Managing the Renewables Challenge in Secondary Distribution Networks

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Managing the Renewables Challenge in Secondary Distribution

• Challenges in grid management
• Monitoring LV Networks
• Looking ahead
Challenges in grid management
Passive Electrical Networks

- Centralised Power Generation
- Grid supply points
- Distribution Networks
  - Normal operation
  - Fault conditions
  - Abnormal operations
  - One-directional power flow
- Predictability
  - Voltage profiles
  - Load factors
  - Fault currents levels
Challenges in grid management
Active Electrical Networks

- Growth in:
  - Large scale Renewable Energy Sources (RES)
  - Distributed Energy Sources (DES)
  - Low Carbon Technologies (LCT)

- Distributed Energy Sources
  - Bi-directional Power Flow
  - Higher voltage profiles
  - Intermittent nature
  - Less predictable
Challenges in grid management
Addressing generation short fall

• Access to electricity
  • Generation shortfall
  • Reliable access
  • Disruption-linked outages
  • Network Intelligence

• Challenges in grid management
  • “Last mile” of the distribution network
  • Planned & predicted in the past
  • Variable now & in future
  • Customer take-up
Challenges in grid management

Predicable Loading

- Workdays (48): 160 to 623 kVA with 1000 kVA rating
- Saturdays (10): 153 to 597 kVA with 1000 kVA rating
- Sundays (11): 157 to 433 kVA with 1000 kVA rating
- Bank Holidays (2): 156 to 412 kVA with 1000 kVA rating
Challenges in grid management
Unpredictable Loading
Challenges in grid management
Management of LV Networks

• Network Management
  • Improving Quality of Service
  • Improving operational efficiency
  • Enabling DER, ES & other LCT

• Managing “electrical headroom” through ANM
  • Rising voltage levels / fault levels
  • Prevention of overload
  • Integration of DER and LCT

• Increased network visibility
  • Fault prediction, detection & location
  • Planned maintenance, replacement & reinforcement
  • Power quality
  • Technical & non-technical losses
Monitoring LV Networks
System Architecture
Monitoring LV Networks
Substation Monitoring

Rogowski coil sensors

MCU
Monitoring LV Networks

Monitoring Voltages on LV substation

Each row is a substation

Measured voltage
Monitoring LV Networks

Current on LV Feeder
Each dot represents a load reading from the substation on a different day, taken at different times of day over several months.
Monitoring LV Networks
Detecting faults on LV joints

Feeder 1 Max Current Values up to 02/07/2013

Amps

Time

26Jun 27Jun 28Jun 29Jun 30Jun 01Jul 02Jul
Exploding Pavements in Pimlico, Central London

Source: BBC News, Posted at 12:30 pm, April 26, 2013
Looking Ahead
Actionable Information

Planning
• Asset Management
• Reinforcement

Losses
• Technical Loss
• Non-technical Loss

Power Quality
• Voltage profiles
• Total Harmonic Distortion

Faults
• Predict
• Detect
• Analyse
• Fix
Looking Ahead
Integration into Monitoring and Control Systems

- Control Room
  - SCADA / DMS
- MV Primary
  - RMU
- MV/LV Transformer
- LV Feeder Pillars
- LV Monitoring

Alarms
- Min
- Max
- Set-points

Data Analytics
Looking Ahead
Linking LV monitoring to the DMS

- Geospatial network views
  - Real-time outages
  - Load profiles / modelling
  - Blown fuses / broken conductors
  - Under / over voltage
  - Location of LV faults

- Managing “Electrical Headroom”
  - Network reconfiguration
  - Embedded generation
  - Energy storage
  - Demand response

Lucy Electric SCADA system, courtesy of SKELEC
Summary

• Response to generation shortfall
  • More management tools
  • Quality of service
  • Intermittent generation
  • Bi-directional power flows

• Visibility and Active Management
  • Centralised control points
  • Microgrids
  • Off-grid

• Data has more than one use
  • e.g. may assist asset management
THANK YOU

engineering intelligent solutions