

# Modernization of Key Substations of the Georgian State Energy System Based on IEC 61850

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# What are Benefits of Fiber Optics?

- Digitized boolean and analog samples on process bus
- Increased safety
- Better resiliency
- Improved electromagnetic immunity
- Potentially lower cost
- Support for optical instrument transformers

# Fiber-Optic Solutions

- Relays in the yard
- Relays in control house + digitizing devices in the yard
  - Shared Ethernet Process Bus - IEC 61850-9-2 Sampled Values (SV) IEC 61869, PTP, and GOOSE
  - Private Ethernet Process Bus – IEC 61850 and 61869 SV, IEC 61158 EtherCAT
  - MIRRORED BITs



# Move Relays to the Yard

- Locate relays closer to equipment
- 100s of thousands installations since 1997
- Run CT, PT, and control wiring to relay in yard



Placeholder for EVN Video

# IEC 61850-9-2LE Flexible Shared Ethernet Network Slows Down Protection

- 4.8 kHz sampling and publishing
- New IEC 61869 supports other frequencies



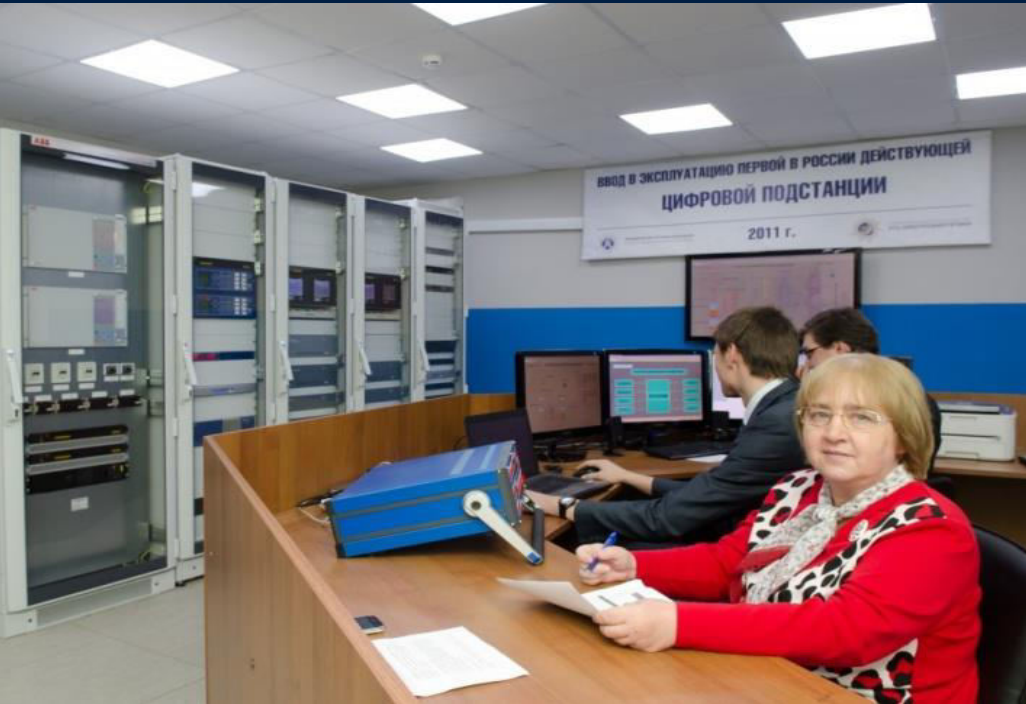
$$\text{Latency} = T_{\text{RELAY}}$$



$$\text{Latency} = T_{\text{RELAY}} + \underline{\underline{2.5 \text{ ms}}}$$



# SEL SV Relays Since 2006, Installations in Russia Since 2011



- Russian Federal Grid Company (FGC) commissioned in December 2011
- Elgaugol (Elginskoye coal deposit) tested in 2013

# Process Bus Faster via Private Ethernet Network

- Point-to-point connections
  - IEC 61158 synchronous 24 kHz sampling
  - IEC 61850 9-2LE, IEC 61869 multiple frequencies
- No distributed time source required
  - IEC 61158 no time synch required
  - IEC 61850, IEC 61869 co-located clocks
- Cybersecure



# Each Method Affects Cost Differently, All Three Increase Safety

- Reduction in hazardous exposure
  - CT and PT connections stay in yard
  - Panels are less cluttered
- Fewer terminations
  - Wire lug failure
  - Terminal block loosening

# Relays in the Yard Chosen by GSE

## Advantages

Proven track record

No special skills required

Speed of installation

Reliability

## Challenges

Testing and commissioning

Placeholder for GSE Video

**Questions?**

