Working Group 1: New Technology Deployment and Grid Integration

Meeting No. 2 – Grid Automation

January 16, 2018

MEETING SUMMARY

[Note: descriptions of comments and discussion are condensed summaries and paraphrases]

Agenda Item I: Why NextGrid?

Working Group Leader Dr. Mohammad Shahidehpour welcomed participants to the meeting and introduced ICC Chairman Brien Sheahan.

Chairman Sheahan - Outlined overall purpose and goals of the study, roles of project participants, and process for working group members and public involvement.

Chairman Sheahan explained the purpose of NextGrid is to define and discuss critical issues facing the utility industry in the coming decade and beyond. The study will:

- focus on trends in electricity production, usage and transactions;
- look at new uses of technology that can improve our state's electric grid and reduce costs;
- identify emerging technological advancements that define grid modernization;
- consider environmental issues;
- look into the need for consumer education;
- analyze grid modernization benefits and challenges for utilities and consumers;
- examine options for legal and regulatory changes addressing the needs of customers as the grid's technology and use evolves.

The purpose of the final report is to provide a comprehensive study that examines the current grid and create a menu of tools, technologies, and policy options for the future. The report is not intended to

determine best path forward. It will track where there is agreement and disagreement, areas of consensus and non-consensus. The goal is not to choose winners and losers. It is to ID issues.

Chairman Sheahan further stated NextGrid is not a docketed proceeding and will not culminate in an order of the Commission. The final report is expected to encourage open and ongoing conversation among participants; educate energy stakeholders, policymakers, and the public; provide a full picture of tools, technologies, policies, and regulatory options available to the state, and consistently focus on how changes will impact customers to ensure a strong, safe, reliable and efficient grid.

Chairman Sheahan explained the Illinois Commerce Commission (ICC) is the project leader and manager of NextGrid. NextGrid is fully supported by Commissioners Rosales and Oliva and new Commissioners will be briefed on NextGrid as they take office. The offices of all commissioners are expected to participate.

Chairman Sheahan introduced Professors Pete Sauer and George Gross from the University of Illinois (U of I) as the Lead Facilitator of NextGrid. They will work with the ICC and will be tasked with producing the final report.

Chairman Sheahan also introduced Marty Cohen and Annette Beitel as Senior Consultants to NextGrid. They will provide support to working group leaders and assist in planning and execution of meetings and materials. Annette will also organize and facilitate meetings of the Technical Advisory Group (TAG) and the Stakeholder Advisory Committee (SAC) on a monthly or bi-monthly basis.

Chairman Sheahan described the process of the working groups. Seven working groups have been identified and tasked with focusing on specific areas of NextGrid inquiry. Each working group is responsible for drafting one chapter of the final report, which the Lead Facilitators will compile into a final draft report to be sent to the Commission.

Key questions to be addressed in the NextGrid process include:

- What are the current capabilities and challenges of new and emerging technologies including renewables, storage, microgrids, and electrification of transportation and other sectors?
- What are the challenges and opportunities posed by increased deployment and penetration of these new and emerging technologies?
- How can reliability and resiliency be assured in the face of increasing demands on an integrated grid?
- How should the utility functions evolve to enable the integration and growth of new technologies?

Chairman Sheahan explained that, to encourage frank, open dialogue and enable a workable process, the number of participants in each working group will be limited. Nominations for membership in the next six working groups are being taken by ICC staff. The selection process will be managed by the ICC, facilitators, U of I, and working group leaders.

To encourage public engagement, all working group meeting agendas and meeting summaries, will be posted online for public comment. The public is invited to submit research and comments which will be posted for consideration in the NextGrid process.

Chairman Sheahan announced that at least three public meetings will be held to report on NextGrid and take public input. These are anticipated to be scheduled in southern Illinois, central Illinois, and the Chicago area. The final report will be posted on the NextGrid Website.

The floor was opened for questions to Chairman Sheahan.

- **Q1:** Question regarding the ultimate audience of the report and whether NextGrid will result in a docketed proceeding or recommendations to the General Assembly.
- **Q1 Responses**:
    - The audience is the public in general. This includes legislators, consumers, and all stakeholders and interested parties.
    - What is intended is a thorough, fair, and balanced investigation into emerging technology, its impact on the grid and its users, how it is changing, and how it will impact the energy infrastructure as well as our regulation of it. Ultimately the report will be about how this evolution will impact Illinois consumers and what are the options to address it.
    - The goal is to do our investigation in a transparent way, and for the report to reflect all viewpoints.
    - The NextGrid report will not be geared toward the opening of an ICC docket or intended to result in legislation or to be a blueprint for utility actions or investments. Anybody of course may use it to support a viewpoint for whatever purpose, but because all views will be included, the content of the report may also be used to present different sides of policy arguments.
    - Facilitator Sauer from U of I added that a major part of the challenge is to provide education for stakeholders and the public about opportunities for Illinois energy users and the current and projected future state of technology, and what the key issues are and what we can and cannot do. Education can provide a clear understanding of what we may want to do as grid modernization occurs.
- **Q2:** Question regarding overall process, report drafting, and public involvement.
- **Q2 Responses**:

    From Chairman Sheahan: More than 200 people initially applied to participate. We made sure that all perspectives are represented in the first working group by including a diverse group encompassing a wide range of expertise, industries, customers and stakeholders. NextGrid is not a class you will audit, and we appreciate that so many people have volunteered their time to work on it. We want real production from working group members; written submissions, presentations, involvement. This is not an adversarial proceeding; it is an attempt to come to agreement in defining the issues facing us and the options going forward.

    From Working Group Leader, Dr. Shahidehpour: We circulated a draft chapter initially to have a focal point for initiating discussions, not as a proposed endpoint. Comments thus far have been very insightful and much appreciated. The specific questions raised by Chairman Sheahan are at the core of our work and the answers we arrive at will be central to the New Technology and Grid Integration chapter as it is drafted through the working group process.

Agenda Item II: Opening and Introductions

- Working Group Leader Dr. Shahidehpour introduced presenters. The slide decks for their presentations are attached to this meeting summary and posted on the NextGrid site and should be viewed to gain a full understanding of the presentations. The following are general summaries.

Agenda Item III: Presentation by Ralph Masiello *(Industry Expert, Quanta Technology)*

Fundamentals of Distribution and Transmission Grids.

- High level overview for those not familiar with current grid system design and architecture.
- The grid architecture today is similar to the way it looked in 1920: Largely central station generation connected to a high voltage transmission system (125 KV and above), which provides power to distribution substations which step down voltage to user levels. The distribution system consists of substations, wires, poles, transformers and other equipment to bring the power at necessary voltage to customers. it is a radial network.
- Transmission is generally above ground because air is good insulator. But in some cases, where overhead is undesirable or not feasible, transmission wires are placed underground. Medium voltage, especially for longer distance transmission, is generally overhead, but also can be underground.
- Distribution operations, as opposed to bulk transmission and market systems run by regional transmission operators PJM and MISO), require continual hardware maintenance, changes, repairs, and upgrades – which is why you see utility trucks in almost any neighborhood on any given day.
- When there's an outage, in the old world you called the power company and said lights are out. That would be how the electric company finds out the location of an outage. In the new world: AMI knows when your lights go out. And distribution automation can often get the lights back on without dispatching a truck.
- Distribution operations are changing a lot. As we get more distributed generation, rooftop PV, combined heat and power, behind the meter storage, the power flow on the distribution system isn't one way anymore. But today's circuits were not designed for reverse power flow and to accommodate tremendous growth of renewables and DER, the distribution system must become more intelligent.
- The second big change in distribution systems: the technology for switching and management of system. AMI today and smart switches and other intelligent devices provide a foundation for DER, improved power quality, resilience and reliability.
- Department of Energy slide shows an overview of the new modern system architecture and how DER functions in the network.

Agenda Item IV: Presentation by Shay Bahramirad *(Director of Distribution Planning, Commonwealth Edison)*

ComEd Distribution Planning

- The ComEd system is designed to meet a peak that is anticipated to occur once in ten years. We have system design criteria. For example, distribution feeders are planned to be loaded at no more than 105 percent of normal capacity. We employ several planning cycles: 2, 5, 20 years over which we forecast loads. We consider historical value, market data, load growth and other trends such as construction of data centers, residential development, activity reports, contracts and other obligations
- ComEd has a large and complex integrated system, with 5,000 distribution feeders and 800 substations in our territory. When planners forecast they look at many technical issues about future load including needs for switching between feeders, load balancing, phase, voltage corrections, reconductoring, system upgrades, transformers and new substations.
- The grid is changing. The Grid of the future will be more distributed, connected, and efficient, have an increased focus on multiple design objectives including resiliency in addition to reliability, and environmental outcomes in addition to incorporate increased visibility and controllability.
- The planning processes will adapt to the new characteristics of the grid and will include and adapt to the penetration levels of new technologies and functions. The traditional load focused planning processes adapt to integrate distributed energy resources and grid edge consumer participation, employing granular and time-series based planning to deal with not just the demand for the peak day but all 8760 hours of the year. We use sophisticated optimization models incorporating real time data and monitoring to ensure resiliency, granular understanding of system dynamics and the ability to integrate customer-side resources.
- Efficiency is key. We must be able to optimize the system under any conditions. R&D is essential to and test different solutions so that we can learn how to make better long-term decisions.
- System will need to be customizable, providing for customers to be active participants on the grid, deploying demand response, storage, microgrids, and other distributed resources. Future grid will need more visibility of what's behind the meter and increased control capabilities. The planning process must adapt to accommodate these new technologies and customer requirements.

Agenda Item V: Presentation by Mike Abba *(Director, Smart Grid Integration, Ameren Illinois)*

Role of Illinois Utility in the NextGrid Development

- The utility grid is beginning a period of rapid evolution. Today's grid is already yesterday's grid. tomorrow's grid must accommodate DERs, must be seamless, must allow universal access for all customers to participate in developing markets. The utility must look at everything from transmission to the end use customer because we are responsible for reliability of the system.

- We know the direction but we don't know how fast we are moving toward customer devices interacting with grid, connected in-home devices, microgrids, electric vehicles, behind-meter solar and other innovations. We know that grid operations will get more complicated and we must be up to the task.
- As discussed earlier, our operations have already changed due to AMI and other installed technology. We used to have a big board with maps and who to call to find out what the problem is. AMI and system sensors provide real-time visibility - tells us who is out and gives operator right info or takes action automatically.
- Specific to Ameren:
    - Six coal plants have closed in recent years. Among the operational challenges this poses is voltage/VAR support. During the same time frame, we have new wind farms and solar farms and these will continue to grow under FEJA legislation. We are working with MISO to make sure transmission system can do its job and are also factoring in distribution system changes such as declining load in some places and reverse flows due to distributed generation.
    - Ameren has 46,000 miles of distribution wires, mostly overhead, some underground. AMI will be fully implemented in 2019 for 1.2 million customers. As grid operator, we use this data for reliability, resilience and power quality. We have more robust communication under development including fiber, mesh network, private LTE, providing communication with thousands of network devices.
    - Substation monitoring and control is changing. While we still have some distribution substations that don't know what is going on until you go there to look at it, it is improving as new technology is deployed. We are automating distribution using equipment including intellirupters, new sensors and other monitoring and control devices to make the increasing complexity, including two-way power flows, manageable.
    - Trends toward DER will continue under SB 1652. We have 60 applications for larger solar installations connected to our distribution system, and 200 pending.
    - More sensors will provide greater visibility and system information to provide improved reliability and faster response in storms.
    - We understand that customer expectations are rising in a digital world. Customers want reliability and instant information and response
    - Also, crucial to maintain affordability. Electric system must be economic for all parties involved.
- Regardless of how fast this is going, Ameren still has role as utility to serve customer needs, maintain safety and reliability of system. Power must be high quality, affordable, and efficient and provide opportunity to participate in markets that may develop in future.

<u>Agenda Item VI: Presentation by Wanda Reder</u> *(Chief Strategy Officer, S&C Electric)*

Role of Distribution Automation in NextGrid Development

- S&C focuses on medium voltage switching, protection and control, distribution automation and other electrical equipment.
- Tomorrow's grid will be integrated. Its transformation has key drivers: environmental considerations, changing fuel mix, declining technology costs, distributed resources, more demanding customers and increased expectations. Other trends include mega storms and need for greater resiliency. Cybersecurity concerns are also real and significant. As we have discussed, the grid is no longer radial in nature and flow is increasingly multi-directional. System will be less substation-based and will require more decentralized architecture and control, accommodating peer to peer communications, though still probably with centralized oversight.
- Distribution operations must be more automatic and dynamic, system balancing needs occurring in real time, microgrids coming on – perhaps controlled by customers rather than utility. Many technical challenges must be addressed to make that happen. Managing local generation and 2-way power flow requires advanced strategies for system protection, voltage support, system inertia.
- Digitization means higher reliability and power quality required – must minimize blinks/momentaries; must seamlessly manage and balance loads, supply, microgrids, DER.
- Limitations of central system are very real from control infrastructure and communications perspective; move to distributed architecture is needed.
- Example of how to evolve distribution system: Distributed intelligence using Intellirupter technology includes pulse closer to address faults, reenergize as much as possible, sense voltage, allow dispatch capability to location. Using software/hardware can restore in seconds, can be upgraded so is future-proofed for long term. (Chattanooga example of quick restoration times shown – six minutes rather than four hours). ComEd and Ameren have seen similar benefits from this technology. 2011 SAIDI (duration of outages) was 110 minutes, now down to 50 min on average. 2011 SAIFI (frequency of outages) was 1.5 outages per year, now average one outage every other year. In addition, this technology positions utility well for future DER expansion because of two-way power flow capabilities.
- Community microgrids such as Ameren's, IIT's make Illinois a frontrunner in this area, show how distribution automation is advancing.
- Funding distribution automation is not easy but it is essential. Utilities across the nation are saying the connections are going up, but load is holding steady or going down. This trend presents a threat to the traditional utility business model, which has relied on increasing loads. As load plateaus, pressure on utilities to reduce costs comes at a time of growing needs and demands.
- For utilities, it is easy and tempting to pick the least expensive approach to meet immediate needs. But we have to look down the road 5-10 years, investing to both meet needs we have today while also looking to the future.

Agenda Item VII: Topic Discussion

- **Q1:** The grid works well, why do we need new technologies?
- **Q1 Responses:**

- New technology must provide value to customers. The question is can we continue to improve reliability and efficiency, by using sensors and controllers to cut operational costs and a keep downward pressure on rates? Investments in new technology can save money for customers and allow integration of DERs.
- A big driver of change is PV adoption. And as electrification increases and moves to new areas such as transportation and digitization advances, customers want consistently high-quality power.

- **Q2:** The General Assembly has already given green light to utilities for investments in tech through EIMA. How do we ensure that utilities are investing in the right equipment (such as reclosers)? If the grid is getting more efficient and electricity usage is flat or decreasing, shouldn't the cost of electricity be decreasing as well?
- **Q2 Responses:**
  - Are the technologies addressing DERs? Load may be flat, from a system perspective, but system planning must look at granular level of the feeder. Utilities must plan for peaks and periods when load is minimal and solar production - two-way power flows - is maximal. DER presents planning and operational challenges that involve grid stability.
  - Overall throughput may be going down, that does not mean that lower usage in some areas will allow for overall lower costs. There are always pockets with capacity growth and new system needs. However, we want to use technology to keep downward pressure on rates as much as possible.
  - Other states can learn from Hawaii, where the system couldn't handle level of PV and they had to prohibit new installations.
- **Q3:** New technologies like blockchain and others, and offerings from Companies like Google and Tesla, others may not assume that we will always have a monopoly distribution system.
- **Q3 Responses:**
  - Planning for the future is about integrating new technology and allowing for innovation. The utility must seek to enable and integrate technologies in a way that helps planning and system operation and provide value to customers.
  - The role of utility might be different depending on the technologies and markets that develop. But we remain responsible for reliability, voltage support, and power distribution through the grid. Utilities must maintain service to customers while accommodating competition and integrating new technology.
- **Q4:** How granular is the data you need on power, voltage, to feed the models you've described? Locational, temporal, power quality data -- How does it compare to what we have today?
- **Q4 Responses:**
  - Large amounts of data must be collected from the grid to have the granular analysis we're talking about – many different times and locations and domains of data, beyond what is collected today.
  - On the grid, location always matters.
  - Integrating new IT and other systems may be the greatest technology challenge. R&D is needed, as is workforce training.

- **Q5:** If third parties are to be able to deploy new solutions for what have been utility functions, there are lots of building blocks that need to be put in place, including compensation mechanisms. What are the ways to move in this direction?
- **Q5 Responses:**
    - We must move away from just accommodating DERs to integrating them into operations. The workforce must be trained for such a new approach, which requires a new mindset.
    - Locational value of resources is a complicated and essential new challenge for regulators.
    - Rebates and NWA incentives must come with performance monitoring and guarantees.
- **Q6 Summary:** Rooftop solar, EE, storage all reduce demand. Some circuits can handle reverse flow. EVs help environment but shift fuel from oil to electricity and result in increased demand. Need to look at all aspects.
- **Q6 Responses:**
    - Electrification and switch from fossil fuel services is underway and will improve the environment and be better for customers and economic in long run. Eventually EVs may be modeled for the system like a mobile battery and provide DR services.
    - Electrification trend goes beyond transportation. Grid services should be seen as a part of the scope of DER.
- **Q7:** FEJA will soon start bringing higher levels of renewables and DER. Can you speak to what are top areas where the state of technology is not yet where it needs to be, or is it in a state of critical evolution to a point where DER can be fully enabled?
- **Q7 Responses:**
    - The systems are not yet available to manage and balance load and generation at the microgrid level seamlessly. Software to manage transactions across the network is still not developed so we don't know yet how one could set up a transactional platform.
    - It is easy to install pockets of technology, but hard to integrate it all, because it involves communications and time domains in modeling and data space. Ideally, different planning horizons need to be thought of in aggregate.
    - We have low cost wireless communication and other technology available but the architecture and policies and business needs don't necessarily line up. Policies to integrate DER that require information to be provided to the utility by third parties may cause commercial concerns about interference in markets.
- **Q8** How have smart grid investments thus far affected reliability? What are their costs and benefits?
- **Q8 responses:**
    - A large portion of Ameren EIMA spending is going into AMI; also system upgrades including more intelliruptors, monitoring and control devices, automation on circuits, infrastructure pole hardening to prevent wind and trees damage. Improvements in

reliability have occurred and AMI is benefiting customers. Other future investments will have to be mapped out as we progress forward.

    - Half of ComEd EIMA funded modernization efforts have been in smart meters and half to modernizing the system to make it more reliable and resilient. These new investments have resulted in the best reliability to date.

- **Q9:** We won't get mass adoption of EVs until we have charging stations, but we won't get necessary infrastructure investment until we have mass adoption. Chicken and Egg?
- **Q9 Responses:**
    - EVs can be beneficial in many ways and infrastructure may be needed. However, there may be different ways to deploy and fund it.
    - Utilities can identify optimal locations for EV infrastructure from the perspective of traffic as well as system opportunities and hosting capacity. But we should look also at the bigger picture of electrification.

The meeting concluded with an invitation from Dr. Shahidehpour for participants to comment on the presentations and discussion and to attend the next Working Group meeting scheduled for January 30.