Advanced LV Distribution Network Monitoring and Enabled Applications

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Outline

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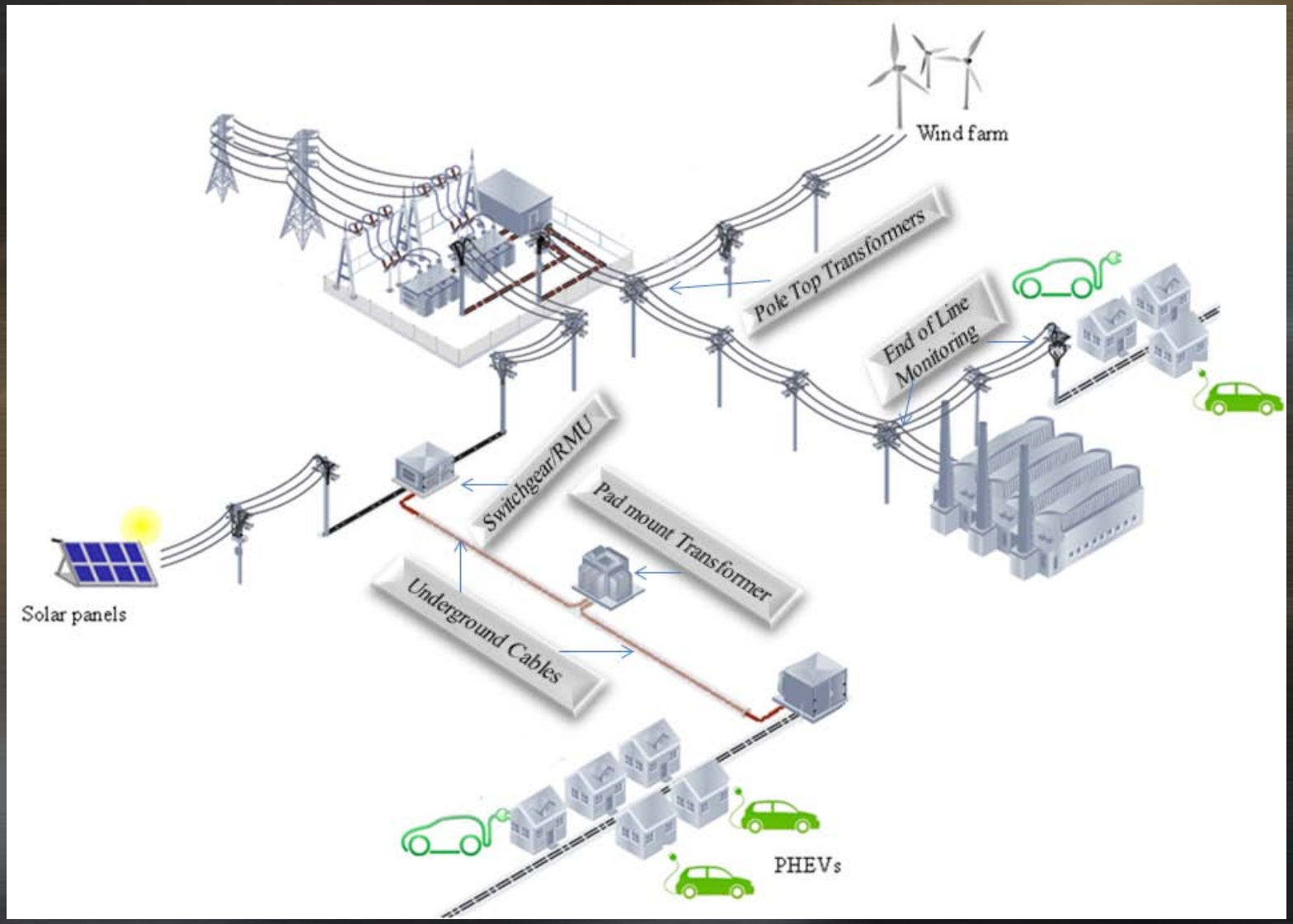
  - Challenges and Opportunities
- LV Monitoring Node Architecture
- Advance LV Distribution Network Applications
  - Pad Mounted/Pole-Top Transformers and Switchgear
  - Cable in Vaults
  - End of Line – Utility/Industrial
- Scottish and Southern Energy (SSE) NTTV Project
  - Utility Overview
  - Project Requirement & Lesson Learned
- Summary

Why LV Network Monitoring



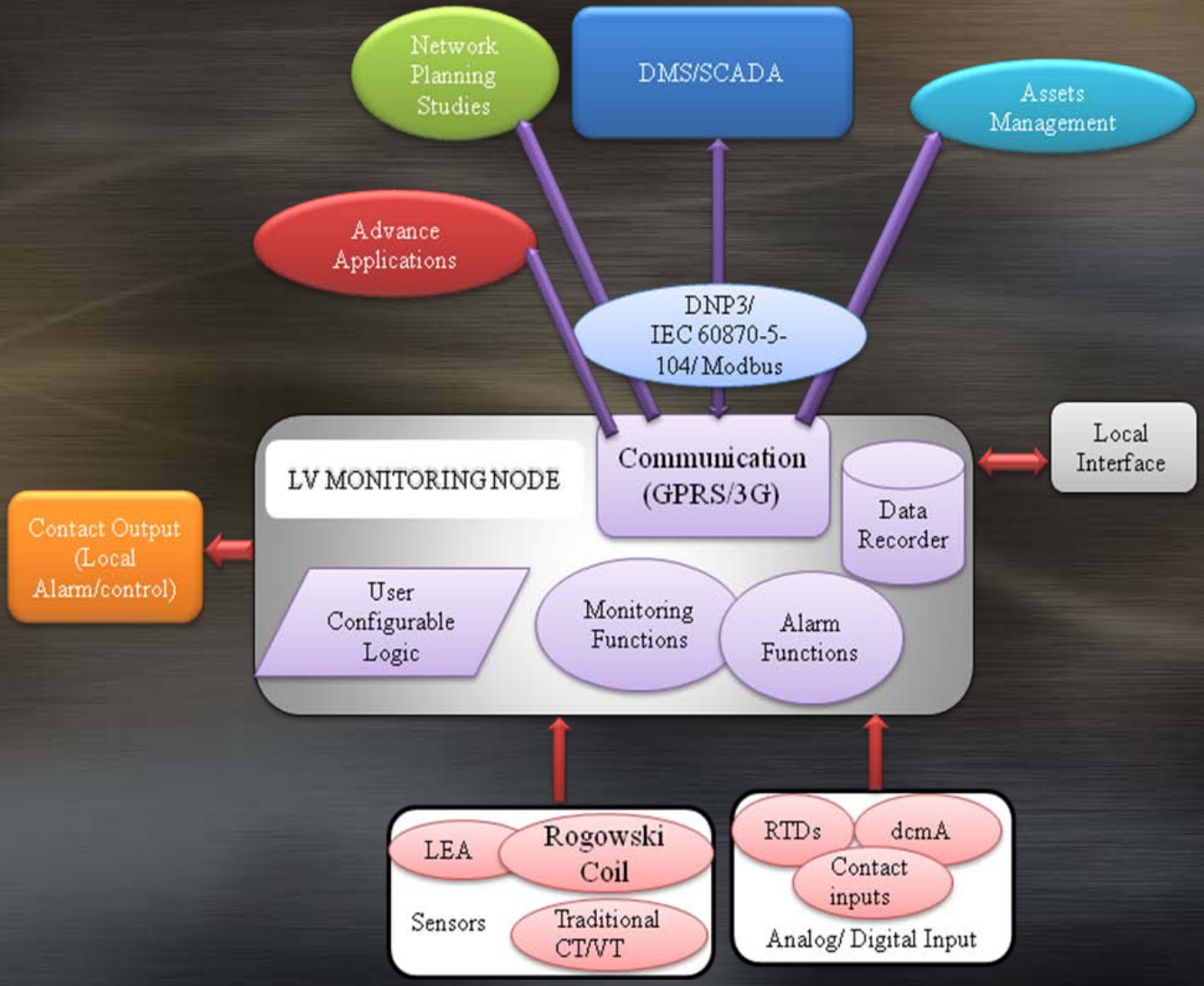
Upcoming Challenge on LV side

- Impact of Distributed Energy Resources (DERs)
  - Large scale interconnection of single-phase distributed generation (DG) with the utility distribution grid can cause current unbalances, resulting in voltage unbalances
  - Distributed generation can complicate the regulation of voltage across the length of distribution feeders
  - Plug-in hybrid electric vehicles (PHEVs) are the next big revolution in the electric transportation market. Distribution grids are not typically built to handle a large amount of increased loads
  - Power Quality (THD) from battery charger/storage

Concerns on Applying LV Monitoring System

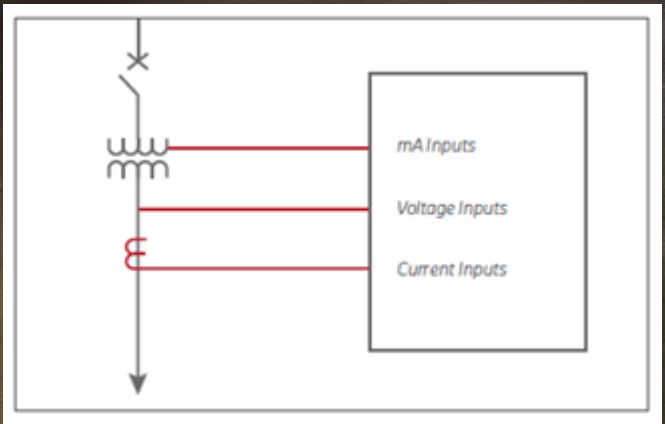
- Outage during installation/retrofit
- Costs
  - Installation
  - Operation and maintenance
- Asset management
- Space constraint for CTs & VTs
- Communication infrastructure
- Integration with existing DMS system

LV Monitoring Node (LVMN)



Applications: Pole Top/Pad Mounted Transformers

- Distribution Transformers – enhancing monitoring, life span, outage time

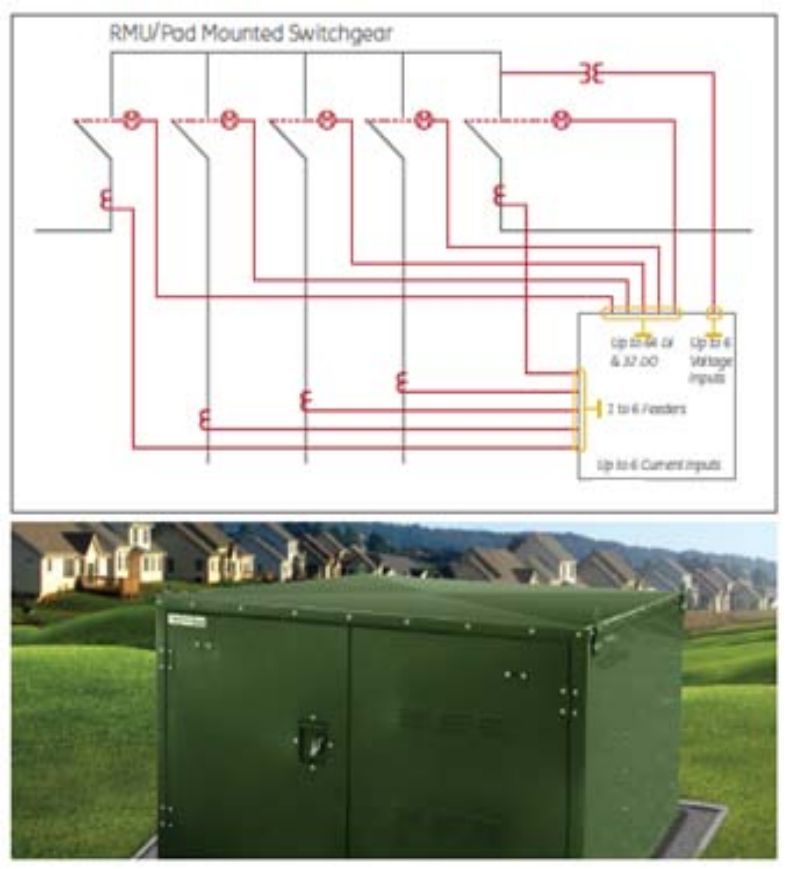


Key Applications

- Transformer load profile monitoring: Peak demand statistics recording; improved load flow/planning studies
- Transformer condition monitoring: oil and winding temperature monitoring through dcmA and RTD sensors
- Quick retrofit installation especially in tight spaces through Rogowski coil current sensors
- Energy monitoring and logging to help theft detection

Applications: RMU/Pad Mounted Switchgear

- Enhancing RMUs (Ring Main Units) and pad mounted switchgear

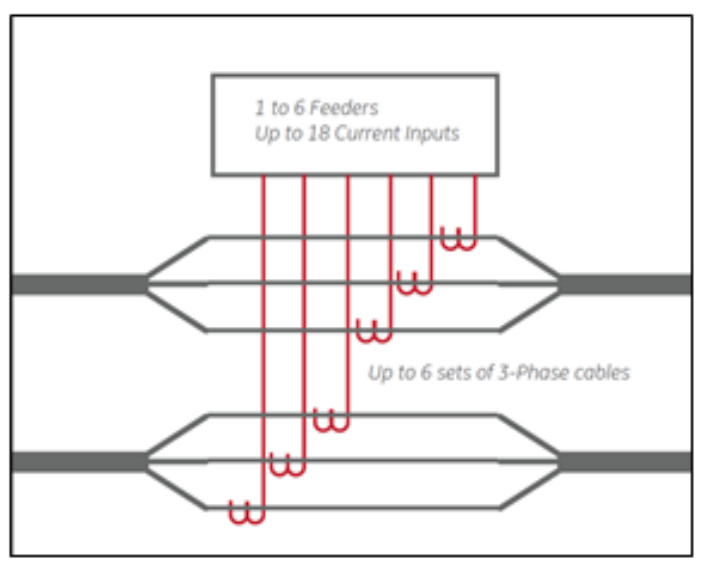


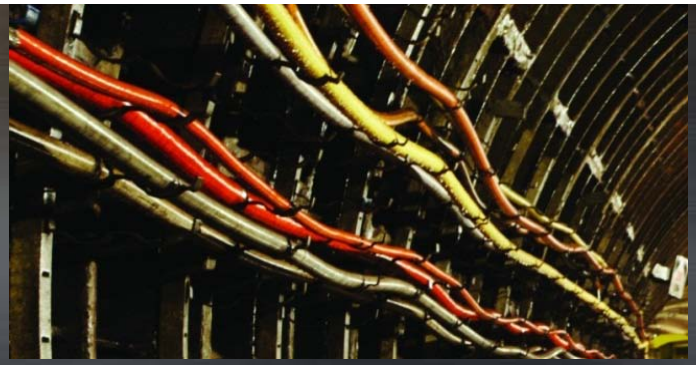
Key Applications

- Overcurrent detection per phase (50, 51) for each feeder to identify faulted circuits and loads approaching overload levels
- Expandable digital inputs and outputs enable remote switching of main incomers or outgoing switches
- Flexible logic engine to enable user configurable controls
- SCADA/DMS based monitoring and controls over cellular network

Applications: Cable in Vaults

- Compact, cost-effective fault detector for underground cable networks



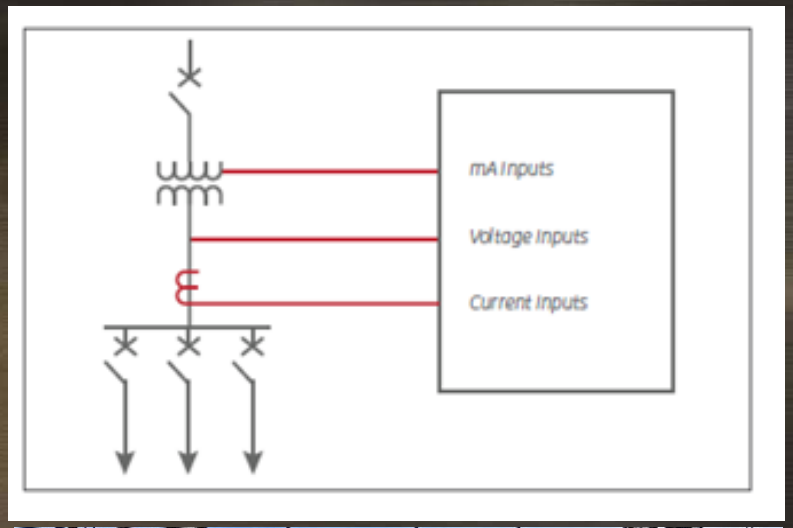


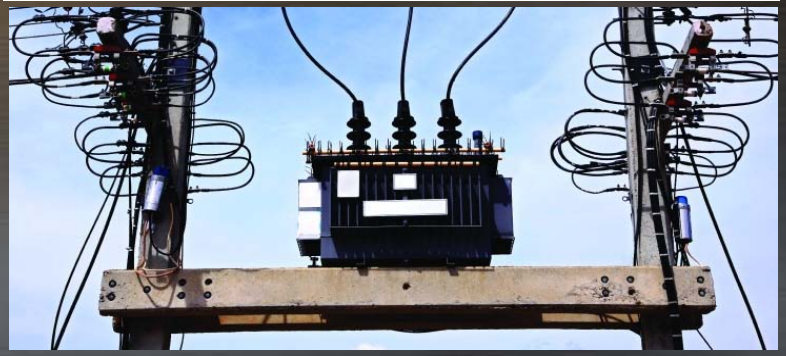
Key Applications

- Deployment of the LV monitoring device at strategic locations along cable paths enables faster fault detection/ faulty section location
- Early warning on overload and alarms for fault detection per phase (50, 51) for each feeder to reduce feeder downtime
- Rogowski coil option to enable retrofit installation in space-limited locations and to reduce the need for outages

Applications: End of Line – Utility/Industrial

- End of Line Monitoring plays an important role





Key Applications

- Enhanced voltage monitoring and control by giving inputs to Volt/Var control schemes.
- End of line voltage and current measurements to help in short term and long term operational planning
- Energy monitoring and logging to help non-technical loss applications
- Power Quality monitoring
- Overcurrent detection with alarm/trip to provide early warning signals of potential failures

SSE's NTVV Project & its Requirements

- SSE is a leading electricity and gas company, operating mainly in the UK and Ireland serving around 3.7 million customers

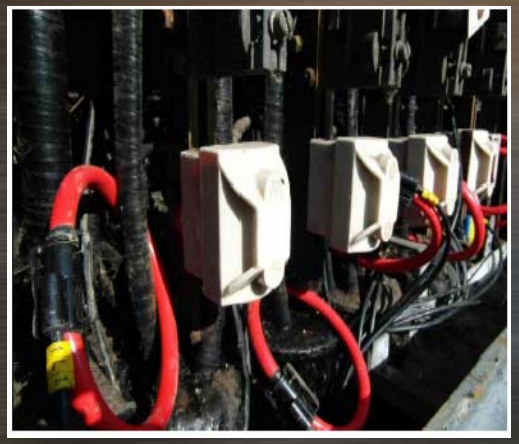
- Demonstrating the benefits of monitoring LV network with embedded photo-voltaic (PV) panels and electric vehicle (EV) charging points (SSET1002)

- Installation requirements,
  - Space restriction to fit within all substation enclosure types & outdoors
  - Weight limitations
    - Can be comfortably installed by one person
  - Installation mounting options for
    - Wall mounted, Pole mounted & Floor/pad mounted

Background of SSE and NTVV Project

- Monitor & Record parameters from the bus bar and up to 6 LV feeders
- Utilize SSE existing 3G/GPRS communication infrastructure
- No customer loss of supply during installation and commissioning
- In addition, the support of a mechanism to remotely set limit thresholds for alarm generation

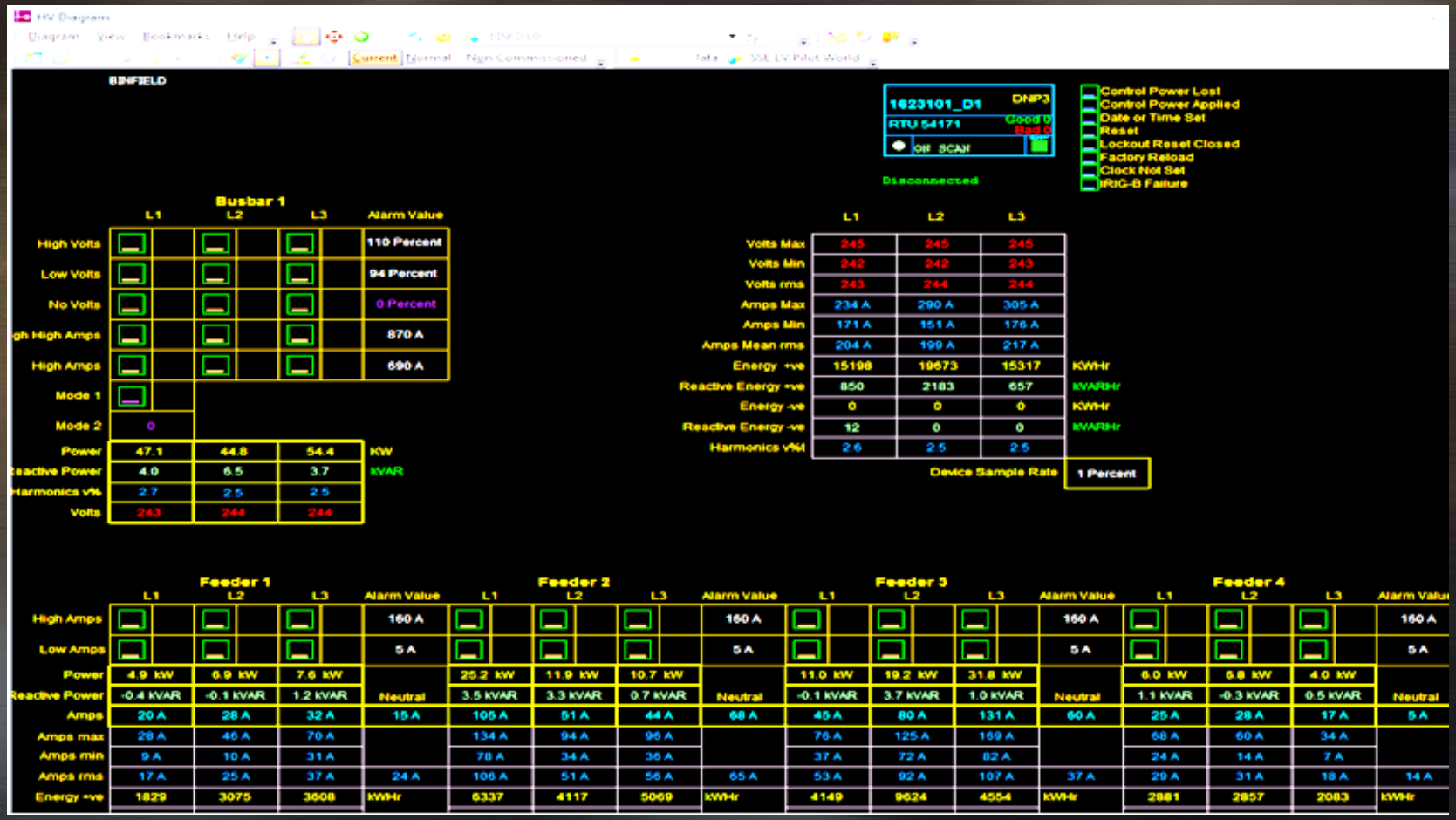
Installations at Distribution Substations



Courtesy : Scottish and Southern Energy

Integration with DMS

- Communication to and from the monitoring node over existing SSE APN, using the industry standard DNP3 protocol.
- DMS TOOL SNAP SHOT



Courtesy : Scottish and Southern Energy

Lessons Learned

- Pad Mounted Substations
  - Some locations are very compact, typically offer very limited access to live low voltage substation bus bars.
  - At two locations that a bus bar connection could not be made without first isolating the busbars, which would involve disconnecting supplies to customers.

- Pole Mounted Transformers
  - Two pole locations were constrained as access to the neutral conductor could only be achieved at the transformer.
  - For a pole mounted transformer, with live exposed high voltage terminations, access to the low voltage terminations cannot be achieved while the transformer is live.

Lessons Learned

- Pre-installation check: strength/speed of GPRC/cellular network signal individually at each site of installation
- Remote firmware upgrade and settings download features were used to subsequent device maintenance and save several site visits (time & money)
- Rogowski coil best suited over traditional CT
- Protection functions (Overcurrent, Under/Over voltage, phase loss, Voltage sag/swell, etc.) were used to alarm the condition at remote locations
  - Improved the system visibility, and narrow down the fault location

Summary

- LV monitoring and control can give better vision of the network with DERs and PHEVs
  - Needs to cost effective, uninterruptable and easy site installation, light weight, compact design
- Pole Top/Pad Mounted Transformers & Switchgear
  - Condition monitoring – overloading, temperatures, etc.
  - load flow/planning studies
- Cable in Vaults
  - Faulty section location; condition monitoring – overloading
- End of Line – Utility/Industrial
  - Power quality monitoring;
  - Inputs for enhanced Volt/Var control and non-technical losses applications
- 100 Monitoring and control node installed in Phase I at SSE Network

Thank You

Questions?