Framing the topic

- What is covered
  - Open architecture (anything that is non-proprietary) focused on control and electrical
  - Electrical/Control/Communication open architecture
  - To allow loads and generation to have plug and play features (interconnection/interoperability)
    - Electric compatibility and communication compatibility
  - Require little customization as long as devices meet standards for all comms/control/electrical
  - Controls:
    - Load matching generation, stability margin, bounded input bounded output, protection, input impedance
  - Control: latency,
  - Electrical: developing interface standards for flexible integration of DER (generation, energy storage, management, and loads)

- What is not covered
- CommsComms: Physical, network, transport, application layer

Current Technology Status

- **State of the Practice (use case or architecture) what has been done 5 years and more?**
  - Controls
    - Building energy management, device specific
      - Distribution controls, generation controls, load controls
    - Demand side management
    - Paralleling switchgear, ATS,
    - Classic generation control
    - SCADA
  - Electrical
    - UL, NEC, IEEE, etc. Standards
- **State of the Art (what is being done within the last 5 years)**
  - Controls
    - Clustering buildings for energy management
    - CERTS
    - Multi-agent distributed control system
    - Wireless controls, remote control from an operator
  - Electrical
    - Load disconnects, load shedding
      - Smart panels
- Current R&D activities

Needs and Challenges

- What is needed and why
  - Controls
    - Autonomy
    - Self healing systems
    - Single control point
    - Centralized control verse distributed control
  - Electrical
    - Define levels of critical loads
    - Use/Store/Import/Export electricity with flexible power networks to respond to different applications
      - Tradeoff between Energy (kWh), Demand (kW), Demand response
- What are challenges

R&D Scope

- Description of the R&D scope responding to the challenges and needs
  - Distributed controls interoperability
    - Address distributed controls with constraints (EPA, etc.)
    - Define interface performance boundaries between different types of equipment(latency, etc.)
    - Boundaries of open verses proprietary
  - Flexible architecture to facilitate different applications

R&D Metrics

- Milestones (within life of the project 1-5 years)
  - Distributed controls interoperability
    - Classes of microgrids/ classes of equipment within a microgrid/control specs for each type of equipment
    - Develop performance criteria for each class
    - Define scalability/modularity of classes of microgrid components
    - Testing methodology
    - Software testbed and hardware testbed
    - Security is important (addressed somewhere else)
- Outcome
  - Set of standards/metrics, control standards, power standards for equipment, test and verification

R&D Metrics

- Milestones (within life of the project 1-5 years)
  - Flexible architecture to facilitate different applications
    - Define use cases/implementation/ and testing with stakeholder input
    - Show single architecture methods can be applied to the multiple microgrid
    - The flexible architecture can improve metrics
      - *Efficiency, cost, security, environmental, power quality, reliability, availability, stability, flexibility, scalability, economics, SAIFI, SAIDI, demand response, peak shaving, transmission congestion reduction*
  - *Flexible architecture definition*