Microgrid System Integration

DOE Microgrid Workshop
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Session Outline

• First 20 minutes (or less): short introductory presentation by Phil and Juan
  – Introduction of technical issues
  – Case study (systems integration in practice)
  – Example discussion topics
• Next 90 minutes: group discussion
• Last 10 minutes: summary and wrap-up
Systems Integration

- Quick definition of systems integration (so we’re on the same page):
  - Includes subsystems assembly, implementation, and operations
  - For microgrids, subsystems include electrical, control, and security
- Example issues include protocol compatibility, communications, etc.
- Systems integration issues lead to significant project costs
- This session focuses on:
  - Controls
  - Security
  - Implementation
  - Operations
  - Others
Systems Integration – Controls

• Five modes of control for microgrids:
  – Protective relaying
  – Automated systems management
  – Human-in-the-loop management
  – Engineering configuration and management
  – Market interaction

• Many sorts of devices need to be integrated
  – Relays, PLCs, RTUs
  – Generator, boiler, motor controllers
  – Breakers and switches (LV and MV)
  – Demand response, etc.

• Communications include:
  – Networking devices
  – Network interfaces
  – Backbone connectivity
  – LANs, etc.
Systems Integration – Security

• Cyber security
  – Key/encryption/authentication compatibility
  – Logging/forensics/tamper adequacy
  – Acceptable impacts from security overhead

• Balance between:
  – Physical and cyber security
  – Technical, procedural, and administrative security controls

• Incompatibilities can cause vulnerabilities (e.g. lack of support for an important security service)

• Complexity and variability of technology tends toward configuration errors and vulnerabilities
Microgrid Partnerships

- Add challenges and opportunities to systems integration
Case Study:
FDA White Oak Campus
Case Study: FDA White Oak Campus
Case Study: Systems Integration Challenges

- Mission requirements
- Procurement sequence
  - Multiple designers
  - Development/communication of criteria
  - Consulting party concurrence
- Funding impacts
- Points of interface
  - Building automation systems (BAS)
  - Plant controls
  - Utility distribution system
  - Technology integration platform (TIP)
- Optimization elements
  - CUP equipment deployment in response to campus loads
  - Campus interaction with PJM grid / market
  - Load management in buildings to enhance demand response capability
- Operational constraints
  - Mission
  - Physical parameters
  - Environmental requirements / restrictions
  - Fiscal considerations
  - Export limitations
- Plant has been operational since 2004
  - CCHP design with absorption chillers
  - Had to integrate ABB controls into turbines
  - Hard to make sure that the right controller is in charge at the right time
- Practical challenges
  - Grid separation
  - Black start recovery
  - Building systems status / restart
  - Critical load management
  - Human interaction
  - Level of automation
Discussion, Part 1
(List of R&D Topic Areas)

• An R&D topic must lend itself to:
  – Understanding baseline (including costs for managing systems integration challenge)
  – Developing target for improvements
  – Describing impactful R&D activities to achieve the target

• Examples R&D topic areas from the lead-off presentation (these are just examples - we need your input!):
  – Demand response as applied in microgrid deployments for ancillary services
  – Technical interaction and integration of controls across various domains (diesel controllers, micro-EMS, building management, etc.)
  – Cyber security, to ensure standard elements of a security architecture and minimize technical incompatibilities and implementation complexity
  – Complex interaction among environmental issues (CCHP efficiency, fewer distributed diesels in favor of larger units, permitting)
Topic Area Example Analysis

- Costs for current applications (very situation dependent)
  - Demand response
  - Controls integration
  - Cyber security
  - Environmental analysis

- Performance targets:
  - Demand response for microgrid applications that optimizes balance between revenue impacts and mission accomplishment
  - Controls integration challenges reduced to X% of project budget
  - Necessary cyber security services defined across various microgrid application scenarios, with interoperable technical controls
  - Provide a single environmental analysis template that supports all permitting/value studies
Topic Area Example Analysis (Cont.)

• How to achieve the performance targets:
  – Education and training
  – Better understanding of component and subsystem reliability to improve performance analysis
  – DR: understand current systems capabilities, improvements necessary for various levels of revenue enhancement, risks associated with market participation
  – Integration costs are reduced through careful attention to standards development
  – Develop microgrid-specific cyber security elements referenced to ongoing activities, including ASAP-SG, NIST-IR, etc.
  – DOE, EPA, and state environmental commissions work collaboratively
Session Reporting

• Show table listing all R&D activities
• Determine the relative priority of all R&D activities
• Elect spokesperson(s)
Contact Information

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