IEEE QER Report to DOE

Summary

Presentation to the
U.S. Department of Energy
by the IEEE Joint Task Force on QER
Modern society depends on a secure and reliable energy and power infrastructure

The National Academy of Engineering considers electrification as the first of twenty engineering achievements that have had the greatest impact on quality of life in the 20th century.
Emerging Trends: Holistic Approach

Achieving Electric Grid Resilience – Energy Sector is uniquely critical as it provides an “enabling function”

- Aging Infrastructure **Investment**
- Reliability/Hardening **Investment**
- Natural Gas, Renewables, Microgrids, Electrical Vehicles, Storage & Demand response **Investment**
- Electrical - Natural Gas Interdependency
- Market and Policy environment, e.g. FERC 1000 Right-of-first refusal elimination

“Affordable, clean, and secure energy and energy services are essential for improving U.S. economic productivity, enhancing our quality of life, protecting our environment, and ensuring our Nation’s security.

Achieving these goals requires a comprehensive and integrated energy strategy resulting from interagency dialogue and active engagement of external stakeholders.

To help the Federal Government better meet this responsibility, I am directing the undertaking of a Quadrennial Energy Review.”

President Barack Obama, Jan. 9, 2014
U.S. DOE requested IEEE provide insights on a specific set of priority issues

- Effects of renewable intermittency on the grid and the potential role of storage
- Utility and other energy company business case issues related to microgrids and distributed generation, especially rooftop PVs
- Technical implications for the grid of electric vehicle integration
- Asset management challenges and options, including the implications and importance of aging infrastructure
- Metrics for addressing smart grid issues, especially to help policy makers determine the importance and necessity of protocols
- Skilled workforce issues
- Report cards on the condition and performance of the electric grid – to be addressed at a later stage
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- Work started in May
- Draft delivered for review beginning of July
- Final report delivered on September 8th
- Focus on the scope of the questions – many other grid-related issues are not addressed

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Effects of renewable intermittency on the grid and the potential role of storage

• The bulk power grid can accommodate a large amount of intermittent generation, although it would require some changes in planning and operating procedures

• Grid-level energy storage is a beneficial resource but it is a grid resource and its absence is neither a barrier to nor is its availability per se an enabler for penetration of renewable energy. Solutions involving curtailment or flexible generation are currently less expensive than energy storage

• The distribution system issues are more complex -- intermittent renewable generation creates many new challenges

• Alternative engineering designs, technology solutions, and new and updated planning and operations practices are needed for the distribution system of the future
Utility & other energy company business case issues related to microgrids and DG, especially rooftop PVs

• Microgrid (MG) and distributed resources should be viewed as integral elements of the overall electrical grid
  – Traditional grids and microgrids should be purposefully integrated into hybrid grids to fulfill all the consumer needs, with transmission as an enabler to support integration of renewable resources

• Microgrid business case depends on benefits achieved for the consumer and the provider
  – Key aspects include costs, efficiency, reliability, safety, and resiliency -- all supported by and coordinated with the balance of the grid in a manner that enables the utility or energy company to defer more expensive investment or to manage its grid in a less costly manner

• Policy should support value creation, with results-based rewards, and not unduly favor either incumbent utilities or non-utility MG sponsors
Technical implications of electric vehicle integration for the grid, bulk and local distribution

• The generation and transmission systems can handle millions of plug-in electric vehicles

• There is a good understanding of technical issues that may arise on the distribution system
  – Potential overloads of distribution transformers and circuits
  – Changes in equipment cooling patterns
  – Inability to accommodate high-power charging in older neighborhoods with legacy distribution infrastructure

• Recommendations include
  – Distribution system upgrades
  – Development of PEV charging infrastructure
  – Battery research
  – Development of modeling and control tools
Asset management challenges and options, incl. the implications and importance of aging infrastructure 1 (2)

• Aging infrastructure should not be treated as an isolated concern; rather it should be viewed in the context of holistic asset management

• The entire equipment fleet must be managed to achieve system reliability and meet customer service needs through effective planning and operations

• Holistic approach in support of business goals includes management of:
  – Aging Infrastructure (incl. condition monitoring and assessment tools)
  – Grid Hardening (weather related response, physical vulnerability and cyber security)
  – System Capabilities (including reliability improvements)
Asset management challenges and options, incl. the implications and importance of aging infrastructure 2 (2)

- Urgently address managing new Smart Grid assets such as advanced metering infrastructure and intelligent electronic devices
- Investigate practical measures to shorten times to replace and commission equipment that failed due to extreme events, physical attacks, or other reasons
- Better coordination of electricity and gas markets, including developing operational tools to more accurately forecast the availability of natural gas supply for generators and improve unit commitment decisions
Recommendations for metrics for addressing smart grid issues, including the importance of protocols

- A Smart Grid metric and any figure of merit depend on the definition of the Smart Grid, particularly expectations as to what will be facilitated by the Smart Grid, and reflect the perspective and the framework of the stakeholder.

- Two sets of metrics are recommended
  - Driven by electricity users’ needs and preferences
  - Driven by national, regional, and state priorities

- Timely development of standards and protocols is key to implementation of Smart Systems
  - Selected Smart Grid standard development must be put on a “fast-track”
Skilled workforce issues

• Workforce implications and educational or training needs should be considered as integral factors of research and policy initiatives.

• A range of partnerships (examples included in the report) should be formed to develop new curricula and enhance secondary and post-secondary energy sector workforce training programs, apprenticeships, and use of best practices.
  – Participation of individuals in standards development, professional activities and conferences, and continuous education.
Common observations

- Institutional challenges can be serious barriers to engineering solutions
- More emphasis on accelerated development of industry consensus standards
Topics of Additional Interest 1 (2)

• Overall system management
  – Probabilistic resource planning
  – Grid dynamic behavior
  – Need for improved models
  – Information and data exchange across interconnections for planning & operations
  – Enhanced grid control and use of real-time limits through technology, including automation during fast developing events
  – System restoration improvements

• Review market protocols to insure consistency with reliability requirements
Topics of Additional Interest 2 (2)

• Need for transmission grid enhancement
  – Renewables integration from remote locations to load centers
  – Grid security and reliability improvements, including congestion mitigation
  – Deployment of HVDC and UHV

• Next generation of integrated EMS, including synchrophasors

• Emergence of Cloud Computing and open source use
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