NIST SMART GRID ADVISORY COMMITTEE (SGAC)

MINUTES OF JUNE 4-5, 2019, MEETING

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

GAITHERSBURG, MARYLAND

ATTENDANCE

NIST Smart Grid Advisory Committee Members
Centolella, Paul (Chair)
Cosgriff, Kevin
Donaldson, Heather
Fine, James
Gracio, Deborah K.
Handley, Jason P.
Holland, Michael J.
Kiesling, Lynne
Lee, Audrey
McDonald, John D.

NIST Staff
Anand, Dhananjay
Bilil, Hasnea
Boynton, Paul
Burns, Martin
Gopstein, Avi
Greer, Chris
Guo, Wendy
Hastings, Nelson
Holmberg, David
Lee, Kang
Linn, Thomas
Nguyen, Cuong
O'Fallon, Cheyney M.
Song, Eugene
Wollman, David

Others
Ansari, Arif
Burkhardt, Robert, PDV Wireless
Hughes, Patrick, NEMA
Marchionini, Brian, NEMA
Villarreal, Chris, Plugged in Strategies
Warren, Arthur, DOC

<u>Welcome and Introductions – *Dr. Chris Greer, Director, Smart Grid and Cyber-Physical Systems Program Office*</u>

Dr. Greer called the meeting to order at 9:00 a.m. Dr. Greer provided safety and security instructions and then requested introductions from all present.

<u>Comments from the Chair – *Mr. Paul Centolella, Chair, NIST Smart Grid Advisory Committee*</u>

Mr. Centolella stated that the smart grid community is at a critical juncture. NIST is about to complete its Smart Grid Interoperability Framework 4.0. It is a significant advance, relative to Frameworks 2.0 and 3.0. Notably, Framework 4.0 focuses on the smart grid as a cyber-physical system. The revised Framework comes at a time when developments are accelerating in the power industry and our economy. NIST’s work in coordinating the development of frameworks for interoperability should continue.

<u>Smart Grid and Cyber-Physical Systems Program Update – *Dr. Chris Greer, Director, Smart Grid and Cyber-Physical Systems Program Office*</u>

Dr. Greer underscored the importance of NIST's mission, as mandated by the Energy Independence and Security Act of 2007, and the committee's role in helping with that mission.

Related to cyber-physical systems, NIST focuses on three areas, because of their associated challenges: 1) smart grid; 2) automated driving systems; and 3) smart cities. NIST's efforts in these areas involve experimentation and measurement science, with its Smart Grid and Cyber-Physical Systems Testbeds supporting.

<u>NIST Smart Grid Advisory Committee Report – *Dr. Mike Holland, Member, NIST Smart Grid Advisory Committee*</u>

Mr. Centolella introduced a committee report, stating it was prepared as advice for the NIST Director to help inform his communications with the Secretary and the Administration. As head of the subcommittee which prepared the report, Mr. Holland presented the subcommittee’s findings on the impact of smart grid program activities. The report addresses the importance of the smart grid's interoperability standards and the role that NIST plays in coordinating their development. The subcommittee endorsed NIST's role in this effort and noted industry areas that benefit from these standards.

Not only is there an enormous change in the domestic power sector, but globally, as well. The report emphasizes the need for the U.S. to remain engaged in setting international standards, and that NIST has played an important role in doing so. While the NIST Smart Grid program has a role in developing domestic standards, it also has a role in developing and harmonizing them internationally.

During the discussion, committee members pointed out the efficacy of previous Smart Grid Interoperability Frameworks as examples of NIST's tangible impact. One member noted that past frameworks were key to the widely used IEEE 1547 inverter standards. Other members believed that the interoperability frameworks were central to accelerating the development of the IEC 61850 standard. NIST also contributed to ensuring privacy standards for the smart grid, specifically NIST IR 7628, Volume 2, July 2010. One member stated, it is one of the best, well-informed documents on privacy in the industry. Additionally, one member pointed out the significance of NIST's analysis of the testing and certification landscape in the draft Smart Grid Interoperability Framework 4.0. It is an example of how NIST shows what needs to be done regarding the future smart grid. Another member stated that NIST's analysis of the testing and certification landscape is invaluable. After the subcommittee received feedback from the full committee, a revised subcommittee report was accepted with unanimous approval of the full committee on day 2 of the meeting.

NIST Smart Grid Framework Overview & Conceptual Models – *Mr. Avi Gopstein, Associate Director, Smart Grid & Cyber-Physical Systems Program Office*

Mr. Gopstein stated that the Smart Grid Interoperability Framework is based on NIST's congressional mandate, the Energy Independence and Security Act of 2007. He reviewed the methodology used to develop the 4.0 Framework, noting how it differed from previous ones. He also reviewed the organization of the 4.0 Framework, which included its chapters and subjects. Moreover, Mr. Gopstein pointed out how grid interoperability is changing, and how the 4.0 Framework can guide stakeholders in adapting to that change. Notably, NIST made major updates to the 4.0. Framework. Its models now reflect a scenario-driven examination of system interfaces. It also includes an ontology, providing common reference language which can be used by stakeholders to facilitate interoperability. For more details, see Mr. Gopstein’s presentation.

During the discussion, a committee member appreciated the revised framework’s focus on function, rather than identity. Another committee member said that the system, seemingly, is becoming increasingly fractal. Consider a consumer, like a college campus, that has distribution, generation and an operations center. It may even have an internal market and services that are provided to it. Mr. Gopstein stated, that was the reason the microgrid communications pathway scenario was created. You can't have one diagram that is good for everything. Thus, we created many diagrams. The customer domain has subdomains, which include local, on-site generation, control and interaction, as well as, many loops for power and communications interoperability.

Dr. Greer stated, that we view these diagrams from an interoperability perspective, both physical and information. We focus on how these domains interact with one another. We’re thinking about interoperability issues, the challenges, and how we lay those out. We help designers, operators and regulators – understand interoperability. One committee member said, the economic driver is asset utilization. There is a need to create ways to integrate control and coordination, integrate DERs, and better operate the overall system. Currently, asset utilization averages about 50 percent in the power sector, compared to over 70 percent in other capital-intensive sectors. Some committee members questioned whether the conceptual model could be updated to emphasize the increasing importance and role of customers in the electric grid, and as the drivers of changes in services and business models.

NIST Smart Grid Framework Operations Chapter – *Mr. Avi Gopstein, Associate Director, Smart Grid & Cyber-Physical Systems Program Office*

Mr. Gopstein began by saying that the operational dynamics of the grid are changing. Specifically, the dynamics of the grid are changing, and most of what is occurring on distribution feeders has very little to do with the increasing penetration of distributed generation. Changing consumer loads, including the use of solid-state electronics throughout the grid, is creating uncertainties. We are only beginning to understand the need for observing these operational conditions. Moreover, how the grid control paradigms can be updated to mitigate this emergent physics demands exploration. Interoperability is changing and will be critical to grid operations. Control schemes rely on interoperability and require updating. The need for timely observation and control across the system is driving interoperability requirements. Additionally, stakeholders have identified to NIST a large number of interfaces for which interoperability must be improved, including: electric vehicles, microgrid controllers, customer storage, customer devices and smart meters. Lastly, regulators and utilities view interoperability as a hedge against asset obsolescence. For more details, see Mr. Gopstein's presentation.

During the discussion, a committee member stated that some in the public and private sectors don't understand that establishment of standards is a continuing process and not an end-state. Some also lack confidence in interoperability. Additionally, some have a limited understanding of new interactions. For example, with deployment of solar panels on distribution nodes, planners, regulators, and utilities will plan distribution assuming that all solar goes off line at once and the utilities will have to serve all the load on that line. The consequence is, they overbuild the distribution system.

Ethics Briefing – *Art Warren, Senior Attorney, Ethics Law and Programs Division, Office of the General Counsel, Department of Commerce*

Mr. Warren addressed the ethics rules that apply to special government employee members of federal government advisory committee.

NIST Smart Grid Framework Cybersecurity Chapter – *Dr. Nelson Hastings, Group Manager, Applied Cybersecurity Division*

Dr. Hastings began by covering the research and stakeholder feedback underlying the cybersecurity chapter in the Framework 4.0 draft. He then addressed the grid's general cybersecurity needs. They include the categories of logical interfaces related to the grid, which are vulnerable to cyber threats, thus requiring cybersecurity. The emergence of architectures with distributed energy resources also introduces new logical interfaces, which must be considered. Based on need and stakeholder inputs, NIST developed a cybersecurity risk profile for the smart grid; it consists of core cybersecurity functions as well as desired outcomes from the NIST cybersecurity for critical infrastructure framework. For more details, see Dr. Hasting's presentation.

During the discussion, a committee member commented that in industry, security is not a business objective. Consequently, an adversary could sit on the network, doing nothing but gathering information that could hurt customers. One committee member stated that microgrids have had third-party developers. The focus for years has been on data requirements and not on that third-party link, from a cyber security perspective and as a potential backdoor. There is a lot of focus on that now – looking at connection agreements. That's something that should be emphasized. Another committee member said the NIST framework could have aided their organization's assessment of vulnerabilities behind-the-meter. NIST's Framework helps focus on what is needed.

NIST Smart Grid Framework Economic Chapter – *Dr. Cheyney O'Fallon, Economist, Applied Economics Office*

Dr. O'Fallon stated that interoperability expands the smart grid's value network and creates innovation opportunities. Specifically, interoperability allows technical barriers to be overcome, as well as, supports the marketing of existing, and new smart grid services. It empowers customers, enabling them to be better informed about electricity use, reduce their costs and even sell electricity back to traditional providers. Interoperability can counter rising production and transaction costs. Additionally, testing and certification of interoperability can instill trust and confidence in stakeholders, further expanding opportunities. For more details, see Dr. O'Fallon's presentation.

During the discussion, a committee member said that to be interoperable in the utility sector, we have to make major changes to the architecture, going from proprietary, to open source software. The utilities have asked for proprietary systems, thinking that they were secure. However, this can result in vendor lock-in, limiting the ability to respond to changing needs and technologies. Open source, in many cases, can provide greater flexibility. One committee member provided an example of a safety standard that was created, based on a company's intellectual property, making it difficult for other companies to meet that standard.

NIST Smart Grid Framework Testing and Certification Chapter – *Mr. Cuong Nguyen, Lead, Smart Grid Testing and Certification*

Mr. Nguyen explained the importance of testing, stating that it provides facts to support claims of interoperability, which is what users seek. He further explained the difference between conformance and interoperability testing; levels of interoperability; the testing and certification process; and three certification regimes. Mr. Nguyen pointed out that this chapter includes an analysis of the testing and certification landscape, as it relates to smart grid standards. The analysis found that of the 240 standards reviewed, only a small percentage have testing and certification programs, existing or planned. For more details, see Mr. Nguyen's presentation.

During the discussion, a committee member asked how hard it would be to get one standard output for all of the labs, who also provided an example of how Nationally Recognized Testing Laboratories (NRTL) differ in reporting. California has a list of inverters that must meet green programs requirements. However, every NRTL has a different report. California's Energy Commission often has said that a NRTL did not test a particular function, requiring the vendor to find another lab. This is a process problem. Each jurisdiction has its own requirements, stated a committee member, but vendors are manufacturing to all of those, creating inefficiencies. Another committee member said, we are seeing a delay in testing. California's doing one thing, Massachusetts another, and some don't have many requirements.

Committee members see a need for industry to agree on standardized requirements. One system may have data, communications and hardware requirements – which can vary between states. These multiple standards for a system pose challenges for buyers and testers. Vendors also want specific requirements, as these reduce risks. Broad agreement on standards will facilitate grid modernization. At our organization, said a committee member, we bring in all these devices to find out which work; most don't. Another committee member said, our lab tested nine inverters. One worked. An example of first party certification is Europe, said another committee member. They do a lot of self-certification. According to the Testing International Certification Group, they are finding error rates of more than 40 percent. It's probably a limited sample, so it is likely higher.

Committee Discussion on NIST's Coordination with Federal Agency Partners

Mr. Centolella addressed the future of the grid for the purpose of stimulating discussion and thought on how the committee might advise NIST in the decade ahead. He also observed that many are working on tomorrow's grid, but greater collaboration is needed.

Mr. Centolella sees the future grid needing five things:

- Affordability: This implies better asset utilization.
- Reliability: This is critical for an economy, that increasingly depends on electricity
- Resilience: Able to adapt and reconfigure resources when disruptions inevitably occur
- Defend, deter, and recover from continuously evolving cyber-physical security threats
- Transition to an environmentally sustainable, low greenhouse gas energy system

One committee member noted that many in the sector are moving from a system with a relatively modest number of large generators and flow gates, that a regional operator is looking at, to a system where an individual distribution operator is looking at millions of devices, hundreds of thousands of electric vehicles, and thousands of megawatts of distributed resources. One result is a highly complex architecture.

Another committee member said, we are taking a very complex grid, and making it even more complex, and bringing it down to the customer level, which we have never done before. The degree of coordination necessary to manage this is very complicated.

End of Day One

The committee adjourned for the day at 5:00 p.m.

<u>June 5, 2019</u>

<u>5-Megawatt Solar Array Tour</u>

The committee saw, firsthand, NIST's new solar array, which helps power the Gaithersburg, MD campus. It also is instrumented to collect real-time performance data to allow smart grid researchers to study methods for measuring electric grid systems as they evolve to accommodate new and more diverse resources such as solar arrays.

<u>Research Presentation: Instrumentation and Monitoring for NIST Resources – *Dr. Dhananjay Anand, Researcher, NIST Smart Grid Program*</u>

Dr. Anand's presentation complimented the committee's tour of the solar array. Distributed energy resources have differing performance parameters. A central issue is understanding how these resources could be best managed to maximize their beneficial impacts to the system, especially since they operate on the edge of the grid. Addressing this issue entails measuring their performance, using simulations with hardware, and emulations. NIST uses hardware on its campus to measure and validate the performance of distributed energy resources. Specifically, its smart grid testbed is tied into the 5-megawatt solar array, another solar array on a building roof top and a data pipeline and repository, all on the NIST campus. For more details, see Dr. Anand's presentation.

<u>Research Presentation: Lessons Learned from Hurricane Irma – *Dr. Cheyney O'Fallon, Economist, Applied Economics Office*</u>

Dr. O'Fallon researched and evaluated the operational resilience of Florida's improved grid interoperability, after experiencing Hurricane Irma, in September 2017. The amount of advanced metering – or smart meters – deployed in Florida's counties was used as a proxy for smart grid interoperability investments. Dr. O'Fallon then assessed the number of hurricane-related long-term power interruptions against the number of smart meters deployed in the counties. Dr. Fallon found that counties with high numbers of smart meters had reduced power outages for a given increase in wind speed, while those with fewer or no smart meters had increased interruptions. Dr. Fallon also reported that the operational resilience benefits from improved interoperability in Florida during Hurricane Irma was between $1.3 and $1.7 billion. For more details, see Dr. O'Fallon 's presentation.

During the discussion, committee members noted that the study informs in several ways. The study could benefit the Department of Homeland Security's ongoing research in this area. The smart meter effect also is a proxy for other kinds of distribution automation, as other members noted. A question was posed as to whether the study could include a comparison of the effects between overhead and underground distribution lines.

Research Presentation: Transactive Energy Challenge Phase-II – *Dr. David Holmberg, Mechanical Engineer, Energy and Environment Division*

Dr. David Holmberg stated that in this initiative, five teams developed a problem scenario, a common grid topology, and metrics for comparing each team's approach to simulating the scenario. The initiative resulted in the following to help the smart grid community assess alternatives for conducting Transactive Energy:

- Co-simulation modeling tools and platforms for system performance analysis
- A scenario that can support ongoing comparative simulations
- Demonstrated approaches for managing voltage on a distribution grid with photovoltaics

Mr. Gopstein pointed out that the benefit of this work was that it established quantitative boundaries for appropriate solutions.

For more details, see Dr. Holmberg's presentation.

Public Comments

Mr. Centolella called for public comments. Stating that he was from the telecommunications industry, Mr. Bob Burkhardt expressed his appreciation and thanks for the framework. It was the one document that he found that pulled together insights and information on the smart grid.

Close

The meeting was adjourned at 2 p.m. on June 5, 2019.