Energy Storage Summit

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A Case Study: Energy Storage Systems For Local Authorities

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Presentation Overview

- Project Parties
- Project Objectives
- Project Barriers
- UKPN Specification
- Proposed Solution: ESS + Export control (Back up Protection)
- Small Scale ESS: Battery Specification
- Single Line Diagram of School
- Large Scale ESS: Battery Specification
- Large Scale ESS: Block Configuration
- Single Line Diagram of TESAM
- Project Innovation
Project Parties

Peterborough City Council (PCC) – Main Client

UK Power Networks (UKPN) – DNO

Mears – Project Management

Smart Power Systems – Supply and Integration of Energy Storage and Control for Dcode / Grid Code Compliance
Project Objectives

• Roll out PV systems across PCC building infrastructure

• Up to 3 MWp rooftop PV in schools and commercial premises

• Largest system 999 kWp

• Smallest System 17.5 kWp

• Up to 20 separate roofs
Project Barriers

- UKPN network steady state operation requirements
- Proliferation of both wind and solar in Peterborough
- Export limited to zero at certain time of day
- Thermal overload of overhead lines and potential voltage rise issues
- UKPN statement that the PV could not be connected due to this reason
- UKPN invited client to offer an innovative solution to overcome grid constraints
- Smart Power Systems took the challenge
UKPN Specification

• Small Scale PV Solar Systems
• Peterborough Load Profile
  – Demand peak ~ 1800 hrs (all year round)
• Peterborough Generation Profile
  – Wind is the predominant generation technology in the area so considered to have greater network impact than PV Solar
• Permissible Active Power Export Times
  – 1700 – 2300hrs (6 hours)
• Maximum Active Power Export Limit (kW)
  – Meet G59/3 requirements
  – 16 A / phase
    • 11 kW (TPN Connections)
    • 3.68 kW (SPN Connections)
• Maximum Available Energy Export (kWh)
  – 66 kWh (TPN Connections)
  – 22.1 kWh (SPN connection)
• Large Scale PV Systems
  – Export active power output being negotiated
Proposed Solution: ESS + Export control (Back up Protection)

- ESS system sized to meet a percentage of PV energy output
- Grid export power flow measured
- Export power flow above set point batteries charged
- PV Solar Export Control System (Back Up Protection 1)
  - Batteries fully charged PV inverters go to Export Limit Mode
  - UKPN Specification “Export Limitation Devices”
- Export Protection Relay (Back Up protection 2)
  - Hardwired reverse power relay (32)
Small Scale ESS: Battery Specification

- Advanced Lead Acid (Carbon)
- Individual battery voltage = 12 Vdc
- Individual battery Ampere hour = 800Ah
- Stack battery voltage = 48Vdc (maximum voltage meets SELV safety requirements of BS7671)
- Stack battery Ampere hour = 800Ah
- Operating Temperature Range = -23°C to +60°C
Single Line Diagram of School
Large Scale ESS: Battery Specification

- Rated voltage = 2 Vdc
- Nominal Capacity (25ºC) = 1000 Ah
- Nominal Energy = 2 kWh
- Maximum discharge depth = 70% (4200 cycles)
- Operating temperature range = 0ºC to 40ºC
- Optimum temperature range = 19ºC to 25ºC
• Each 2V cell is connected in series giving a total voltage of 72V.
• There are multiple blocks to achieve MWh rating
Virtual Power Plant: Unlock Further Revenue Streams
Project Innovation

- Overcoming Grid Export Constraints to guarantee Grid Code Compliance Of PV System
- Integration of PV, ESS, Export Control
- Development of ESS control system software
  - Battery charging / discharging
  - Container thermal management
  - Export control
- Work with battery converter vendor to modify firmware
- Physical integration of systems into existing infrastructure