This creates a clear safety benefit to anyone working in or near the switchgear.

CTs are normally well-behaved, but open-circuit secondary terminal over-voltages can be deadly. If an energized-current transformer wire is incorrectly disconnected, it will create an open CT secondary with dangerously high voltages that are likely to cause arcing. In an NCIT, multiple high-power conductors are replaced with a single RJ45-output signaling cable. In addition to enhancing technician safety, this also reduces potential damage to equipment and downtime for the facility.

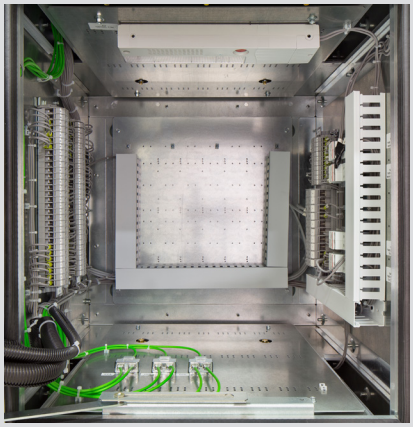
The main criticism of these low-power sensors is their inability to drive multiple devices. This disadvantage can be overcome using sampled-value data sharing, as described in IEC 61850-9-2.

Communication

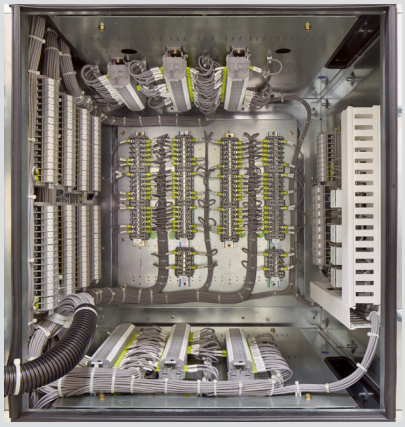
As IEC 61850-compliant devices, NCITs also offer a huge communication advantage. The switchgear can easily be connected to a network via process bus communication with no additional communication devices required. This enables remote monitoring and

control, whether at the facility level or from any network-connected computer.

The potential span of operational control is greatly expanded, and safety is further enhanced. Instead of exposing a tech to the dangers of an open switchgear cabinet, many common monitoring and control activities can be accomplished from the safety of an operations or control center.



Typical wiring connections in digital switchgear.



Typical wiring connections in conventional switchgear.

Physical benefits

Relying on digital-monitoring solutions makes it possible to rethink switchgear design and configuration. The measurement devices are smaller and require far less cabling. Replacing the large number of copper cables in an analog approach with a few digital Cat 5E-type communication cables means less labor and space. Fewer cable connections also mean more reliability with lower installation and maintenance costs.

In many cases, current and instrument transformer compartments can be eliminated. The freed-up space can be used for circuit breakers or other devices, resulting in reduced switchgear frames and a smaller footprint.

Finally, digital measurement devices generate virtually no heat. That advantage creates an internal switchgear environment more conducive to long device life, reduces energy losses, and reduces the need for special ventilation and ductwork infrastructure.

Accuracy

All the above benefits would be meaningless if NCITs couldn't match the accuracy and reliability of their analog predecessors. Fortunately, in both areas, the digital option excels.

Traditional current transformers can become saturated when measuring high current levels. NCITs, with current sensors based on the principle of the Rogowski coil, have no iron core to saturate. This feature ensures very accurate outputs even when measuring large currents. These NCITs operate linearly over a wide dynamic range, from metering to protection. Voltage measurement has improved to the point that voltage sensors with digital outputs provide excellent accuracy, stability, and fast-frequency response, as well as offering easy installation. The high integrity of the digital signals ensures the accuracy of switchgear status data.

The digital advantage

Traditional current and voltage instrument transformers are the sentinels for your power-delivery system; but in many ways, they aren't doing a very good job. Until now, we've had to live with their shortcomings.

Today's generation of NCITs overcomes all those shortcomings and provides superior performance in almost every way. Digital solutions are available for a range of applications, including low- and medium-voltage switchgear, gas-insulated switchgear, dead-tank circuit breakers, and hybrid switchgear. Specifying digital-measurement devices enhances safety and control, while reducing space and maintenance requirements.

As in most analog vs. digital matchups, digital switchgear is the clear winner.

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