Community Energy Storage

Communicating with a Smart Utility Grid

Don Berkowitz
CES – A “Virtual” Power Plant

A distributed, storage based power plant...

- 2 MW Storage-based
- Substation-located

- 2 MW Storage-based
- Grid-edge
CES – A “Virtual” Power Plant

• Unlimited scalability – no financing
• Cost-competitive within 1-2 years
• Superior feature set
• Limited energy storage
• Barriers are regulatory and “mindset”
Leveraging the Capabilities of Distributed Storage

- Risk-averse climate of electric distribution
- Control system must leverage capabilities
- Edge-of-the-grid capacity management
- Balance/prioritizing multiple constraints
- Improved service reliability
  - Islanding
  - Reserve capacity for reconfiguration
New Challenges in Distribution

• Distribution grid design – built for estimated growth
• Electric vehicles – significant new load
  – High non-linear demand while charging
  – Two cars per household
  – Multiple customers per transformer
  – Growth cannot be predicted
• Multiple cars per transformer already happening
• Mindset-changing circumstances
Feeder Capacity Management

“Overcapacity Zone”

- Assumptions gone wrong
- Abnormal weather
- Unexpected growth
- Unanticipated technology (Ex. PEVs)
Feeder Capacity Management

Underground Feeder – Cutaway View

- Shielded Cable in Conduit
- Concrete-lined duct
- Pavement
- Sand/earth fill
Underground Feeder Capacity

- Thermal factors are complex
- Variation over length of run

- Cable life is dominated by thermal history
  - Through-fault duty
  - Integrated time while “overcapacity”
Underground Feeder Capacity

- Measurement tools
- Modeling tools
- Real-time capability
CES – Distributed Energy Management

- Ability to address thermal capacity
- Transformer overload
- Phase-dependent issues
  - Phase imbalance
  - Voltage support
  - Reactive power
Control System Architecture - Challenges

- Distribution equipment communications ... no
- Algorithms
- Reliability
- Integration with central office applications
- Cyber Security
Control System Architecture - Reliability

Substation-centric application

• Colocation with critical equipment
• Reduction of NERC-level impacts
• Cyber security isolation
Reliability – Fault tolerance

Operation Center

Substation 1

Substation 2

Substation 3...

Feeders & Communication Infrastructure

Fleet 1

Fleet 2

Fleet 3...
Control System Architecture - Reliability

- Substation-hardened
- Self-contained
- Sized for individual substation
- Protected from failures of comm. backbone
Control System Architecture

Integration with operation center & substation applications

- GIS
- OMS
- DMS/SCADA
  - Circuit reconfiguration
  - Volt/VAR
The Smart Grid CES™ Hub Control System
Control System Architecture

Database-driven design

- Oracle database
- Secure
- Interoperable
Control System Architecture

DNP Device Server

• XML-configurable
• Isolates applications
• DNP-agile
Control System Architecture

Security… again…

- Self-contained
- Limited application environment
- Application whitelisting
- Application blacklisting
- Isolated from the Internet
- “Call-home” functions can’t
- Intrusion protection
- Intrusion detection
- Single sign-on

... convenient and transparent
Conclusion

• Scalability and adaptability uniquely address uncertainty
• CES can be secure, reliable, cost-effective solution