U.S. Department of Energy

Electricity Advisory Committee Meeting

National Rural Electric Cooperative Association Conference Center

Arlington, VA

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Meeting Summary

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Meeting Summary

This was the second day of the U.S. Department of Energy (DOE) Electricity Advisory Committee (EAC) October meeting. John Adams, EAC Smart Grid Subcommittee Chair, provided an update about the Smart Grid Subcommittee's activities, work products, and priorities. Ramteen Sioshansi, Energy Storage Subcommittee Chair, provided an update about the Energy Storage Subcommittee's activities, work products, and priorities. Gil Bindewald and Sandra Jenkins, both of DOE's Office of Electricity (OE), Advanced Research and Development Division, gave a joint presentation about OE's synchrophasor and sensor research and development (R&D) activities, which set the stage for the panel presentation. This day's panel covered the topic of impediments to leveraging phasor measurement unit (PMU) data and synchrophasors. The panel was moderated by Tom Bialek of San Diego Gas & Electric Company. The panelists included Jeff Dagle of Pacific Northwest National Laboratory, Ali Yari of San Diego Gas & Electric Company, Hamody Hindi of Bonneville Power Administration, and Paul McGlynn of PJM Interconnection. The panel was followed by a question-and-answer session. There were no public comments. Brian Plesser of DOE's Office of General Counsel provided the annual ethics briefing to the membership. The meeting was concluded shortly thereafter.

Opening Remarks

Michael Heyeck, EAC Chair, welcomed everyone for the second day and noted there would be an opportunity for public comments at the end of the day. Mr. Heyeck shifted the agenda to accommodate speaker arrivals.

Smart Grid Subcommittee Update

Mr. Adams, EAC Smart Grid Subcommittee Chair, started by going through what the subcommittee has done over the past few years and mentioned reports that will be coming out in the near future. He emphasized the current events issue of the California wildfires—specifically PG&E shutting off people's electricity. Mr. Adams suggested environmental factors (population and weather patterns) will cause more of these events to occur in the future. He believes the committee should look more in-depth into planning. Mr. Adams brought up OE's priorities and mentioned how the subcommittee is taking these into account.

Mr. Adams discussed the resilience framework that the subcommittee has drafted. The framework was developed because DOE is going to craft a resiliency framework handbook. DOE asked the EAC for a framework to give direction. Mr. Adams motioned to approve the subcommittee's resilience framework. The motion was seconded and moved forward with unanimous support.

Mr. Adams next brought up the Operating Reserves recommendation. He gave the full committee context that further edits were made the day before during a Smart Grid

Subcommittee meeting. The changes were purely grammatical and not substantive enough to trigger a full re-vote. Mr. Adams made a motion that the EAC accept the *Operating Reserves* recommendations. The motion was seconded and passed with no objection.

Mr. Adams pivoted to bringing up data analysis. He suggested we are not using synchrophasors sufficiently. There are three things he would like to see in the future:

1. How to make PMUs part of normal operations.
2. Address workforce development—members are struggling to fill positions with qualified people.
3. Address grid planning in the face of changing environments. He mentioned the factors of a future with an increased amount of distributed resources, changing input and peak times, and scenarios like the California wildfires.

Mr. Heyeck added a comment about the planning process. He mentioned that NERC criteria does not take into account the loss of a pipeline, thus there are factors putting our national security at risk.

Bob Cummings made a comment addressing state and federal coordination. Given his involvement with the Institute of Electrical and Electronics Engineers (IEEE), states, and industry, he said there is clear disconnect. IEEE is putting forth standards but if the states do not adopt them, then they mean nothing.

Richard Mroz talked about a program he implemented in New Jersey to address cybersecurity threats. He was an early adopter, but there are still many states lagging behind that need to update their infrastructure for the threat of cyberattacks.

Wanda Reder followed up by saying that many states are discussing action about how to go about a retrofit. She said something needs to be done now. While this is dragging on, old legacy technology is added to the grid and new smart inverters are being added, but we cannot yet use them properly.

Sheri Givens emphasized the point of cybersecurity and suggested bringing in states (for example, New Jersey) to discuss what actions they are taking.

Paul Cicio brought the conversation back to Mr. Heyeck's point about natural gas pipelines. He emphasized that pipeline capacity is not receiving proper attention and we have to keep a closer eye on export levels affecting the domestic supply.

Dr. Bialek wrapped up this subcommittee report by saying manufacturers and developers have been lacking when it comes to addressing cybersecurity.

Energy Storage Subcommittee Update

Dr. Sioshansi, EAC Energy Storage Subcommittee Chair, said the subcommittee's main focus is the 2020 Biennial Storage Assessment update. He reiterated the two requirements the subcommittee must follow:

1. Every five years, they create a five-year plan for the Secretary about where energy storage should be.
2. Every two years, they provide an assessment of the performance about where the Department is in regards to meeting the goals set forth in the five-year plan.

He gave a brief overview of the previous biennial reports that have been produced by providing the scope of each one. The purpose is to show how they have progressed through the years. The hope is to have the 2020 report published in February 2020.

Dr. Sioshansi then walked through the review process for the 2020 report. There was a webinar a few months ago during which each program office gave a presentation, and in September they had a peer review. Some of the stakeholder groups involved with input include the energy-storage industry, generation industry, and state regulators. He noted they are transitioning how the interviews are conducted. In the past it was by phone, but now it is through a web form and, if necessary, the interviewee will be reached out to for a phone call. This should expedite the process.

Dr. Sioshansi concluded the update by talking about the 2021 five-year plan. He clarified that this report will cover the first requirement the subcommittee must meet. His goal is to build off momentum from the 2020 report.

Discussion About Department of Energy, Office of Electricity Synchrophasor and Sensor R&D Activities

Mr. Bindewald, Director of Grid Communications and Control within the Advanced Grid R&D division of OE, gave background about the start of OE. He then described what synchrophasors are and some of their initial applications. Synchrophasors are great to gain insight into what is happening in a system and can allow for coordinated observability. Mr. Bindewald also mentioned they will help address the challenges of reliability and resilience objectives. As the technology has developed, major areas of success have included interdependency, system resilience, fault detection/failure identification, and behind-meter DER impacts. At the moment, the two areas of focus are cybersecurity awareness and valuation.

Mr. Bindewald said there are five key elements that will be tackled in the next-gen versions.

1. Sensor application
2. Communication related to how sensors come together and integrate
3. Applications (how data informs decisions)
4. Standards (areas of jurisdiction across the board need to be aligned and we have to identify what else is needed)
5. Culture, both internal and external, which he believes is the least defined and most challenging. For sensors to be used effectively, we have to understand how businesses can use them

Ms. Jenkins, General Engineer within the Advanced Grid R&D division of OE, talked about funding opportunity announcement (FOA) 1861. This project uses PMU data across interconnections and shares it with people on both the industry side and academia. She made sure to note that this project does not include national labs. The connection between the industry and academia will push a focus on machine-learning and cutting-edge techniques. An exciting part of the project is that each group that received funding from this FOA is making their research open source for anyone to see.

Currently, we have lots of data but are not utilizing it correctly. Ms. Jenkins provided an outlook for what she expects the FOA project technology to unlock. Overall, it will provide different areas for development in transmission research. A theme of previous speakers that she also brought up is that coordination between systems must take the next step forward. An example of this is to layer the data to relate weather forecasting/weather events with outage data. They want to see system visualization technology and receive user feedback. Ms. Jenkins wrapped up by saying all this data allows for opportunities to understand the science and specifics of how electricity works.

Mr. Heyeck reiterated that we are data rich but information poor.

Panel Session: Impediments to Leveraging Phasor Measurement Unit (PMU) Data and Synchrophasors

Tom Bialek, San Diego Gas & Electric Company, moderated the panel discussion. Before the panel started, Mr. Bialek went over how sampling rates are done at different time scales. The left side was a display of engineering accomplishments. These are the mechanisms being used to collect electricity data. Mr. Bialek concluded by reiterating the data-rich, information-poor mantra. Panelists were:

- Jeff Dagle, Chief Electrical Engineer, Pacific Northwest National Laboratory
- Ali Yari, Director of Grid Operations, San Diego Gas & Electric Company
- Hamody Hindi, Bonneville Power Administration
- Paul McGlynn, Executive Director of Operations, PJM Interconnection LLC

Mr. Dagle's Opening Remarks

Mr. Dagle began by talking about the North American SynchroPhasor Initiative (NASPI). The program got its first unofficial boost in 2002 because at that point data was being collected, but none of the separate entities were sharing with one another. This prompted DOE to start an interconnection program to connect utilities and share their data. In 2006, NASPI was officially formed to connect the eastern and western regions of the United States. NASPI was originally used for identifying time-area benefits of synchronized measurements. During the Recovery Act, billions of dollars in grants were awarded for the recipients to deploy this technology across the country, in an effort to jumpstart it on a large scale, to get it running on a large scale. It was also a platform for utilities to share best practices between themselves and DOE.

Currently, NASPI has three main initiatives they are working on. The first is to improve the networking and communication technologies. This will come with increased scalability. The second is to improve statistical analysis of large datasets. Third, they are trying to increase the amount of measurements being collected per second. The outlook for the future includes promoting synchrophasor activities and keeping their core leadership team.

Mr. Hindi's Opening Remarks

The Bonneville Power Administration (BPA) has an infrastructure that spans 15,000 miles of transmission lines and accounts for 75% of high-voltage transmission in the Pacific Northwest. Mr. Hindi proceeded to give more background of BPA and its major projects. He then discussed the history of synchrophasors with BPA. Synchrophasors were put online at BPA in the early 1990s. Today BPA has 148 control PMUs and 25 data PMUs.

Mr. Hindi pointed out there are three main types of applications PMUs are used for. Engineering analysis is the first. BPA was having an issue that their models were not matching the actual performance of generation. Given PMU data, they were able to recalibrate and create different models that matched real-world data. From this, they were also able to operate the power plants differently. The second application lies within the control room. The main use for this application is oscillation detection. Synchrophasors light up differently on the control room panel and each light indicates a different problem occurring. This data is sent to dispatchers who can

instantly see the type of problem occurring and act both quickly and correctly. This application also entails Island Detection, Frequency Event Detection, and Mode Meter Detection. Mr. Hindi wrapped up by saying big data analysis is the next big thing they are looking forward to addressing.

Mr. McGlynn's Opening Remarks

Mr. McGlynn began by giving an overview of PJM's portfolio that includes 400 PMUs and collects about 42 gigabytes of synchrophasor data per day. He shed light on their decision-making process for synchrophasor placement. Some of the factors included model validation and targeting areas of known stability concern. Mr. McGlynn continued on the theme throughout the EAC that they have a lot of data and now are transitioning to analysis. A main challenge PJM faces is working with members on education to better understand the value of PMU technology. He said buy-in occurred from local transmission owners and generators once PJM was able to show the effectiveness of PMUs through the information they provide. The other challenge is that existing PMUs are limited because they were installed during the Recovery Act grant program so they need to be updated. Mr. McGlynn wrapped up his portion by acknowledging two ongoing issues he is facing. The first is the high maintenance cost of PMUs not allowing them to expand. The second is that troubleshooting is a long, dragged-out process.

Mr. Yari's Opening Remarks

Mr. Yari came from a different perspective on his presentation because he is an operator and end user of the data. He talked a bit about SDG&E's portfolio, highlighting that 45% of their load is already supplied by clean energy resources. California's progressive energy standards are forcing rapid innovation and the dynamic of the operating system is changing along with transmission infrastructure. The addition of synchrophasor technology provided them with real-time data as opposed to seasonal data. Mr. Yari provided a story about how PMU data solved a problem that was not registering with their other monitors. Without this technology, the solution to an outage problem would not have been solved.

The presentation then shifted to barriers Mr. Yari is experiencing. The two that stood out were the lack of communication between policymakers and companies along with limitations for the communication between different parts of grid infrastructure. Mr. Yari then described a few projects they are working on. He emphasized the usefulness of receiving real-time data and a system they have in place that alerts dispatchers of the type of problem that is occurring. This is similar to one of the applications Mr. Hindi outlined.

Questions and Answers

Q1. Mr. Mroz asked the panel a couple of questions. He started with how they are functioning from a cost standpoint and what role regulators are playing in terms of moving forward. He followed this up by asking about legislation that targets a smart grid. Also, what challenges have they seen from an investment perspective?

Mr. McGlynn responded that since installation is not expensive they do not need regulator support. He addressed the high maintenance costs by saying eventually the technology will get

better so these costs will decrease. Mr. McGlynn expanded on this point by saying that once synchrophasor analysis gets up to speed they will be able to plan and model better.

Mr. Hindi emphasized Mr. Dagle's point that instillation is low-cost so there is no need for regulator support.

Mr. Yari believed that standards would help expedite the entire process of a smart grid and synchrophasors.

Mr. Dagle said there is a wide degree of variation between different regions and even utility companies. There are early adopters and companies adding synchrophasors to their infrastructure, while others still believe them to be unnecessary.

Q2. Arthur Kressner offered an observation about synchrophasors and their implementation. He said they offer solutions, but at the same time cause problems. He noted that in real-time we still do not know how to effectively use them and their data. Mr. Kressner suggested that the people on the front lines should have more involvement or input in the development process because they are dealing with synchrophasors first-hand.

Mr. Dagle agreed to this comment and suggestion. He mentioned how big blackouts used to often be the turning point that pushed for innovation and now we have to rebuild that intensity.

Q3. Mladen Kezunovic talked about EMS and PMUs interacting with one another. He then asked a series of questions under the umbrella topic of "where we are heading with PMUs." He said the initial cost of a synchrophasor is much lower than the price tag due to many outside, associated hidden costs. Dr. Kezunovic said he has observed that people want to see how the data they already have is utilized before they consider adding more data.

Mr. Dagle responded that although there are different techniques being deployed by providers, many of them are taking steps forward. This will allow for systems to naturally become better. NASPI focuses on the task of increasing sharing and communication between electric entities. He acknowledged Dr. Kezunovic's point about hidden installation costs by saying depending on the device that is installed the costs will differ. Utility companies are trying to lower these costs and he added that DOE played a big role with pushing down costs in the past. Mr. Dagle concluded by making predictions that convergence will be time-synchronized and data systems integration will be customizable.

Mr. Hindi faces the challenge that when alarms go off to signal an oscillation event they are not being archived. He wants to see auto event archiving as the next breakthrough. Mr. Hindi is optimistic about mode metering development because it allows them to see the health of the present system and in turn give better insight into future events.

Mr. McGlynn said PJM sees great resilience benefits from PMU data in the future, but the dataset is currently not big enough. He sees voltage stability being the next area of focus. Once there is more PMU infrastructure, Mr. McGlynn would like to see a backup system. If one system goes down, they will be prepared.

Q4. Mr. Adams asked a series of questions toward Mr. Hindi and BPA operations. He first asked if Mr. Hindi believes BPA's control room applications should be adopted by the masses and if their development process is internal. Mr. Adams then asked for clarification about what a control grade PMU is. He also asked how BPA's recalibration application works with NERC, and if they plan to share their various applications. Mr. Adams then asked if the PMU data is integrated with EMS data. Mr. Adams went on to ask if they have duplicate PMUs at the same substation and, if so, does that provide value to the stream. Mr. Adams capped off this back-and-forth by asking Mr. Yari if the advanced falling conductor protection he mentioned really exists.

Mr. Hindi said there should be broad-scale adoption of BPA's control room applications. He cited the example from his presentation about the PMU catching the oscillation problem. Their development is mainly internal, but they also receive outside input from a few sources. Mr. Hindi clarified that a control grade PMU is when it goes to the control center and they take action. He said there is a different type where the dispatchers take action. To the question about the recalibration application, Mr. Hindi said it ensures the models match real performance and referenced back to his presentation about when their model was recalibrated. BPA does not have plans to share their application, but Mr. Hindi invited everyone to come and see them for themselves. Addressing the integration question, Mr. Hindi was not fully sure but knows they use PMU data. Lastly, Mr. Hindi said redundancy is valuable.

Mr. Dagle added input for a few questions. The first was in regard to defining control grade PMUs. He said BPA has control and data PMUs then gave examples of each. Mr. Dagle added to the recalibration question by discussing interesting discoveries that have been made from PMU data. He then provided a story showing how the data helps solve problems and have better solution for the future. Anyone who wants to learn about BPA's applications should visit BPA's website.

Mr. Yari also jumped in on a couple questions. To the question about PMU and EMS integration, Mr. Yari said although he does not know their system, EMS and PMU will most likely be different because they are not connected. To the last question, he said they have the protection installed in some circuits.

Q5. Ms. Reder asked what DOE OE can do to help facilitate adoption.

Mr. Yari stated data analytics would be a big help. Currently, the data is there but it is vastly time-consuming for operators to dig through it. He emphasized how analytics would automate this, in turn making people better at their jobs and increasing overall efficiency. He would also like to see EMS legacy systems be addressed in the sense vendors should look at PMU-based EMS.

Mr. Bindewald said he has been open-sourcing his work with EMS. In this, there are three approaches he's been testing:

- NASPI
- Training simulators
- Getting suppliers involved to address workforce development needs

Building off the third point, Mr. Bindewald mentioned a program where DOE partners with several universities across the country to get students involved with internships and other projects both within the agency and at companies within the industry. He also commented that we have to remember that the same data can be used to inform a variety of applications. The data owner might not be the primary beneficiary. He emphasized the importance of sharing data.

Ms. Jenkins noted that when looking at data analytics, it is important to look at how it is developed—because most of the time it is used for business applications. With this in mind, the right stakeholders have to be invited to the table. She specifically mentioned the importance of data scientists. A big question she contemplates is how to make data available while maintaining security.

Mr. Dagle mentioned a few programs they are doing. The main takeaway is that you have to know your audience and target people in different ways to appeal to them.

Q6. Christopher Ayers asked the panel what questions, as a commissioner, he should be asking to evaluate the value propositions.

Mr. McGlynn suggested he ask what they will be using the technology for and what they hope to get out of it.

Mr. Hindi wanted to clarify the cost discussion. The marginal cost of a new PMU is not high, but if this a totally new project the cost will be much higher.

Ms. Jenkins' first suggestion was to ask who and how they are planning on sharing their data. She also said to ask if the data analytics will be done in-house, or if they plan on bringing in outside expertise and, in turn, working with other sectors.

Mr. Dagle said utilities are looking for better information to improve reliability.

Q7. Clay Koplin made a statement about the Cordova Electric Cooperative (CEC) system and some of CEC's various initiatives. It currently has several PMUs online and it has opened the door for many opportunities. A benefit of the system being on a smaller lake is that they have a firm sense of all the details occurring within the system.

Q8. Mr. Cummings began by saying the concern about PMUs used to be about oscillation, but now they have become more digitally focused. He proceeded to give a historical context of innovation. The next phase of this technology and gathering data is knowing when to use hypersensitive testing. Mr. Cummings did give a shout-out to BPA for being successful because of their data sharing program. His question is what DOE can do.

Mr. McGlynn said it would be massively beneficial to have real-time data available for system operators.

Mr. Bindewald replied that it is imperative to be able to put data into context—this follows the theme of "data rich, information poor." Syncrophasors give us the tools to know how the system is operating so the proper action can be taken if necessary. He said we also have to see how data and sensors fit into the entire environment of the system.

Q9. Tom Weaver asked someone to explain what an oscillation is, its cause, and what impacts it can have. He noted that a lot of major events have occurred from either an oscillation or angular separation.

Mr. Dagle gave context that a normal system runs at a 60-hertz frequency. A few outliers run at a different level but they are uncommon. He described that oscillation is rotational inertia of generating facilities exchanging electricity at a certain level. When the system is well-damped, there is no concern. He went onto describe forced oscillation and mentioned problems occur when frequency lines up with electromagnetic inner area modes. If you are only using scada telemetry you would never know a problem is occurring. There are tools now being created to see oscillation and act upon it.

Mr. Hindi added that oscillations can vary in speed and range, which give us the information needed to know how to act. Control rooms then interpret the data and know what to do.

Q10. Mr. Kressner commented that from a consumer point of view, a value proposition that can be asked is: What can the consumer get out of the data? He went on to say that customers are also part of the grid and they too can take action.

Q11. Dr. Bialek asked about how DOE plans to share data especially incorporating network topology as the combination provides better insights.

Mr. Dagle said there are certain things that cannot be shared with the public. Utilities already share information with one another. He brought up DOE playing a big role after the Recovery Act initiative to increase data-sharing requirements in the Western Interconnection. He said DOE is also increasing coordination efforts across the eastern part of the United States. Mr. Dagle discussed a program he is part of to make sure people understand mechanisms of the technology and technical issues, and let them know how to get involved. One problem he sees is that integrating researchers has been tricky due to red tape and concerns about how the data will be used.

Q12. Ms. Denbow asked how there will be assured integrity of electronic data. She found it odd the utilities are asking for regulations. From this, she asked the panel to clarify the real costs for small operators.

Mr. Dagle said that data integrity is covered under NERC's Critical Infrastructure Protection (CIP). As more data is appearing and being shared, he does believe there should be CIP requirements for electric utilities. Mr. Dagle then gave a brief outline about when CIP may or may not be necessary. Addressing the question of cost, he said it depends on various factors, including what the application is used for and what the owner wants to get out of it. He also reiterated Mr. Hindi's point about marginal versus startup cost.

Mr. Heyeck pointed out that the grid is out of date and only hanging by a thread. He thanked DOE for the priorities being pushed and the panelists for their comments.

Public Comments

There were no public comments.

Annual Ethics Briefing

Brian Plesser, from DOE's Office of General Counsel, gave the briefing via teleconference.

Wrap-Up and Adjourn

Deputy Assistant Secretary Chuck Kosak said he was impressed by the last two days and is excited to get to know the members. He reinforced the need to address the severity of security threats and our grid's vulnerability. He thanked the Transmission Permitting & Technical Assistance staff, contractors, EAC members, and those who developed the recommendations. Mr. Kosak said he would like to set up individual calls with each member.

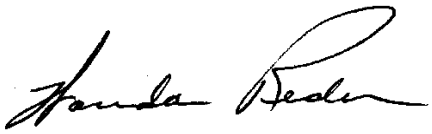
Ms. Reder emphasized her excitement about being part of the EAC. She thanked everyone for their feedback and allowing for productive conversations over the meeting.

Chris Lawrence of DOE noted key action items, including soliciting feedback on the annotated outline for the Smart Grid System Report from members. Mr. Lawrence then closed the meeting.

Respectfully Submitted and Certified as Accurate,

Michael Heyeck
The Grid Group, LLC
Chair
DOE Electricity Advisory Committee

12/05/2019
Date



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