U.S. Department of Energy
Electricity Advisory Committee Meeting
NRECA Conference Center
Arlington, VA
June 29, 2015

Summary of Meeting

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Welcome, Introductions, Developments since the March 2015 Meeting

Mr. Richard Cowart, Electricity Advisory Committee (EAC or the Committee) Chair, welcomed the Committee. Mr. Cowart invited all members to introduce themselves.

Mr. Cowart reviewed the agenda. He explained that the EAC new member appointment process is complete and the new member terms will begin on July 1, 2015. There will be six new EAC members. Mr. Cowart noted that ad hoc cybersecurity workgroup had developed a paper for EAC consideration but that the work product would not be submitted for Committee approval. He further confirmed that no documents were up for formal approval by the Committee at the meeting. He noted that all discussion will be recorded by transcript and made available to the public.

Update on the DOE Office of Electricity Delivery and Energy Reliability's Programs and Initiatives

Honorable Patricia Hoffman, Assistant Secretary, Department of Energy (DOE or the Department) Office of Electricity Delivery and Energy Reliability (OE), provided an update on current OE initiatives.

Ms. Hoffman explained that OE is refreshing one-third of its budget to support the grid modernization laboratory consortium. She added that grid security is an issue that the Department is moving forward on with the help of the industry. She highlighted several topics for the EAC to consider for future meetings including documenting the value and contributions of projects funded by the American Recovery and Reinvestment Act of 2009 (ARRA). Ms. Hoffman explained that the Department's approximately $4.5 billion from ARRA funded grid infrastructure projects. She also encouraged the EAC members to provide DOE with a list of priorities the Department should focus on such as security, grid modernization, and the interdependency between the two. David Meyer added that it is important that the pieces of a modern grid must work well together in order to maximize the value of the system.

Update on the DOE Quadrennial Energy Review

Mr. Larry Mansueti, DOE OE, presented an update on the DOE Quadrennial Energy Review (QER). Mr. Mansueti noted that the full set of QER slides are available on the DOE website. He explained that the QER is organized based on analysis (i.e., qualitative or quantitative). Mr. Mansueti highlighted the changing U.S. energy landscape due to new technologies coming onto the electric grid and policy developments. He provided an overview of stakeholder input during

the QER process, which included public meetings. The broad themes from the public comments included how to operate the system safely, fairly, and efficiently, who should be responsible for reliability, and how to allocate costs of resilience measures.

Mr. Mansueti commented on vulnerabilities and disruptions to the grid and presented illustrations of examples such as tornado and hurricane tracks, wildfires, earthquakes, and coastal inundation. Extreme weather and climate change is a leading environmental risk to the grid's infrastructure. He reviewed several recommendations on how to build a resilient, reliable, and safe energy infrastructure. He highlighted several key trends in electricity from the QER. For example, growth in the U.S. electricity demand is at its lowest level in decades. Mr. Mansueti presented a graphic depicting the reported drivers of projected circuit-miles of transmission addition and noted that reliability was the key driver behind roughly 48% of transmission additions.

Mr. Mansueti reviewed the findings of modernizing the electric grid. For example, the potential range of new transmission construction is within historic investment magnitudes. He explained that the different business models and utility structures rule out a "one-size-fits-all" solution to current grid challenges. Mr. Mansueti highlighted QER recommendations including providing $3.5 billion in grid modernization research and development, analysis, and institutional support. The QER recommends conducting a national review of transmission plans, including assessing barriers to their implementation.

Mr. Mansueti presented key findings from the QER on improving shared transport infrastructures. He noted that key recommendations included supporting a $2-2.5 billion program of competitively awarded grants for shared energy transport systems and support public-private partnerships for waterborne transport infrastructure.

Mr. Morgan requested additional information on the QER recommendations. Mr. Mansueti explained that there are 63 recommendations in the QER. The Secretary has allocated responsibilities for the recommendations to individuals within the Department. Ms. Hoffman added that some DOE offices are trying to address what the metrics of resiliency are and noted the QER will address the value across all the different systems.

Mr. Brown suggested using as few metrics as possible and added that several metrics will be necessary due to the unknowns within the electric delivery system.

Mr. Brown asked if anything unexpected resulted from the QER research. Ms. Hoffman responded that shared infrastructure and interdependence (e.g., energy-water issues, transportation issues) were notable. She noted the importance of the QER's findings on the dynamic energy environment that must take into account all aspects in order to move forward.

Ms. Sanders supported the recommendation to align jurisdiction goals and noted current jurisdictional issues related to interconnection in California pertaining to Distributed Energy Resources' proposed participation in the wholesale markets.

Mr. Mansueti explained that the next topic has not been selected, but expects that it will be

posted shortly. The Secretary told Congress that the next report topic will require two phases (e.g., results in the first six months and results in the longer term).

Update on the DOE Quadrennial Technical Review

Mr. Akhlesh Kaushiva, DOE OE, presented an update on the DOE Quadrennial Technical Review (QTR). He provided an overview of the QTR chapters and highlighted those that focus on assessments. Mr. Kaushiva noted that the target release date for the general public is July 2015. The objective of the QTR is to provide reliable and affordable electricity to power the national economy. The objective will be achieved through evolving and adapting to changes in the system.

Mr. Kaushiva explained the drivers behind the electricity system transformation. The drivers include changing mix and characteristics of electricity generation sources, changing demand (loads) in retail electricity markets, integration of smart grid technologies for managing complex power systems, and growing expectations for a resilient and responsive power grid. Mr. Kaushiva stressed that the future grid will be different from the current system in significant ways.

Mr. Kaushiva highlighted the QTR key research themes including transmission and distribution control systems observability, controllability, and components; distributed energy resources; electrical energy storage; planning tools; and physical and cyber security. He noted that the QTR is strictly a technology review and was designed to stay away from budgets. Operating the future grid will require significantly improved visibility, quick and secure communications, and improved models and controls to take actions to maintain system stability and performance.

Mr. Kaushiva concluded that advancements across the electric power system are needed. The integration of IT and electrical systems will enable system operators to "close the loop", establishing a fundamental change in the system. Operating the future grid will require significantly improved grid visibility, models, and controls so actions can be taken to maintain system stability and performance. Mr. Kaushiva noted that a new generation of components (e.g., transformers, batteries) is needed to take advantage of the grid's new structure. He commented that cyber and physical security are becoming ever more critical. Mr. Kaushiva concluded the presentation with research and development opportunities.

Mr. Centolella asked to what extent DOE is conducting a gap analysis on where the technologies are today and where the technologies will be in 20-30 years. Mr. Kaushiva responded that long term technology development is hard to predict. He noted that DOE is creating a vision for the 10-15 year scale and focusing on research and development being conducted over the next few years.

Ms. Reder commented on the rate of change in the electricity industry, noting that change is considerably faster now than in the past. She stressed the importance of ensuring that all aspects of the grid work together to provide efficiency and reliability and the importance of establishing a cross functional process.

Update on the DOE Grid Consortium Effort

Mr. William Parks, DOE OE, presented an update on the DOE Grid Consortium Initiative (GMI). Mr. Parks provided an overview of the goals of delivering reliable, affordable, secure, resilient, and clean electricity to consumers where, when, and how they want it. DOE's Grid Modernization Initiative goal will be to accelerate the modernization of the North American grid through core research and development, technical assistance and institutional support, and partnerships within the industry community.

Mr. Parks reviewed the GMI's six integrated technical focus areas: design and planning tools, system operations, power flow and control, sensing and measurements, devices and integrated system testing, and security and resilience. He outlined the high level outcomes for each technology innovation and selected major technical outcomes. Mr. Parks descried the timeline of the GMI. From 2015-2019 DOE plans to deliver new capacity for modernization including analytical and valuation tools, architecture platforms, technical assistance, and technologies. From 2020-2024 DOE plans to provide demonstrations and technologies transferred to utilities, vendors, states, and consumers to modernize the grid and deliver outcomes.

Mr. Parks provided an overview of specific efforts such as the Lean Bulk Power Systems, Clean Distribution Systems, and Grid Planning and Analytics. He provided updates on the multi-year program plan (MYPP) status noting that the technical sections are complete. The development of a multi-year laboratory call for grid related activities will be distributed the week of June 29th. He welcomed follow-up input from Committee members before the next EAC meeting. Mr. Parks explained that outreach coordination is scheduled with EPSA, EERE, and OE over the next six months. He reviewed the stakeholder and engagement framework for the GMI. DOE plans to conduct regional dialogues to gather input on grid modernization needs and priorities and there is an ongoing peer review to support the grid modernization initiative.

Mr. Cowart suggested establishing an EAC group to review the laboratory call information and provide feedback on what aspects are most important. Mr. Parks supported Mr. Cowart's suggestion.

Mr. Centolella noted the lack of information on the innovation process between the laboratories and their outcomes and requested additional information on the innovation process. Mr. Parks supported Mr. Centolella's suggestion noting that the GMI will call upon the laboratories to collaborate and conduct outreach.

Value of a VAr Panel

Mr. David Till introduced the Value of a VAr panelists including: Ken Donohoo, Director of System Planning and Distribution and Transmission, Oncor Electric Delivery Company; Charlie Vartanian, Northwest Territory Manager, Mitsubishi Electric Power Products; Denis Bergeron, Director of the Energy Programs Division, Maine Public Utilities Commission; and Tom Sloan, Representative, Kansas House of Representatives.

The first panelist, Ken Donohoo, Director of System Planning and Distribution and Transmission for the Oncor Electric Delivery Company, presented from a system planner's perspective of voltage support. Mr. Donohoo explained voltage support issues as well as other system planning considerations such as customer engagement, locational resource needs, system load changes, evolving grid structure and use, and workforce issues. He also touched on the current state of understanding of voltage support services, tools, and valuation. He described the role of N-1 contingency analysis, the role of power electronics in system stability, and the extent to which real time communication and control are included in planning models.

Mr. Donohoo explained it is essential to understand that the power system is never in a steady state. There is a need for dynamic voltage support models that take into account loads, locations, and the resources available to support the provision of reactive power. Current steady-state planning models usually misrepresent reliability and resiliency conditions resulting in the potential for increasing grid instability. Increasing reactive compensation and voltage support can address grid instability resulting in a more reliable, dynamic, and responsive system.

The second panelist, Charlie Vartanian, Northwest Territory Manager at Mitsubishi Electric Power Products, explained the business drivers behind voltage support. Mr. Vartanian explained that the greatest challenge is adding voltage support that can deal with the deep voltage deviations that occur on the grid, which becomes increasingly challenging with increasingly dynamic systems. Mr. Vartanian explained the VAr resource characteristics that must be understood in order to provide unique voltage support solutions. He noted that there are already technologies with amazing capabilities but there is still a need for voltage support that is specifically designed for the system it is supporting. He further remarked that industry can facilitate mass production of voltage support technologies and increase technology capabilities which could further drive down costs.

Mr. Vartanian suggested reducing the use of generation as voltage support by continuing to develop technology and tailoring VAr support to the particular system. This could be achieved by developing tools that consider system factors such as the types of generation, VAr characteristics, PV penetration, and the regulatory framework to identify the optimal location for new resources. VAr technology and tool development could provide synthetic inertia and allow for greater grid flexibility while meeting reliability obligations.

The third panelist, Denis Bergeron, Director of the Energy Programs Division of the Maine Public Utilities Commission, presented on the value of reactive power from a regulatory perspective. An increase in the number of wholesale transactions across the entire system since 1990 caused people to change their perception of reactive power from a small cost that should be bundled with other utility services to a valuable system service. FERC Order 888 enabled reactive power to become an ancillary service product. However, reactive power is a public good which raises the issues of cost allocation and the potential of being undervalued with attendant impacts on reliability. One solution could be to put in place a central system voltage support administrator to avoid undervaluing voltage support.

Mr. Bergeron explained that voltage support provided by a transmission device is purchased through cost of service rates compared to voltage support from generators in unbundled regions

where the opportunity cost needs to be assessed and paid for. Changes on the system are creating the need for reactive power compensation and illuminating the fact that it is currently undervalued.

The fourth panelist, Tom Sloan from the Kansas House of Representatives, provided remarks on the value of voltage support from a legislative perspective. Mr. Sloan explained that technological capabilities are transforming the electric grid and traditional utilities, customers, ancillary services, and storage all play a role. Self-generation and storage will allow the customer greater control over electric consumption and generation which is directly contributing to electric grid instability. Voltage issues are not well understood by the general public, policymakers, and regulators and it is critical that they understand grid concerns and solutions moving forward.

Mr. Sloan suggested that DOE use its resources to develop and provide tools such as webinars, videos, game-like simulations, handbooks, demonstration projects, and non-technical conferences that are easy to understand to facilitate understanding of grid complexities among regulators, policymakers, and their constituents. Mr. Sloan also suggested that DOE provide models and associated glossaries for voltage regulation and energy storage that allow regulators to define, assess, measure, and mitigate electric grid risks. DOE already has the resources to develop and validate models that determine when and where new technologies have the best value. These models could explain issues, such as rising rates, and identify solutions, which will ease the transition to a modern grid. The DOE is in a position to provide new tools to operationalize how we adjust to a changing electric industry and should maintain transparency and be informative to all stakeholders while they facilitate the transition.

EAC Members Discussion of Value of a VAr Panel

Members discussed the barriers for the general public to understand the technical issues of voltage support, including the fact that the majority of people in the discussion have little technical background. Mr. Till added that even as the head of a planning department, he still does not understand all of technical aspects and suggested communications between grid planners and designers is critical.

Mr. Brown noted that voltage support problems often stem from loads, using the example of air conditioners (AC), but noted that voltage cut-offs will probably not fix the problem. Panelists explained the difficulty of determining compensation for voltage support suppliers and the barriers to solving the AC load problem with technology or from the customer side. The tools exist to maintain steady state VArs but issues occur at the crossover between the transmission and distribution system and where autonomous action takes place. Now the need is to understand the customer and the load we are trying to serve on our system. Mr. Sloan suggested creating an annually approved state legislation list to help illuminate model legislation moving and to avoid creating additional problems.

Members discussed the need for a common framework that could provide the type, amount, and optimal location of voltage support on the distribution and transmission systems while producing a rate of return on investment and maintaining reliability with penetration of renewables. Mr. Zichella added that quantification of VAr support is key for accomplishing this. Mr. Lauby

explained NERC's efforts in these areas. Mr. Donohoo and Mr. Gellings added that planners are conducting analysis to determine the level of penetration, the specific substation codes, and the appropriate technology and location for voltage support that will allow distributed resources to operate in real time. However, one major issue is the numerous variables and the array of technical options, which can result in "analysis paralysis."

Mr. Centolella, Mr. Cowart, and Mr. Mount discussed the possibility of creating a market that will allow real-time valuation and integration, facilitating the identification of the appropriate voltage support and cost allocations. Mr. Gellings and Mr. Mount agreed that, because voltage support is not worth anything most of the time but extremely valuable at other times, a competitive market is currently not feasible in most circumstances. Mr. Bergeron and Mr. Donohoo noted the difficulty in taking measurements and identified the need for improved metering to help assess voltage support needs. Until that data is available, the costs need to be socialized.

Mr. Till explained the lack of understanding of voltage support among the stakeholder community and local nature of voltage support due to the limitations of how far VArs can propagate. Planning for voltage support should account for dynamic conditions in order to better protect the grid against voltage collapse. Mr. Sloan raised the need for new regulatory models to better regulate self-generators and their impacts on system stability.

Mr. Mount discussed hierarchical distribution controls that aggregate load resources and adding storage that can shift and manage peak loads. Mr. Donohoo, Mr. Mount, and Mr. Till discussed the peak load issues due to AC as well as possible solutions and barriers. Mr. Donohoo and Mr. Brown discussed the development of micro-synchrophasors to monitor the distribution system in real time. Members were in agreement that the addition of storage for managing peak loads could become an important resource in the future.

Mr. Bose explained that, from an engineering perspective, the need to balance VArs on the system and the methods to address this are clear. However, policymakers must decide who is responsible for balancing system VArs and fill the policy gap surrounding voltage support. It is difficult to value VArs and to design a market because VArs need to be localized. Mr. Till disagreed that the technology is fully developed and noted that aggregate residential models exist but there is still a need for research to determine the amount of voltage support on the grid. Mr. Bose and Mr. Donohoo discussed that synchrophasors are able to provide generation and load measurements and agreed that more grid monitoring would be advantageous.

EAC Power Delivery Subcommittee Activities and Plans

Value of a VAr Paper

Mr. David Till explained that the objective of the Value of a VAr work product is to bring the topic to the attention of grid planners. He indicated that the panel was very helpful in advancing the level of understanding among the Committee of where knowledge gaps lie and how to address them.

EAC Smart Grid Subcommittee Activities and Work Plan

Ms. Wanda Reder provided a brief summary of the Smart Grid Subcommittee's status and plans. The recommendations on Distributed Energy Storage (DES) is scheduled be completed in the fall of 2015. The ARRA Projects white paper is scheduled to be completed in the fall of 2015. There are also two proposed white papers, one on the Clean Power Plan and one on Microgrids.

Status of Distributed Energy Storage Paper

Mr. Carlos Coe discussed the status of the Distributed Energy Storage (DES) white paper. DES is defined as energy storage that is located at or down stream of distributed substations and the white paper includes behind the meter applications, thermal energy storage, and microgrids. The purpose of the white paper is the identify gaps and provide recommendations to DOE.

Mr. Coe presented a map of DES projects from September 2014 noting that the number of projects has doubled since then (mostly in California and Texas). Mr. Coe highlighted recent industry news pertaining to DES and reviewed the topics discussed in the DES expert interviews, highlighting several observations and recommendations that came from those interviews.

Mr. Coe reviewed the timeline for completing the DES white paper. With the expert interviews complete, and the draft recommendations will be formed in the coming weeks. The draft white paper is due in July 2015 with a target completion date of September 2015.

Status of the Paper on ARRA Projects Information, Data, and Next Steps

Ms. Reder provided the status of the ARRA white paper including project information, data, and next steps. The white paper will discuss the development of a vision for the grid, changing relationships between utilities and their customers, macro drivers for change, and recommendations for next steps. The final paper will be submitted to the Committee in the fall of 2015.

Status of Proposed EAC Smart Grid Subcommittee Work Products

Ms. Reder noted that the EAC is ideally suited to reflect upon the implications and possible risks associated with the final 111(d) Rule because they provide varied backgrounds and have unbiased views.

Ms. Reder explained the proposed microgrid work product. She noted that projects and market interest are increasing and ARRA projects have advanced adoption rates. The draft work product is tentatively scheduled for completion in 2016.

EAC Member Discussion of Smart Grid Subcommittee Plans

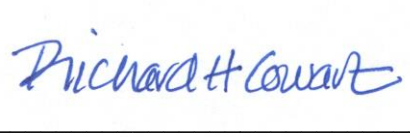
Mr. Cowart and Ms. Reder invited EAC members to ask questions about the EAC Smart Grid Subcommittee activities and work plans. Ms. Heather Sanders noted that infographics would be effective to convey information about the ARRA grants. Mr. Zichella commented on the 111(d)

work product noting that the subcommittee should assess what other groups are doing on the topic as well. Members discussed the timeline for a hypothetical work product and means of getting feedback from the Committee on the proposed scope.

Wrap-up and Adjourn Day One of the June 2015 Meeting of the EAC

Mr. Cowart thanked everyone for their comments and adjourned the first day of the meeting.

Respectfully Submitted and Certified as Accurate,



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9/14/2015
Date

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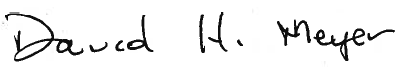

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