Bonneville Power Administration
Next Generation Grid Components

DOE Next Generation Grid Components R&D Program Planning Workshop, Pittsburgh, PA, USA

August 17-18, 2016

Jeff Hildreth
Laboratories and Field Services
Bonneville Power Administration
I. Present grid challenges
II. Grid components of the future
III. What BPA is doing to prepare
OUTLINE

I. Present grid challenges
II. Grid components of the future
III. What BPA is doing to prepare
Present Grid Challenges (drivers)

• Maintain existing infrastructure
  • Life extension
  • Condition assessment
• Security and Resiliency
  • Natural disasters (ice, earthquake, volcano, GMD, fires)
  • Manmade threats (physical, cyber attack, EMP)
• Capacity Expansion
  • Flexibility
  • Renewable integration
  • Difficulty siting new lines
• Worker safety
  • Arc flash, fall protection
  • Safe by design
OUTLINE

I. Present grid challenges

II. Grid components of the future

III. What BPA is doing to prepare
Grid Components of the Future

Technology Characteristics

• Incorporate simple self-diagnostic, self-reporting features.
• Fault tolerance and resilience
  • Loss of one or more components does not result in system failure.
• Flexible assets
  • With uncertainty around the geographic distribution of loads and generators, grid components must be able to adapt to changing requirements
• Safety
  • A design philosophy of placing a high priority on worker safety.
Grid Components of the Future

Wish list

• Economic and reliable control over power flow on major transmission corridors.
• Power transformers that self-diagnose and are more flexible, resilient, easier to move without sacrificing reliability.
• Protection and control systems (relays) that are more secure, resilient, and simpler to set and maintain.
• Structures incorporate fall protection features.
• Available arc flash energy is minimized.
• Means of controlling overvoltage during live line work.
**Grid Components of the Future**

**Wish list (continued)**

- Mitigation measures for seismic and GMD, and EMP vulnerabilities.
- Autonomous vehicles that enable inspection and assessment without having to put workers in ‘harm’s way’
- Environmentally friendly alternative to SF-6 insulated circuit breakers.
I. Present grid challenges

II. Grid components of the future

III. What BPA is doing to prepare
What BPA is doing to prepare

What is BPA doing to prepare for these challenges?

- Internal technology innovation program
  - Diverse portfolio with 72 projects in flight
  - Roadmap development
  - Collaboration with manufacturers, DOE, national labs, universities, others
- EPRI participation
  - Actively engaged in Substations, Lines, HVDC
  - Special collaboration on power flow control to address flexibility
Collaborative Transmission Technology Roadmap

**External**

Researchers and technical subject matter experts learn about specific research questions and technology characteristics that might help deliver solutions to pressing needs.

**Internal**

Executives, managers, and staff ensure that needs are aligned and documented prior to the TI Office’s annual solicitation.

**Research community** learns utility industry needs, increasing the likelihood of receiving higher-quality proposals expanding partnerships based on topics of mutual interest.

**Executives and senior managers** can read down the diagram to learn about business opportunities and challenges and barriers that stand in the way of meeting these.
Roadmap Diagram

Drivers: Critical factors that influence organizational decisions, operations, and strategic plans, i.e., existing or pending regulations and standards, market conditions, consumer behavior, organizational goals and culture, etc.

Capability Gaps: Barriers or shortcomings that stand in the way of meeting Drivers.

Technology Characteristics: Specific technical attributes of a product, model, system, service, etc., that are necessary to overcome Capability Gaps.

R&D Programs: Current and planned research, development, and demonstration programs to deliver the needed Technology Characteristics, undertaken at utilities, universities, national laboratories, and vendors.

What are the reasons to change?

What are the barriers to change?

What are the technological solutions needed to overcome barriers?

What research needs to be pursued to develop technological solutions?
To Learn More:

www.bpa.gov/ti

technologyinnovation@bpa.gov

Jeff Hildreth
Laboratories and Field Services
Bonneville Power Administration

jghildreth@bpa.gov  |  360.418.2657