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

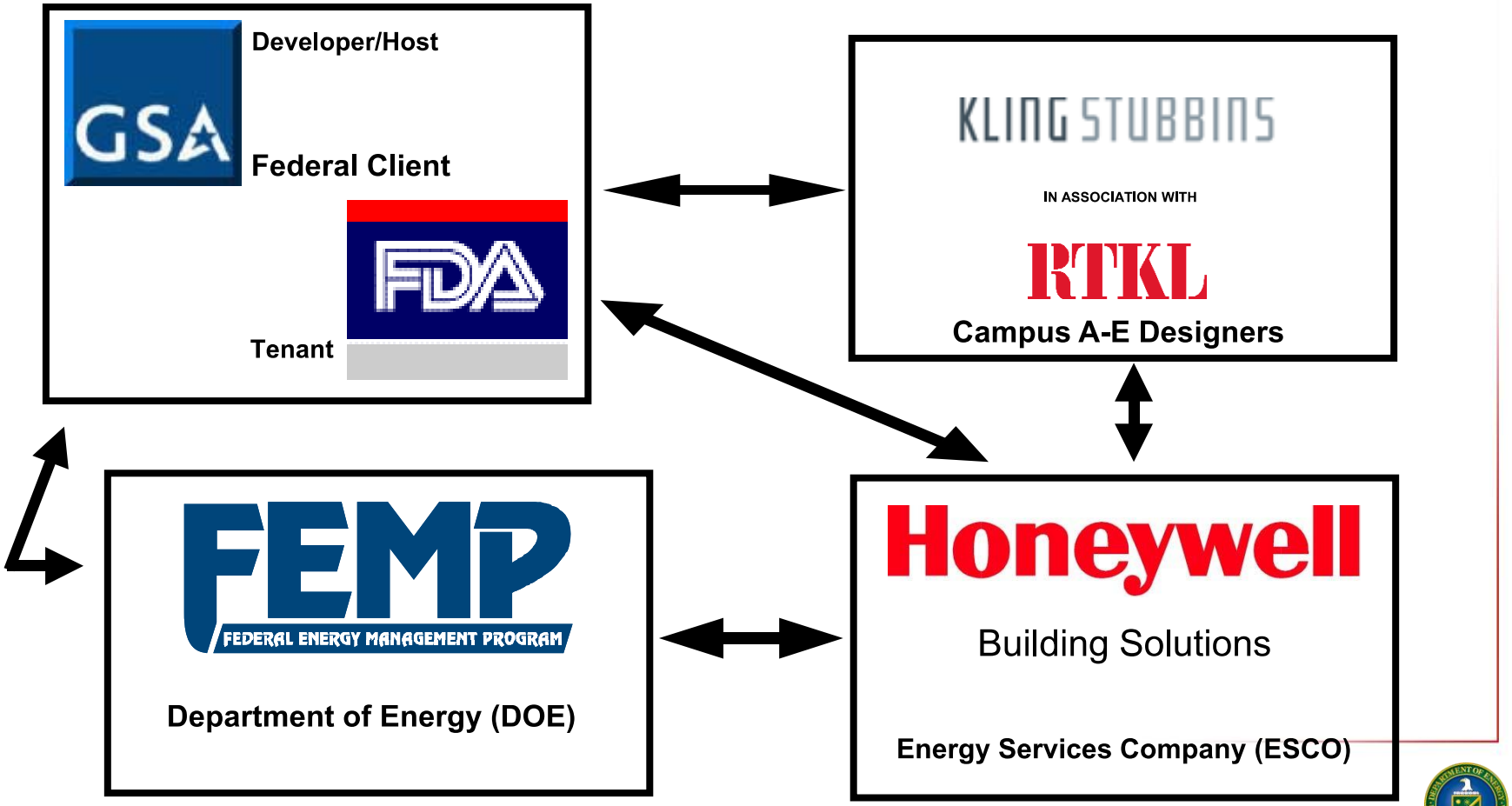
- Five modes of control for microgrids:
  - Protective relaying
  - Automated systems management
  - Human-in-the-loop management
  - Engineering configuration and management
  - Market interaction
- Many sorts of devices need to be integrated
  - Relays, PLCs, RTUs
  - Generator, boiler, motor controllers
  - 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

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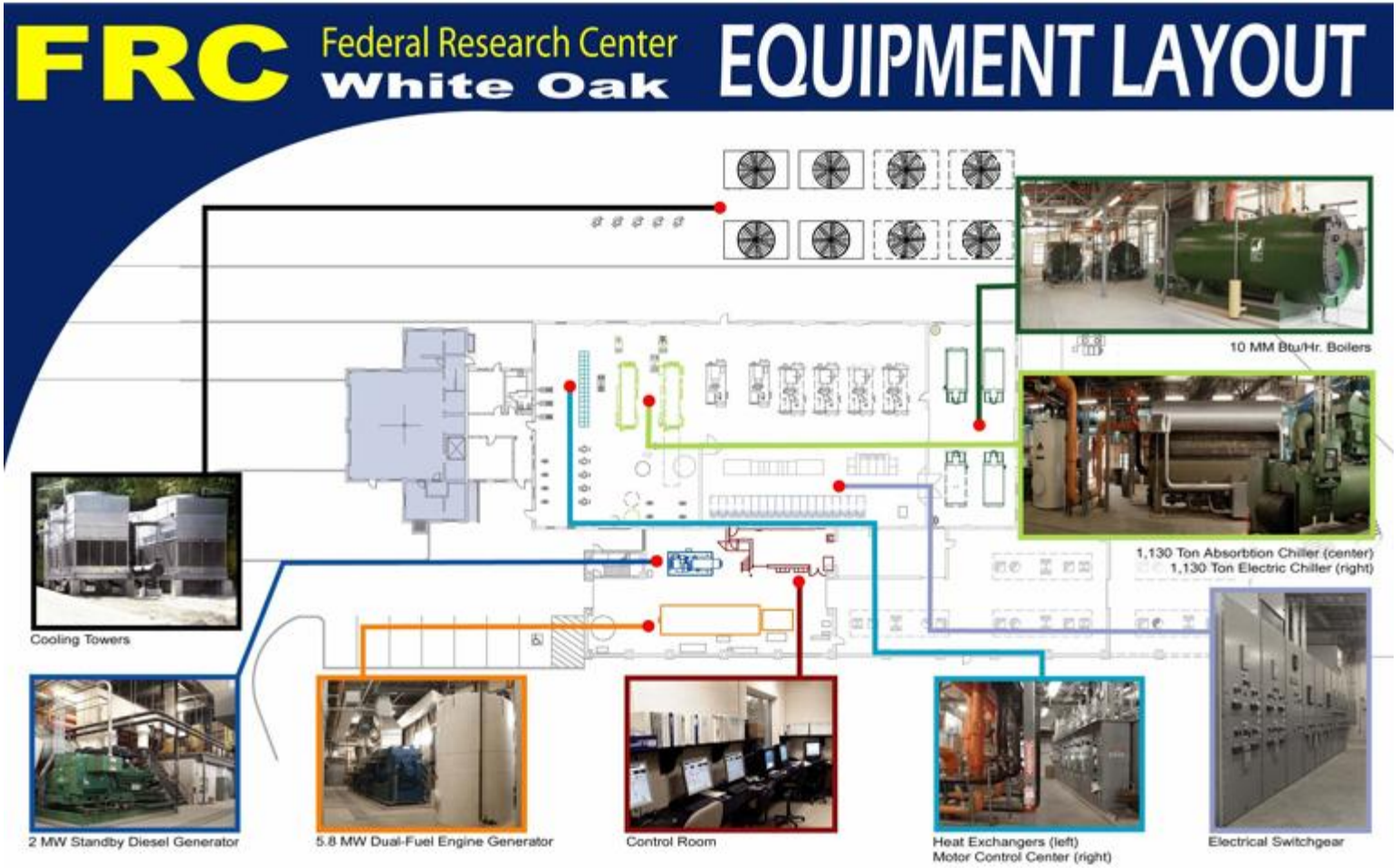

Case Study: Systems Integration Challenges

- 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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