U.S. Department of Energy
Electricity Advisory Committee Meeting
NRECA Conference Center
Arlington, VA
March 17, 2016

Summary of Meeting

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Welcome, Introductions, Developments since the September 2015 Meeting

Mr. Richard Cowart, Electricity Advisory Committee (EAC or the Committee) Chair, and Matthew Rosenbaum, EAC Designated Federal Officer (DFO), welcomed the new and returning Committee members.

Mr. Cowart reminded meeting attendees that a meeting transcript is being prepared and all members who wish to make a comment should sign-up to do so during the designated comment period at the end of the second day. He then invited all EAC members to introduce themselves.

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

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

Ms. Hoffman began by thanking the EAC for their willingness to provide feedback to DOE and noted that a lot of activities have been taking place, making the Secretary quite active and busy. She explained that she would begin her update by providing the EAC with her sense of OE's priorities and ongoing activities to act as food for thought for upcoming meetings.

The first topic Ms. Hoffman explained was mission innovation. The DOE Secretary, along with 19 other countries, recently announced mission innovation plans, which is part of Paris COP21, that aim to accelerate the carbon emissions reduction through near applied and higher risk applied R&D efforts for clean energy technology investments. OE already has the task of advancing innovative technology that will lower carbon emissions, which includes determining how to get some of the higher risk technology into the market place and develop technology alongside higher risk environments. Ms. Hoffman suggested that this be one topic or question that the EAC keeps in mind moving forward. A parallel to the mission innovation effort is the effort Bill Gates announced as part of the Breakthrough Energy Coalition which includes the venture capitalists and investment side of future cleaner energy technologies. OE will look at these activities when looking at subsidies.

Ms. Hoffman noted that meeting attendees will hear about the QER later in the meeting and explained that OE is engaged in the second round of QER (i.e. QER 1.2) which will focus on the full suite of electricity, from generation to end-use. OE has been actively engaged in some of the significant efforts in electricity, including policy, thought process, and analytical baseline of recommendations that are expected to come out in the future.

The third effort is grid modernization, which is an effort that includes activities across all of DOE's departments. DOE took the time to pull together a consistent, cross-agency GMI strategy. In addition, DOE challenged the national laboratories to give value added GMI efforts that link technologies that seem somewhat distant in order to pool technologies for regional value. Part of that effort includes looking at the nature and diversity of a region and developing a process to do this.

The fourth DOE effort is looking at an international partnership. The Department has been supporting the Clean Energy Ministerial (CEM), which includes 23 major European Union countries. DOE anticipates having CEM meetings after committing to supporting clean energy, with OE leading the next meeting which will be held in the U.S. June. Part of the CEM and QER is fostering a relationship with Canada and Mexico. Currently, OE is focusing on Canadian relationships because the Canadian Prime Minister and the White House announced an effort to secure the North America grid so the next step is for Ms. Hoffman to think about common interests between OE and Canada and how to incorporate the necessary entities, such as NERC, in order to achieve that effort.

Ms. Hoffman explained that OE is planning a strong effort to look at emergency response capabilities and resilience activities, including the efforts that need to occur in order to move those efforts forward. In addition, cyber security is an issue that continues to grow, as reflected by the recent news report about cyber security in Ukraine. Ms. Hoffman explained that concentrated efforts around cyber security are needed and recovery, from a litigation point of view, is one topic to look at in the future.

The Aliso Canyon is one current topic regarding California gas code, gas storage, available gas, gas generation, and the potential impact of reliability on markets. This topic connects to previous EAC conversations about gas interdependencies, which continues to be an important topic. OE has been thinking about the need for a stronger dialogue around availability of gas storage and the

distribution and correlation between gas and electric reliability, as a near term Department activity, especially in light of the recent discussion around gas infrastructure. OE would like EAC's thoughts, either as a panel or review, during future EAC meetings and efforts on the gas conversation topic.

Ms. Hoffman explained that the 2017 budget request of $262 million is currently on the hill for approval. 2016 was the first time the Department broke over $200 million in appropriations, which shows the Department's commitment to grid modernization and investment in grid infrastructure.

The priorities for 2017 and the current activities under the 2016 budget all fall under the Grid Modernization strategy. The first priority is energy storage, which has a significant budget increase proposed for 2017. DOE will continue to focus on reducing the cost of energy storage and pushing institutional and state issues in order to get energy storage into the marketplace. One of the topics to think about is how to capture the value of energy storage to help address the biggest barrier of getting it into the marketplace. Efforts to support this could include cost benefit analysis and case projects through state testing and lifecycle testing for energy storage.

The second focus is to increase partnership with states and OE would like to focus in on two areas to achieve this. The first is the emergency response area. DOE would like to see the impact and paradigm of energy emergency response in emergency situations by conducting regional exercises and support state exercises. The second is to support conversations about the distribution system including discussions about what the future system infrastructure will look like and how that structure interfaces with the market, consumers, third party interests, etc. The Department would like to organize technology support, from systems point of view, for the states to address questions about distribution system requirements and associated costs. OE has already started a partnership dialogue with interested states and hopes to develop an integrative approach in the future. Ms. Hoffman added that Devon Streit will be the lead person organizing these state efforts.

The third effort is a new area called the Grid Institute, which is an effort under the Office of Energy Efficiency and Renewable Energy. The effort was in response to a call for ideas aimed at getting manufacturing capabilities and jobs back into the U.S. The Department partnered with Oak Ridge National Lab and proposed the Grid Institute examines if there is an opportunity, based on the critical materials and devices needed, to develop an institute that will train the workforce and bring manufacturing capabilities back to the U.S.

Ms. Hoffman summarized her update by noting that the three efforts described are the significant new efforts DOE proposed to congress that reflect the continued importance placed on grid investments. She added that OE is interested in having round table discussions in different regions that involve state regulators and utilities to determine the current challenges and needs in different regions. Although these discussions are not new, they do highlight the importance of industry dialogue and will help reveal the technology and integrated capabilities need on the system in the future.

Update on the Second Installment of the Quadrennial Energy Review

Carol Battershell, Deputy Director for Energy Systems, DOE, provided an update on the

Quadrennial Energy Review (QER). The review examines energy policy issues and was broken into two sections, QER 1.1, which was completed, and QER 1.2, which is currently in progress. QER 1.1 focused on transmission, storage and distribution infrastructure and looked at how all types of energy moved through the system. A wide range of 63 recommendations came from the first round of the QER, including recommendations for various levels, fields, and geographic areas. QER 1.2 added electricity generation, distribution, and customers to the QER 1.1 scope and primarily examines how the electric power system as a whole is evolving and the role of various players in the current and future electric system, from a policy perspective. Ms. Battershell explained the policy examination was broken down into a subset of 14 issues that are expected to be addressed and reviewed the questions.

Ms. Battershell explained that the QER has completed the scoping and policy assessment phases and is moving into the policy options analysis and recommendations phase, which is expected to give rise to the QER 1.2 recommendations. The policy options analysis and recommendations phase is expected to be completed this summer and the final report is expected to be released by early 2017. She suggested that EAC members review the QER 1.2 questions and examples provided in her presentation, noting that a Federal Register Notice will be published when the public report is released, and encouraged members to submit any comments they have at that time.

Mr. Cowart thanked Ms. Battershell for her presentation and opened up the discussion to questions. Mr. Merwin Brown and Ms. Battershell discussed distributed generation and energy storage as two unclear and challenging factors when looking into the future. Ms. Battershell explained that the QER approach to generation questions is to conduct analysis from multiple perspectives and this approach has found that every aspect of distributed generation intersect, rather than viewing it together with central generation or as a negative load. She added that energy storage was being considered as part of grid operations, rather than a grid substitute or a paradigm changing warehousing technology.

Mr. Clark Gellings and Ms. Battershell agreed that the traditional view of first generating energy and getting that energy to customers can be turned around so the system can be optimally designed to supply energy to meet the customers' needs and Ms. Battershell added that EPRI had a good chart depicting the power system transition to a much more intricate, multi-direction system.

Mr. Carl Zichella, Mr. William Ball, and Ms. Battershell discussed the QER 1.2 stakeholder engagement plans. Ms. Battershell explained that the methods will be similar to 1.1 with the addition that each stakeholder engagement meeting will have a generation and transmission panel, a distribution and end-use panel, and a third panel on a regionally specific topic. She added that stakeholder engagement meeting locations and panel topics are expected to be published in the Federal Registrar in the near future.

Ms. Marilyn Brown and Ms. Battershell discussed the QER sub-issue of employment and workforce development. Ms. Brown asked about plans for using a sophisticated analytic systems modeling approach to determine where jobs will come from based on the types of technology evolutions expected and suggested using the hypothesis that the grid will transition from one that is heavily dependent on natural resources to one that consumes less energy than expected in the models. Ms. Battershell agreed that a huge shift in the energy workforce is expected but explained

that the current workforce effort is focused on capturing energy workforce data so as to fill that data gap.

Representative Jeff Morris and Ms. Battershell agreed that there is regional variation in the degree of connectedness to the North American Integration initiative and that it is impossible to separate the natural gas question from this initiative. Ms. Battershell explained that the QER is taking a more holistic approach to assessing cross-border markets and is looking beyond the physical grid to examine possible regulatory or guiding principles that would be impacted by cross-border integration.

Update on the DOE Grid Modernization Initiative

Mr. Bill Parks, Senior Technical Advisor for Office of Electricity Delivery and Energy Reliability, and Carl Imhoff, Pacific Northwest National Laboratory, provided an update on the DOE Grid Modernization Initiative (GMI).

Mr. Parks explained that GMI was in response to the Secretary's effort to coordinate and clarify grid modernization (GM) efforts and the focus of the effort is to facilitate GM in order to ensure prosperity in the face of a changing world. The regional demonstrations under the MYPP, which combines the six areas of focus defined in the QER and the 5 drivers of change identified in the QTR, will determine regional needs and gaps that will help characterize and drive grid modernization and asses if the demonstration solution is a possible avenue for achieving the GMI goals. Mr. Parks responded to the issue of safety raised by Ms. Heather Sanders by explaining that safety is treated like reliability and affordability in the GMI, which are critical to the system and are captured in the QER and QTR text.

Mr. Parks explained that 88 of the project proposals submitted by the Grid Modernization Lab Consortium (GMLC), which includes 14 national labs, were awarded in January and a list of those projects can be found on the DOE website. The projects span from 1 to 3 years, totaled in $102 million, included both short and long-term R&D projects, and include tremendous collaboration with partners. Additional grants to address key regional issues and support national lab and state collaboration have also been awarded.

Mr. Parks explained that the GMLC is currently trying to determine the desired grid attributes, establish a baseline that future efforts within the six focus areas can be measured against, and examine the set of solutions so as to find the most cost effective way of achieving those desired attributes. In addition, DOE is working to link or package different projects together in order to leverage their investments in a more efficient and productive way, specifically by linking common themes such as microgrids, resiliency, and high penetration of renewables. The DOE GMI has finalized the projects and plans to continue to engage state, university, and industry participation in grid modernization solution discussions, including the six upcoming DOE regional workshops that will focus on the technology and policy interface, identify the gaps in the current GMI and QER, and will coordinate the next iteration of GMI plans. Mr. Parks added that the first workshop was held two weeks ago in Austin, TX and the next two workshops are expected to be held in Boston and New York. In addition, DOE expects to have a summit in Washington, D.C. in June that will provide a snapshot on where GMI efforts are and where they are going.

Mr. Zichella noted that interconnections with Mexico presents a huge opportunity for making much more rational connection that can reduce carbon emissions in Texas and California and added that U.S. AID is a potential partner for DOE's North American Interconnectedness (NAI) effort because they already working on the ground in Mexico. Mr. Parks responded that Canada and Mexico have been part of a trilateral cross border effort for some time but Canadian efforts have taken priority because of state submitted permit requests for bilateral movement of energy generation across the border. He was unsure of any DOE short-term plans with Mexico and noted that DOE is on the technical side rather than policy side of international relationships. Ms. Meghan Conklin explained that she has worked on the trilateral side of the NAI and DOE is talking about developing a roadmap for achieving the NAI goals so DOE will be able to provide more information on that topic in the future.

Ms. Wanda Reder noted that DOE's metrics and demonstrations sounded great but moving beyond that to adaptation seemed to be a challenge. She, Mr. Parks, and Mr. Carl Imhoff, Pacific Northwest Regional Laboratory, discussed the thought process behind selecting the 88 GMI projects. Mr. Parks explained that the GMI efforts are still more piecemeal than DOE would like but that was the reasoning behind considering short-term needs for states. He and Mr. Imhoff noted that DOE recognized the importance of partner collaboration and the GMI effort has engaged stakeholders from its conception. Mr. David Meyer added that DOE saw the recent announcement about the grid formation coalition, which includes 17 governors, as a collaboration opportunity and some of the effort's leaders have already expressed interest in working with DOE. The Mr. Imhoff explained that the GMI effort has also identified regional priorities and needs that will be used to inform future efforts and added that the EAC workgroup's effort to frame the legislative and regulatory questions will also be very valuable.

Mr. Paul Roberti, Mr. Parks, and Mr. Imhoff discussed taking variability out of the system through the Clean Power Plan demonstrations, rather than adding reserve margins, and how broader system reliability fit into that effort. Mr. Parks and Mr. Imhoff explained that the GMI demonstrations are designed to find the best options available for specific situations and also have unique metrics, in addition to the asset utilization metric, to ensure reliability.

Mr. Gordon van Welie explained his frustration about discussions of moving towards a hybrid grid without examining the critical components of management and financial accountability at the distribution level. Mr. Parks agreed that the technology for a hybrid grid is very advanced but the financial structure and system operator accountability are not yet there. However, technology is DOE's priority and the goal of the first set of demonstrations is to imbed the best solutions into future thinking and move grid modernization efforts in the right direction. Mr. van Welie and Mr. Parks agreed that no single entity is responsible for addressing all the problems associated with grid modernization implementation but there is a critical educational component to these challenges.

Ms. Pam Silberstein asked if policy and process are parallel issues and how they fit into each other. Mr. Parks explained that DOE is trying to build off of EPSA's evaluation efforts and expects more information on policy to be released in the next quarter.

EAC Member Discussion of the Grid Modernization Initiative Working Group Plans

Mr. Anjan Bose, EAC Member and Working Group Chair, provided an update on the plans of the GMI Initiative working group. Mr. Bose explained that the working group selected three topics to provide EAC comments and guidance on DOE's GMI plans and projects.

Mr. Bose explained that the first topic was the federal role in grid modernization, more specifically, DOE's role in efforts that depend on industry and state acceptance. The second topic was the connection between technology and policy, which is acute in the grid modernization area because of the large research focus on system wide topics. Under this topic, the EAC will focus on how to ask researchers to think about and discuss the effects of different policies on their developing technologies. The third topic was metrics, specifically if the GMI demonstrations are based on real world simulations and if they will provide the correct results and data. Mr. Bose concluded that the EAC would like to provide guidance on how to ensure all the technology being developed has a pathway to industry adoption.

Ms. Phyllis Currie noted that education is also an essential component of DOE's GMI and noted the need to explain, in plain language, the value of a rate increase and what is expected in the future to the general public so they understand and support grid changes.

Valuation and Integration of DERs Panel

Mr. Centolella introduced the Valuation and Integration of DERs panelists including: Bill Kallock, Integral Analytics, Michael Caramanis, Boston University, Deepak Divan, Georgia Institute of Technology, and Heather Sanders, Southern California Edison.

The first panelist, Bill Kallock with Integral Analytics, shared that his company is primarily focused on understanding cost effectiveness of energy efficiency. Integral Analytics' focus has been on avoided costs, but they have realized that the value of DER is based on a much granular avoided cost.

Mr. Kallock gave examples of the customers Integral Analytics has worked with over the last 11 years, including Duke Energy, KCPL, and all three IOUs in California. Mr. Kallock discussed how location of DER matters, and how putting a PV system on one part of the grid is going to have more benefits than the other. Integral Analytics is exploring how one quantifies the benefits.

Mr. Kallock explained that there are four quadrants that Integral Analytics has identified as going into the grid edge avoided costs. They are trying to understand where on the distribution system you can get credit for deferring capacity upgrades. As a company, Integral Analytics is trying to capture all of the benefits and put them into a distributed marginal cost. By using long-term forecasts, Integral Analytics can better understand where the grid is going to be constrained in the future.

Mr. Kallock explained three different approaches his company uses to forecast – Spatial Load Forecasting, Corporate Forecasting, and a Circuit Peak Load Forecast. A graph was shared to represent the different outcomes of the forecasts. The next aspect is understanding the load on each of the circuits and feeders, and what the technical limits are for DERs. Integral Analytics is

currently doing this type of analysis for utilities around the country.

Mr. Kallock proceeded to explain that after understanding what is going on with the load at the edge of the grid, you can take power flow models and snap that down to the customer level load forecast and get a very granular look at the power flow analysis to understand exactly what the limiting factors are.

Mr. Kallock shared some of the lesson learned in California, which include, reliability remains top priority, "Wild West" edge solar development strains reliability and least-cost performance, hosting maps are needed to streamline PV/DER interconnection, each circuit has different operational needs, and 10-year circuit-level forecasts and DER hosting technical limits are foundational. Mr. Kallock ended his presentation by noting that granular analysis is needed to capture full utility benefits of DER at the edge of the grid. Integral Analytics is implementing this type of analysis for utilities around the country, and it is not just theoretical.

The second panelist, Michael Caramanis with Boston University discussed the idea of looking at the dynamic marginal costing on a location basis, which is related to multiple time scales.

Professor Caramanis briefly shared some DER examples and their capabilities, including PV, EV, Space Conditioning, Computing, and Duty Cycle. All of these examples can promise and deploy reserves. Loads and generation has changed with the entrance of DERs and storage-like loads, as well as the prospect of storage and of the broader capability of DER.

At the transmission level, voltage is not a constraint but transmission line congestion is what is important. At the distribution network, there are not hard line constraints but there are soft line constraints which have to do with transformers. Professor Caramanis continued to discuss the interface between transmission and distribution. He shared that it is important to be able to capture the response of marginal costs through transmission leads and the ability to deliver reserves to the transmission system.

Professor Caramanis noted that many people are talking about DLMP, but sometimes the D can be negative. He shared some of the real results that have been obtained by doing a computer study on an 800 bus distribution network. In his closing remarks, Professor Caramanis stated that the interface between physical system and the performance level of the system is very important.

The third panelist, Deepak Divan with the Georgia Institute of Technology, talked about the physics of networks. He shared that there is a lot happening on the physical network that creates volatility that doesn't allow us to do all of the things we want to do.

Professor Divan stated that the challenge is that a lot of money is invested in the infrastructure, and even if the best technical solution was developed, it is not clear that there is a clear path to implementing the solution. He added that data from the field is being looked out, there are some really big gaps beginning to emerge.

As an example, Professor Divan shared real data from a feeder in Southern company territory in Georgia. The data is showing something that doesn't track with the model that every utility uses

to predict what the voltage profile is. Professor Divan stated that gaps are becoming really visible, and the first thing is secondary voltage volatility. The second thing is the desire to have a central control lever, but specific problems are not being solved because different control actions are needed at different control points at different times.

Professor Divan shared that there has been a lot of discussion about technical loss, and we see that loss of voltage, because the reactive power drops, is a major contributor to revenue loss for utilities as well. The lack of grid edge control really impacts the ability to have high levels of PV and distributed energy on the grid. Every time a micro grid has to be put on the system, the utility has to do a recalculation of whether relays are invading or whether VAr currents are being managed properly. This is a major costs and limits the amount of microgrids that can be deployed.

Professor Divan noted that if a system could be managed properly, the distribution grid could be used as a predictable, dispatchable, dynamic virtual resource, and a lot of value comes out of that. He then continued the discussion by sharing examples that show that this can be done. The new paradigm shift is to distributor control, where its non-dispatchable variable edge-up real time control. Professor Divan has seen a significant reduction in technical losses and related loss to revenue, and increased PV hosting because issues can be absorbed locally.

Professor Divan ended his presentation by making a few recommendations, which included the need for incentives to make grid-connected assets inherently grid supporting to preserve investments and maximize value; power electronics research; and new tools to manage the new system; initiate a research initiative.

The fourth panelist, Heather Sanders with Southern California Edison, started her discussion with putting DER valuation in context in California. Ms. Sanders shared that AB-237 required utilities to submit a distribution resource plan by last July, which SCE did. The guidance given by California's Public Utilities Commission included a number of values that DERs could provide, including energy losses, generation capacity, ancillary services, transmission capacity, distribution capacity, environment, and avoided renewable portfolio standard energy requirement.

Ms. Sanders explained that the first thing that has to be examined is the process for distribution planning. Her perspective is that forecasting is one of the most important things, and that planning assumption drives everything else.

One of the challenges Ms. Sanders shared is the distribution plan for load growth, which is done every year for all four regions. Many of the things forecasted out as a need in ten years, eventually go away, or they show up in five years. So not only are the forecasts not accurate to being with, but people did different things.

Something that SCE does is a screening process after forecasting and determining a need. Once projects fall out of the screening framework, SCE then determines that operational requirements and then the attributes that the DERs need to have in order to replace the infrastructure solution. Ms. Sanders also said that an equivalence study is also needed because replacing infrastructure with a DER does not have an equivalent solution.

The next step is to then pilot that equivalence and make sure it actually does what was expected. The last step Ms. Sanders explained gets down to valuing of DER. Using competitive solicitations has been a successful approach for SCE to do price discovery.

Ms. Sanders closed with stating that visibility, motoring, control and investment are all important for the future, but messaging is the most important. It is critical to know and believe that DERs can replace infrastructures.

EAC Discussion of Valuation and Integration of DERs Panel

Ms. Hoffman asked for comments on granular load forecasting from the states perspective. EAC members commented and offered opinions. One member commented that he always started out from the question of fair and equitable starts with what is the economically efficient answer, and then one justifies variations from that. He added that many people start from the perspective of the past, which can produce very different perspectives on the atmosphere.

A question was raised about how one plans for a product that is sold through pop up ads and not by system planning. He added, what is being done with the information in order to get the results that are wanted. Ms. Sanders answered this question by referring back to the importance of forecasting. The system would be planned based on load forecasts that are historical. She also added that SCE has established Rule 21 which are parameters so people with rooftop solar can interconnect and it does not affect the grid and then reflected in the load forecast because it is only historical data. Mr. Kallock added to the discussion by noting that you may have a regulatory or policy issue of handling incentives from having extra money. He added that you do not want to incentivize solar to one customer and not another. Professor Caramanis also made comment about the notion of fairness, and how to depart from the notion of fairness that requires everyone to be treated the same to a pricing or incentive scheme.

Mr. Cowart added a comment that he is convinced there is a middle ground that everyone will get comfortable with without having the price structure reflect the high degree of variability that was evident in the charts Professor Caramanis shared in his presentation.

Mr. Zichella also commented, that we are going to get people who are investing thousands of dollars in technology that does have a boarder system benefit, having this kind of conversation, come to a conclusion about what that sharing should be is the way to go. This is a recommendation made in the EAC Modernizing the Grid report. Mr. Zichella also noted that there needs to be an understanding and better tracking of the changes that are routinely made to the system and the distribution grid.

Professor Divan stated that the models that utilities have are very inaccurate most of the time and it is very complex in any case because you have to take into account the variability of the load and everything else on top of that. What was discovered is that when you start controlling from the edge of the grid, there is a cell balancing property that emerges, where the entire grid becomes well behaved and very predictable.

In addition to Professor Divan's statements, Ms. Sanders noted that when calculating integrated capacity availability, we do it based on normal topology. What needs to be done is not just study that in its normal configuration but in other configurations as well so that the amount of DER that is deliverable can be maximized. This does require complex modeling.

Ms. Reder made comment regarding regular planning and the amount of work it takes. She believes that conversation needs to be held about the skill sets needed. Ms. Reder also noted that on the distribution side, we expect accountability, reliability, and safety, yet there is acknowledgment that that there is more and more back feed on to the system. It seems that the distribution utilities are in a "catch twenty-two" on the operation side. Ms. Sanders responded that Southern California Edison has a whole team working on it and that it is really important. SCE tries to involve operations in the discussions about interconnection and protection schemes and how things are being changed up. Professor Caramanis added that there is a huge difference between the investment at the utility, the distribution utility level, and the types of investments that Professor Divan referred to.

Mr. Brown passed along some information about the micro-synchrophasor development that CIEE is currently doing. From one hundred units being deployed, they have learned that you can see things such as phase imbalances, where relays are open, and what the load is behind a distributed generator with these devices. They are still researching if they are worth it economically or not. Mr. Brown prefaced a question by stating that in Mr. Kallock's presentation, the work that was done was working under the assumption that there would be no reverse power flow in a line, and they came up with the value of distributed generation of that scenario. He believes that there will be a lot of pressure to force reverse power, and asked for thoughts on what would be the increase value and what it would take in physical changes in the grid to be able to allow and capitalize on reverse power flow.

Ms. Sanders responded that reverse power flow has not been a problem for SCE because of the way the system is designed. As part of a demo project, SCE is going to study the reverse power flows impact on the substation because all of the cities have just been circuit to circuit. What SCE is really concerned about is the reverse power flow because you have multiple circuits going into one substation will overload the transformer in the substation because that transformer has a loading. Mr. Kallock shared that at Integral Analytics, the modeling and optimization algorithms allow for switching on the assumption of now power, no reverse power flow or reverse power flow.

Professor Divan shared that his team has done extensive simulations and now have gotten a few feeders running with high solar and they do not see that diverse power flow is a problem.

Ms. Pramaggiore shared her observation that from the collective presentations is that while often in transformation we see technology as sort of overrunning policy or regulation, in this case it seems that policy is in one sector of our business that is really outrunning the technological ability of another sector, which is the grid. So, the technological features of the grid about the ability to economically capture what is being attempted, is limited. She asked if someone who has to operationalize, are there opinions on what might be the critical path on the road map.

Ms. Sanders responded to the question and stated that for SCE the most critical thing is getting the monitoring out there so it is known what is going on, and then getting field personnel trained to know what questions to ask. The second piece, she added, is the analysis, and the third piece is control. Ms. Sanders also added that grid reinforcement is another critical element.
Mr. Mount asked Professor Divan do we need a distribution system operator who decides what needs to be done, and if that is the case should that person work for the ISO, utility, or independent entity?

Professor Divan shared that so far we have treated that utility as our customer and giving the distribution utility the tools to being to do things with heir system that have not been done before. So far, Georgia Tech has worked with utilities, but it is possible for some distribution utilities who coordinate and give it to someone else and then charge for transmission. Companies like Southern Company are starting to use this. Ms. Sanders added that at SCE they see the DSO's as a real natural extension of what the utility does. Operation needs to evolve and the new function is to lay the market on top of that from a retail perspective.

Mr. Morris addressed Ms. Sanders and stated that Edison does a life cycle risk analysis in their integrated research planning, much like the NY utilities. He asked how they propagate the granularity they have with load forecasting and the DER process into that. In response, Ms. Sanders said they are working on it, and they have three ways to look at it – distribution planning aspect from the load growth, planning aspect from infrastructure replacement, and the reliability and risk aspect. SCE has also established a very direct coordination with the reliability planning as well.

Mr. Lauby asked the panel, what kind of tools and guidelines will need to be developed from a planner's perspective? Ms. Sanders responded that from a planning perspective, the planning entities have different objective functions. Transmission planning objective function is simply supply and demand balance and recovering after contingencies. Distribution planning objective is about managing voltage and overload. So, from a grid planning perspective these things can be done this way but coordinated assumptions is needed. Moving to resources planning, we will need to think about the construct for committing and procuring resources for bulk system reliability and what that is for, and when it needs to be available versus distribution.

Ms. Sanders also noted that SCE rolled out their architecture at DistribuTECH conference this year. From an architecture perspective, SCE has tried to push most of the functionality into software and limit the hardware.

Ms. Carmody shared that she is in Maryland, a restructured state, part of the PJM wholesale market. She noted that the processes that were shared in the panel presentations can be a very complicated process that requires a lot of modeling and analysis and granularity to try to get to the point of the most cost effective and reliable way to do things. Ms. Carmody shared that in terms of companies doing distribution planning, a planning process no longer exists in Maryland. Companies are doing planning but it is not transparent to the stakeholders. She asked what would be the top five things the panelists think should be asked to the utilities in terms of distribution system planning in the DER world.

Professor Caramanis answered with a single point that he thinks what is missing is the actual

awareness and calculation of what the costs are by location and time. That essentially quantifies the distributor control, decisions, and investments and allows for a coordinated and efficient way forward.

Mr. Kallock added that in terms of planning, calculating the technical limits are for DER hosting. Professor Divan stated that they work with a lot of utilities now and most of the time you do not see that they have the data to do the analysis to understand what happens when distributed resources are put on the system. He added that the way to structure the solution is to try to get some of the guess work out of it, and if you can understand what your feeder looks like and you have an idea of how much the projected DR load is going to be to host the capacity. Ms. Sanders added that it is critical to be clear about what the goals are, and California has their own goals. Every utility has its planning process and it becomes visible in the rate cases because that is where you get recover for distribution upgrades and it is based on load growth. She added that granular forecasting is critical

In response to the statements, Ms. Carmody noted that since there is not an external transparent planning process, the utilities are planning, but it does not come up in the six month rate case. That level of detail needed does not come out so that type of planning does not exist.

Presentation from FERC Commissioner Cheryl LaFleur

Commissioner Cheryl LaFleur, Federal Energy Regulatory Commission (FERC), provided an overview of FERC's electricity efforts and highlighted the areas of interest to the EAC. She introduced one of her three advisors, Andy Weinstein, who work included ISO NE, gas rates, and enforcement. Commissioner LaFleur also noted that she represents herself and does not speak for FERC.

Commissioner LaFleur explained that a lot of FERC's work is in relation to the change in energy resource mixes occurring across the nation, which are largely being driven by natural gas affordability, renewable growth, state and federal tax, and environmental policies. FERC is working in two major electricity areas, markets and infrastructure.

Commissioner LaFleur explained that markets continue to grow despite energy resource changes and explained how a large part of that growth can be attributed to growing regional collaboration and integration. She discussed how the aging markets are being stress tested to see if they can still bring in new assets to support customers and the work FERC is going in the capacity and energy markets to ensure reliability and appropriate price formation. She added that the grid evolution is in the early stages and changes in the market and how we pay for resources will continue in the future.

Commissioner LaFleur explained that infrastructure is the second main topic FERC is working on. From the transmission side, FERC is examining the success of retracting Order 500 (i.e. creating competitive processes to build the cost of transmission into prices) and reviewing a lot of gas pipeline construction proposals and opposition, which reflects that national debate about fossil fuels. There are also efforts to acquire data so as to develop metrics for determining how to build

transmission in the most cost efficient way.

Commissioner LaFleur explained some of FERC's work on emerging issues around reliability (e.g. cyber security, physical security, geothermal disturbances, electric storms, and the interface between wholesale markets and state policies) and FERC's efforts to make their standards more transparent and robust in order to address the fact that developing standards lag behind emerging issues. She explained that FERC also plays a role in ensuring sustainable reliability on the electric grid when Clean Power Plan rules come into effect and is evaluating how to work with EPA to make the electric markets and infrastructure work under CPP.

Mr. van Welie and Commissioner LaFleur discussed concerns about accountability and reliability with behind the meter generation and the next phase of the policy and wholesale market interface discussion. Commissioner LaFleur agreed that regulators have not been able to keep pace with technology and explained some of FERC's thoughts on behind the meter generation and inclusion of new resources on the grid.

Mr. Brown and Commissioner LaFleur discussed grid capacity in the scenario when renewable generation exceeds consumption and possible short- and long-term solutions to mitigating the potential of negative pricing.

Mr. Tim Mount and Commissioner LaFleur discussed the role of aggregators in changing retail into wholesale customers and Commissioner LaFleur added that California has taken the lead on that topic.

Ms. Brown raised the issue of energy efficiency in terms of state and federal government involvement in behind the meter resources, the CPP, and building new transmission infrastructure. Ms. Brown and Commissioner LaFleur discussed the reasoning behind the Southeast's plan to build a lot of transmission that may be well motivated but not robust, given the anticipated load growth and stakeholder discussions. Commissioner LaFleur added that creating a revenue stream or more targeted state efforts will induce efficiency more than building a substation.

Mr. Zichella and Commissioner LaFleur discussed the benefits of regional collaboration and current regional coordination efforts, in terms of the number of asynchronous connection projects FERC has seen from Order 1000 and citing as a barrier to these efforts. Commissioner LaFleur added that energy is tied into economic development and public opinion through the states and states will not make climate change an energy priority without constituent consensus and motivating factors (e.g. the environment, jobs, rate savings, and federal requirements), which we do not currently have.

Wrap-up and Adjourn Day One of March 2016 Meeting of the EAC

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

Respectfully Submitted and Certified as Accurate,

Susan Tierney
Analysis Group
Chair
DOE Electricity Advisory Committee

8/18/2016
Date

Carl Zichella
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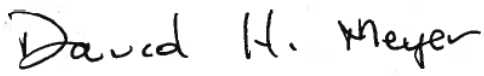

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Date