Report-out Presentation

By:

Name, Affiliation

Framing of the Topic- DC Power

- **What is covered**
  - **DC busses for loads**
  - **AC-DC circuits**
  - **Converter circuits**
  - **Superimposed AC/DC**

- **What is not covered**

  standards

-

1 slide

Current Technology Status- DC Power

- **State of the Practice (best COTS / approach)**
  - **Dedicated AC microgrids (Japan, Military, IIT. Etc)**
  - **Part AC, Part DC microgrids (Japan)**
  - **LV DC lighting (EMERGE Alliance)**
  - **Analytics to determine if needs require AC or DC grid**
- **State of the Art (Best R&D???)**
  - **Buildings,**
  - **US Navy Ships (under development), ABB has a DC ship**
  - **data center (2MW Zurich)**
- **Current R&D activities (examples of either of above)**
  ESRDC Electric Ships, ENIAC EU program, LBNL DC systems in build
- DC Forward Operating Bases (under development)

Needs and Challenges- DC Systems

- **What is needed and why**
  DC interface on consumer loads- higher efficiency
  - DC wall plugs needed- allows higher efficieincy
  - Throwing away AC-DC power supplies creates e-waste
  - DC charging for EVs without conversion- higher efficiency
  - Energy Storage/PV without conversion – higher efficiency
  - DC GFCI,etc- safety
  - Voltage regulation / upfc fault detection for dc systems- caps don't work and increased reliability
  - Mulitiple PE devices versus few PE device- reduces losses
  - DC controls and Comm QOS- results in power quality problems
- **What are challenges**
  cost effective solutions
- Code violations/ codes missing, educating indpectors, contrators, regulators, etc
- Achieving critical mass for high market penetrations (e.g dell and DC server farms)
- PE based/low loss DC UPFCs, Voltage regulation, system protection, etc
- Simplify retrofit applications

R&D Scope- DC Systems

- **Description of the R&D scope responding to the challenges and needs**
  - To lower cost, we need to develop standard design methods, training, codes and standards.
  - We need to develop simulation and design tools and control methodologies
  - Work on dc system control algorithms
  - We need codes and standards
  - Push and pull strategy for DC microgrids (push to hostpitals etc, pull from Dell computers etc)
  - Advanced power electronics, need lower cost, higher function, higher reliability

R&D Metrics- DC systems

- **Milestones**
  (Bulleted descriptions with timeline)

- **Outcome**
  - Established codes and standards for DC apps in residential, commercial, industrial (by joining industry efforts already underway)
  - Software to enable operation and design of dc microgrids
  - Establish standard design methodologies and software tools
  - Need advanced power electronics and controls
  - Need PCC to big grid to dc microrid
  - Need utility scale DC meters

Current Technology Status- MG Integration

1. **State of the Practice (best COTS / approach)**
   energy storage systems and PE devices by S&C, Schneider, ABB, GE, Siemens, and many smaller ones.
   - Non renewable gens and associated switchgear that allows MG operation. (low tech MG)
   - Fuel cells
   - Direct load control for demand response, balancing, reliability
   - Service to itself (e.g. peak shaving)
- **State of the Art (Best R&D???)**
  - Distributed control, area control, exogenous control
  - Use of smart meters
  - Services to the main grid as a market participant (MG?)
  - controls
- **Current R&D activities**
- Advanced controls- multi objective, adaptive, etc
- High renewables penetration at a low cost

1-2 slides

Needs and Challenges- MG Integration

- **What is needed and why**
  information on what has been done, what are the current building blocks and how can I use them for my project?
- Standard method for Analysis of storage siting , sizing and use in the system. Using main grid resources versus installing utility level storage (if feasible for MG operation)
- Universal PE devices needed that can be a “lego brick” PE device to fit multiple resources
- Code change requirements (IEEE 1541/ UL 1741) to enable grid services and islanding
- Control and Comm interface from MG to outside the MG (e.g. utility or big grid)
- Modeling needs… to benchmark performance, support design, sizing and siting, deal with stochastics, EVs
- **What are challenges**
  Obtaining relevant data in order to develop the models and analysis methods.
- Shrinking DOE R&D budget in this area
- Predicting utility market and regulatory conditions to justify the investment in developing a MG- how do we better develop and quantify the value proposition
- MODELS
- Cyber and physical security needs to be better specified- especially under open protocols and archtitectures

R&D Scope-MG Integration

- Handbook development- a resource guide to available products, costs, installation methods, valuation methods…
- Need Standard and Observable models to be used in modeling and analysis (AKA Open Architecture Standards)
- Standard Analysis methods and software models to be developed
- Surety Design methods and metrics- reliability, security
- Advanced power electronics and advanced controls

R&D Metrics

- **Milestones**
  (Bulleted descriptions with timeline)

- **Outcome**
  -Base template(s) for a microgrid design
    - MW size, geog size, CHP, reliablity, configurability, exogenous connection, control objectives, system cost, operating cost, reliability definitions and partitions,
  - Further smart grid goals of, increasing renewables, increased efficiencieny, increased integration of storage, increased cyber security, lower emissions.
  - Models created that can be used to to benchmark performance, support design, sizing and siting, deal with stochastics, EVs
  - Decrease cost for given performance metrics