Adoption of Digital Solutions to Improve Grid Reliability

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Agenda

**Industry challenges**
- How to leverage digital transformation?

**Unifying oversight**
- Digital technologies for a digital workforce

**Digital Substation**
- Quick review of the benefits of industry digitization

**Security**
- Technology to improve our industry’s risk profile

**Summary**
- Reaping the benefits digital technology
## Industry context

<table>
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<tr>
<th>The grid is changing</th>
<th>The stakes are increasing</th>
<th>Technology is advancing</th>
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Digital transformation means relying more on intelligent systems than on specific individuals.

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Asset health

Predictive / Prescriptive Maintenance

Conventional Time-Based Maintenance
Routine, in-person inspections may not pick up problems early

Digital Sensors and Predictive Analytics
Asset performance models predict failures before they occur

Preventing just one transformer failure saved an Ellipse customer $5M in the first year of using the tool
Challenges with the existing digital landscape

- Unintuitive and laborious
- Information and action are disjointed and spread across multiple systems from different vendors
- Constrained ability to extract value
- Ability to deliver new business outcomes
- Ability to automate
Digital Enterprise
A single pane of glass for IT/OT data and action

Access to the answers you need, when and where you need them.
Digital substation
Embracing digital protection, control and communications

IEC 61850 bus
Substation automation protection and control system

Bridging the gap
Stand-alone merging units, bridging the gap between analog and digital world.

Communication systems

Asset management
Advanced system and equipment supervision for efficient management

Increased safety
Non-conventional instrument transformers increase safety and reduce footprint

IEC 61850 bus
connecting the switchyard to the protection and control system
Faster installation, smaller footprint
Modular SW and HW concepts

**Conventional Substation - Hardwired**

- 14 IEDs, 8 different models

**Digital Substation – Fiber optic cables**

- 4 IEDs, 1 model, 1 typical panel design

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Functional consolidation using multi-object protection and control: 50% reduction in number of panels
Digital Transformation
The substations protection and control devices

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<tr>
<th>Conventional Substation</th>
<th>Digital Substation</th>
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Safe process interface, faster installation and replacement, application independent physical standard solution
**Speed and supervision from digital communications**

Faster and more reliable protection

**Faster data exchange compared to hardwired signals**
- Using GOOSE services the response time between IEDs is considerably faster than traditional hard wired
- Response time of hard wired is constrained by auxiliary relay on/off delay of sending IED and by input filtering of receiving IED

**Real-time supervision**
- Supervision functionality and data quality handling
- Data sending is event based and when a change in GOOSE data occurs, a message is sent multiple times to the network to ensure the data has been received.

**Example: Busbar reverse blocking scheme**

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<tr>
<th>Hardwired</th>
<th>GOOSE</th>
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<tbody>
<tr>
<td>Time to block A</td>
<td>47ms</td>
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Additional benefit from digital sensors
Geomagnetic Induced Current (GIC) Protection

- Geomagnetic Disturbances (GMD) from solar flares results in **direct current induced** into the electric grid

- GMD event, GIC may cause transformer hot-spot heating or damage, loss of Reactive Power sources, increased Reactive Power demand, and misoperation, the combination of which may result in voltage collapse.

- Large Power Transformers at risk and neutral DC measurements not adequate

- NERC TPL-007-1 requires vulnerability assessment of their systems to a benchmark the “one-in-100-year” GMD event
Increased reliability

Line differential protection and mission-critical communication

- Performance increase of protection system using GOOSE based Teleprotection
- Significant reduction of installation and cabling complexity, all copper cables are replaced by optical fibers
- Further increase reliability by using PRP redundant communication
Quantum-Safe Encryption Card SENC1 - Next Level of Cyber Security

First encryption solution for mission-critical infrastructure with quantum technology

- Best in class security encryption technology
- Quantum-Safe with quantum physics
- Ultra low latency - no influence on the traffic
- Deterministic end-to-end encryption
- High-secure and trustful
- Future-proof and long term protection

Trusted Security for a secure, reliable and highly available network
Summary – From Grid Digitizing towards Grid Digitalization

Extending from device to edge to cloud – enable to know more, do more, do better, together

**Digitalization (and Digitization) bring to our conservative industry:**

**Challenges...**
- Security
- Different (younger) user expectations
- Training challenges

**...but bigger Opportunities**
- Better care for heavy assets
- Improved synthesis from point applications
- Faster and more reliable protection
- Smaller, more economic substations
- Safer workers