Before the
Department of Energy
Washington, D.C. 20585

In the Matter of

National Broadband Plan Request for Information:
Communications Requirements

To: The Office of General Counsel

COMMENTS OF
THE AMERICAN PUBLIC POWER ASSOCIATION

The American Public Power Association ("APPA") appreciates this opportunity to respond to the Department of Energy ("the Department" or "DOE") regarding its Request for Information ("RFI") on Implementing the National Broadband Plan by Studying the Communications Requirements of Electric Utilities to Inform Federal Smart Grid Policy.

I. INTEREST OF APPA AND ITS MEMBERS

APPA is a national service organization that represents the interests of more than 2,000 publicly owned, not-for-profit electric utilities located in all states except Hawaii. Many of these utilities were developed in communities left unserved as private-sector electric companies pursued more lucrative opportunities in larger population centers. Residents of these communities banded together to create their own power systems, recognizing that electrification was critical to their economic development, educational opportunities, and quality of life. Public power systems also emerged in several large cities – including Austin, Jacksonville, Los Angeles, Memphis, Nashville, San Antonio, Seattle and Tacoma – where residents believed that competition was necessary to obtain lower prices, higher quality of service, or both. Currently, over 70 percent of APPA's members serve communities with less than 10,000 residents, and approximately 45 million Americans receive their electricity from public power systems operated by municipalities, counties, authorities, states, or public utility districts.

This same type of development is occurring today in the area of advanced communications services, just as it did in electricity over 100 years ago. Public power systems in some areas are meeting the new demands of their communities by providing broadband services because such services were otherwise unavailable, inadequate, or too expensive. These services, provided with high quality and at affordable prices, are crucial to the economic success of communities across the nation. These advanced communications services can serve as the "infrastructure pipeline" that will carry the data that allow the growth and innovation of the "Smart Grid."

II. GENERAL COMMENTS

Most electric utilities manage internal communications systems among their various generation, transmission, and distribution assets, and some have installed these systems directly to the meter, to ensure the safest and most reliable delivery of power to the ultimate consumer. These communications systems are critical components to utility operations and demand the highest quality of durability and reliability. These systems can cover entire utility service areas, operate continuously, can never be congested by the data flowing over them and, in the event of an electrical outage, must still be able to operate. They are often redundant to ensure continued coverage in the case of a communication outage. APPA member utilities that have installed these communications systems generally manage and maintain them internally due to the overall system reliability that is required. Electric utilities also tend to be technology neutral when selecting the type of system they will use. Those technologies range from fiber, wireless and satellite to broadband-over-power-line. The determining factors of selecting a particular technology ultimately come down to reliability and cost-effectiveness.

As noted previously, APPA members have begun to offer external communications services to their customers, including combinations of internet service, leasing fiber, phone or cable offerings. While separate from their retail electric services, APPA members have the benefit of offering this service on a preexisting infrastructure that other entities were unable or unwilling to provide.

As the world has evolved and technology has become more advanced, the boundaries between the electric and advanced communications worlds are starting to meld into the generic concept of a “Smart Grid.” The term “Smart Grid” has many meanings to many people. Investments in the ”Smart Grid” have been highlighted by the national news media, Congress and the Administration, and by the $4.5 billion in funding made available to DOE through the American Recovery and Reinvestment Act of 2009 or the “Stimulus Bill.” However, there is often confusion about what the term means. Misuse of the term implies that electric utilities and the electric power delivery system are not functioning well now, when in fact the industry has an outstanding record of reliability. In the past, technological advances have been focused on actual assets like transmission lines, substations and the power plants, while more recent advances have been made at the residential customer level -- at the meter. APPA has not attempted to dictate one definition of the "Smart Grid" to its members, recognizing that for different members in different circumstances, the needs and the investments required to meet them will be different. APPA has, however, published a "Smart Grid Essentials" manual for our members to use in assessing their needs. APPA has noted in previous filings with other agencies that "Smart Grid" can mean many things, including utilizing members' existing infrastructure to its fullest potential.

While advancing technologies have great potential to do more and make us "smarter" about events on the "bulk electric system" (comprised of higher voltage transmission and generation assets) and at the distribution level, the industry does not often get credit for many of the concepts and investments that are already in place that make the grid "smarter." While speed and impact are considered "best" in relation to advances in information technology, the best advances for the electric utility industries are centered on safety and reliability. Though technological advancements can often significantly improve the response to any disruption on the grid, safety for our employees and public are still of the utmost importance to our operations. APPA's membership is concerned that every incremental advancement in technology, whether or not it is cost-effective and sufficiently proven to put in place, will be labeled as "Smart Grid" technology.

APPA member utilities have been entrusted with customer usage and billing data since their inception. Only recently have data and the communication transfer methods used come under greater scrutiny and publicity, while utilities at the same time need to address all aspects of grid "cyber security." Smart grid infrastructure has created numerous means and methods for utilities to make new decisions based on far more points of data. This data can consist of both utility operational data and customer usage information. Both types, if left unprotected, can result in reliability and privacy risks and exposures. For a utility considering an investment in automated metering infrastructure (AMI) or other smart grid installations, this can raise significant concerns. The North American Electric Reliability Corporation ("NERC") and the Federal Energy Regulatory Commission ("FERC") already enforce numerous regulatory standards for the proper control and management of bulk electric system generation and transmission assets, as well as associated cyber assets. Most of the cyber security standards are based on the underlying identification of critical assets on the grid. These cyber security standards, however, apply to assets that are part of the bulk electric system, and therefore do not include distribution smart grid networks and technologies. As organizations rush toward implementing AMI and other distribution-level smart grid applications that require data collection and management, they need to develop standard operating procedures to ensure the safekeeping of the data, and the integrity of electric operations.

APPA does not underestimate the value that a smarter grid could potentially provide to our member utilities and their customers. Once implemented, smart grid concepts could also provide benefits to local governments. Additional services could be used to assist municipal governments through the communications systems deployed for smart grid applications. Faster identification of traffic light malfunctions, for example, could be incorporated into the smart grid. Video cameras on major intersections could be used to remotely control traffic signals for more optimum traffic flow. Assistance to vehicles could also be provided. For instance, with remote connect and disconnect, the power could be turned off before the fire trucks arrived at a fire. Also, emergency medical teams could be apprised of any power outages in order to better maintain critical life support systems.

III. COMMENTS ON QUESTIONS IN THE DOE NOTICE

APPA appreciates DOE's request for comments and information on the communications requirements of electric utilities, focusing on the "Smart Grid" but not limiting the inquiry solely to it. The Federal Communications Commission ("FCC") was directed by Congress to write the National Broadband Plan ("NBP"), and it devoted an entire chapter in the NBP to "Smart Grid" related issues. The concern from the utility perspective is that this could lead to too much focus by the FCC on what services telecommunications companies can provide, as opposed to what services electric utilities actually need. Such a focus could in turn lead to undue emphasis on telecommunications-related changes to current utility infrastructure and the upgrades required to accommodate possible innovations in communications technology. Our members believe that DOE is better suited to process the relevant information into recommendations, due to its comprehensive understanding of electric utility operations and infrastructure, and the dynamics of meeting retail electric customer needs.

In the RFI, DOE has requested comments on nine items, and APPA responds to each request in turn below.

(1) What are the current and future communications needs of utilities, including for the deployment of new Smart Grid applications, and how are these needs being met?

Responses to this question from APPA members varied widely, based on their respective abilities to provide advanced communications services. Some APPA members face barriers to entry in providing advanced communications services to their consumers, due to state laws and regulations. These laws and regulations either forbid public power systems from providing these services or impose onerous conditions that make it infeasible for them to do so. Such prohibitions deter an affected public power system from seeking to upgrade its existing infrastructure, whether solely for internal use, or to offer advanced communications services to its customers. We believe that such barriers to entry for public power systems run counter to the avowed goals of Congress and the Administration to upgrade and increase broadband deployment nationwide, and to further the development of the "Smart Grid."

One of the basic elements of a smarter electric grid is the ability for the various remote systems and end-use devices to communicate with each other. Many utilities have established communication between certain systems and end-device components, such as meters, relays and intelligent electronic devices (IEDs). Much of the connectivity to these systems has been minimal or limited, such as one-way low-bandwidth data streams. One way to make such end devices more "intelligent" is by increasing the amount of data the device can receive. Such increased data payloads are essential to building a network that can support smart grid functions.

The full integration of the customer into the smart grid generally requires two-way communication between the utility and the customer, so that electricity cost and usage information can flow to the customer. It also requires information about customer consumption to flow back to the utility.

Other common themes expressed by APPA members regarding their future communications needs were speed and reliability. While responses varied as to the types of technology and deployment they were using, many cited speed and reliability as features their chosen technology would provide. Speed is important for real time communication and system controls. Electricity is an instantaneously produced and consumed product. There is no lag time between production and consumption, or storage of the product for later consumption (although there are promising storage technologies that could change this in the future). Maintaining the speed and flow of information transfer becomes more crucial as the amounts of data grow exponentially. Reliability and redundancy are also important because there is little room for failure. If failure were to occur, there must be a backup communications method that can be quickly deployed. Fiber is the current or preferred communications vehicle most cited by APPA members, due to its high bandwidth, low latency and secure structure.

(2) What are the basic requirements, such as security, bandwidth, reliability, coverage, latency, and backup, for smart grid communications and electric utility communications systems in general— today and tomorrow? How do these requirements impact the utilities' communication needs?

Public power systems are looking at investments in any "smart" technology under a framework tailored to their specific needs and operating environments. Because of public power systems' not-for-profit business model, incurrence of costs without clear, defined and desired benefits is unacceptable. Moreover, compared to other industries, the electric utility industry evaluates equipment investments using a long-term time scale, paying considerable attention to equipment life. As such, utilities require that equipment exhibit durability under harsh and demanding environments for years into the future. This construct for evaluating the usefulness of technology is distinctly different from typical commercial services.

Utility equipment must be designed to operate both safely and reliably in environments where there are occurrences of high voltages, currents and natural hazards. This makes utility investment decisions in emerging communications technologies highly complicated. Not only must equipment be rugged and proven, but the technology ideally will continue to be a sound investment over the typical 25 to 30 year depreciation cycle. As a result, it is important that communications equipment not be subject to technology obsolescence in a short period of time.

Security is the ability of a communications network to withstand and recover from cyber and physical attacks, as well as to protect sensitive data. Security is essential to any digital overlay. Without security, any digital technology is much less useful to an electric utility. Due to the nature of communications technology development, security is a moving target. To implement widespread digital communications technology, electric systems will, at a minimum, need "protect, detect and correct" capabilities. A resilient, secure and reliable digital communications system, however, may not come without cost and additional data requirements; for example, basic security would require authentication and encryption at all data collection nodes, adding considerable lag time and requiring additional computing power to support these functions.

When the electric system fails it is typically costly and can be dangerous. Therefore, no digital technology that can be compromised through a communications network should have direct digital control capability. Non-routable direct connections are most suitable for communications with reliability-related infrastructure. Fiber optic technology has therefore been a "go to" solution for many utilities. Such technology is a more secure communications pathway for technologies classified under the smart grid umbrella. Additionally, it has been suggested that a backup communications system should exist for vital infrastructure points at each utility.

Bandwidth is the ability of a communications network to transmit data. Since utilities' usage needs will vary given their specific smart grid installations, the amount of data that must be transmitted can be expressed in bytes per day or megabits per second. At present, operational data requires little bandwidth. If, however, utilities are required to collect a myriad of data points on routine timescales, bandwidth availability could become a problem. Additionally, increasing bandwidth through use of wireless technologies could adversely impact security. Most likely, utilities will be collecting integer data remotely and performing any computationally intensive processes at an office or other central location (including that of a third-party contractor to the utility). This may keep bandwidth requirements lower. Ultimately, all bandwidth requirements will depend on the scope of the communications functions for the sum of utility projects.

Reliability is the degree to which a communications system remains operational. Where digital communications systems are installed, reliability is essential and ties into security. If communications system data is traveling wirelessly, it has been shown that it can be manipulated by computer hackers. This manipulation could result in invalid data that cannot be verified. If data cannot be verified and validated through a means other than digital, it cannot be used to help a utility make decisions in its operations. Accordingly, data that can be manipulated by a computer hacker poses a significant difficulty for a utility that may want to use smart grid technologies. Outside of security issues, the communications systems used should be operational at least 99.999% of the time in order to be useful for the provision of smart grid grade utility services. This is not a reliability standard under which commercial communications networks typically operate. For utilities to use existing telecommunications commercial networks, these networks would have to increase dramatically their reliability.

Coverage refers to the extent to which a communications network serves or can serve a given area. Appropriate communications coverage will be selected by a utility based on the service advantages that are desired and the needs of its customers. This will vary significantly among different utilities and among a single utility's customer groups. As such, a high degree of flexibility will be needed to select the most appropriate coverage.

Latency is the time that it takes a unit of data to be received after it is sent. Latency in data systems has degrees of acceptability depending on the importance of the data for decision making. Where decisions are being made solely based on data sent over a digital communications network, data latency should be reduced as much as possible. Many important systems in a utility are pre-set to respond in a protective manner to conditions on the electric system. This makes data latency a lesser problem. Where Supervisory Control and Data Acquisition (SCADA) systems are connected to important systems, latency should be in milliseconds.

In the area of communications, data backup can be a part of reliability and customer service. While not necessary for many decision-making and communications functions, data storage is essential for any network where long-term information is needed. Where smart meters are used, the underlying data collection and management system is generally the first piece to be designed. The features of the data management system, including its backup capabilities, determine the future infrastructure that will be available for deployment by the utility.

In the area of distribution system functionality, physical backup and safety methods are essential. At present, any digital technology overlay should be backed up by a physical method of control and should have limited ability to change system parameters. In the future, it may be possible to adequately protect important systems from unauthorized access by outside entities.

However, a backup would still be necessary to ensure system safety. Additionally, back-up power is necessary to ensure that important communications networks remain functional even during power outages.

(3) What are other additional considerations (*e.g.* terrain, foliage, customer density and size of service territory)?

The four examples of system characteristics noted above vary greatly from public power system to public power system. Which characteristics they display influences the systems' communications needs. Each characteristic has an influence on the procurement and maintenance cost of new networks and service. Terrain and foliage are used as examples of things that adversely affect the use of wireless and satellite transmissions, while customer density and the size of the territory can be a benefit to the use of those technologies. The reverse is true of fiber, where terrain and foliage do not typically play a role in its performance, while low customer density and a large service territory are often cost prohibitive for its use. Consideration of terrain and foliage are taken into account for areas that are often hit by storms, such as hurricanes and tornados; in such cases, the ability to restore communications services quickly to support electric service restoration is very important.

Customer density and size of the territory are not often deterrents to types of technology choices available due to the urban/suburban characteristics of many public power systems. However, many public power systems provide service to very small and remote customer bases where there might be a technology fit, but the cost is currently prohibitive and therefore not justifiable.

(4) What are the use cases for various smart grid applications and other communications needs?

APPA published a document in 2009 entitled "Smart Grid Essentials," which outlined for its members potential uses for various smart grid applications based on surveys and discussions with them. APPA broke those uses into four areas: customer capabilities; distribution capabilities; transmission capabilities; and generation capabilities.

There were various use cases in the customer capability area. Time of use rates have been cited as modifying consumer behavior to change when energy is consumed. This can be provided through an advanced meter to the home which allows the consumer to see his/her own consumption. What if you could store hot or cold energy during times when the demand (and cost of energy) was low and release it during the high demand and cost times, for example? Thermal storage could allow customers to do just that. In this new technology, special bricks are used to store heat in heating systems while ice is used to store cold for air conditioning systems. New home area networks (HANs) are being developed that allow customers to monitor and control their individual appliances. Smart meters would be able to interface with these HANs with the use of two way communications between the utility and the meter. Interface with these HANs could be made possible through the Internet or other communications means.

There are also many possible use cases in the distribution area. Distribution systems are designed to provide reliable power with proper voltage to customers under a variety of peak and off-peak conditions. The systems have typically been designed to provide a single source of power to an end-use customer. When an interruption occurs at one point on the system, all loads downstream from that point are removed from the distribution system. Smart grid devices can be used to minimize the impact of this common "radial" design and enhance reliability. Distribution systems consist of overhead and underground distribution lines, substation transformers, distribution transformers, switches, voltage regulators, reclosers, shunt capacitors and a host of other devices. These devices number in the thousands for a small utility and in the millions for a large one. Monitoring the status of these devices, controlling the devices and making sure they are working properly is primarily done through manual means now, but doing this automatically could improve power quality and reliability and extend the life of devices by identifying problem areas before failures occurred. In locations with a highly transient customer base, such as university towns, remote connections and disconnections can significantly reduce the amount of time and work force required to change service status. The smart grid can also limit service to a predetermined amount of usage. This can be provided by pay as-you-go cards and meters or similar means.

Management of customer loading on the system through the smart grid would allow peak loading to be reduced. Since the load losses are proportional, reducing the peak current by 10 percent would reduce peak load losses by 19 percent. Load loss reduction can occur through cycling appliances off, using thermal storage to shift peak loads to a lower load period, use of voltage reduction and a variety of other methods.

Transmission system elements include large power transformers, lines, breakers and switches, shunt devices for voltage control, series capacitors and phase shifters for power flow modifications. Capabilities for new devices, such as variable frequency transformers and flexible AC (alternating current) transmission systems devices, are also being added for power flow and voltage support. Large High Voltage Direct Current (HVDC) systems are currently operating on the grid, and more are being considered to move large amounts of renewable energy to load centers.

The transmission system is monitored more closely than most distribution systems through SCADA systems and the modern generation of solid-state relays being deployed. These systems monitor switch and breaker status, relay targets and settings, magnitudes of voltage, frequency and power flow at all substations. Often security video is also included at substations. The smart grid extends the use of traditional SCADA systems to monitor and control more of the transmission system, including enhanced integration of the data for better analysis and planning. New monitoring systems are being developed to allow more precise measurements of system capabilities. Devices that monitor the line temperature and the resultant sag of a line, for instance, can be deployed so a transmission line can be used to its full capabilities based on the limitations of sag and conductor temperatures. This allows a dynamic rating of the line to be considered with real-time loading data rather than a static rating with a projected loading. These systems allow utilities to avoid sending crews out for routine issues. This can be done by moving away from interval or usage-based maintenance procedures to real-time, condition-based monitoring. This allows a utility fully to understand the condition of the asset. For instance, when a breaker opens due to a fault on the system, this operation causes the contacts of the breaker to wear down. Smart grid technology allows utilities to measure the actual condition of the contacts to determine if maintenance is required versus projecting the need for maintenance based on the number of breaker operations.

Smart generation ensures power quality and holds sufficient capacity in reserve to make sure power is always available to the grid. In the United States it is common for utilities to maintain generation reliability reserve margins of between 12 and 15 percent of peak load.

Relevant standards allow interruptible load to be counted toward the reserve margin requirement. The use of interruptible load or demand response to provide this reserve margin would release generating capacity to meet future load growth. One use of the smart grid will be to allow a clear understanding of where load is available for control and how much load could be managed or called upon to reduce usage to maintain the expected power system performance. This load reduction could then displace generation being held to meet reserve requirements.

(5) What are the technology options for smart grid and other utility communications?

Current available technology options listed by our membership for utility communications were: fiber-to-the-home; power line communications; mesh network; repeater networks; cable television piggyback; wireless local area networks (LANs); high speed copper wire; public Wi-Fi networks; Wimax; and point-to-point microwave.

(6) What are the recommendations for meeting current and future utility requirements, based on each use case, the technology options that are available, and other considerations?

In consideration of the use cases provided, utilities will need access to the communications bandwidth spectrum on network tiers 1 through 3. Communications needs vary by project and can be met by increasing available communications bandwidth at network collectors and nodes as necessary.

New systems should be scalable. Even under a worst case scenario, there should be a way to ensure passage of necessary utility data during times of high network congestion or emergencies. For utilities choosing wireless technology, a portion of the available MHz in the communications spectrum should be reserved for exclusive utility use. At the highest levels, utilities will need high capacity point-to-point communications.

(7) To what extent can existing commercial networks satisfy the utilities' communications needs?

The usefulness and ability of commercial communications networks to fulfill utilities needs depends on their functionality. In some cases, there are no existing commercial networks that will guarantee to meet the reliability and coverage requirements needed by electric utilities. Outside of those cases, there are some services that can be provided by commercial wire-line and wireless networks. Ultimately, the need to use those networks will be determined by their usefulness in meeting practical utility requirements, and the ability to protect the data from unauthorized disclosure.

(8) What, if any, improvements to the commercial networks can be made to satisfy the utilities' communications needs?

Overall reliability will determine which technologies utilities use to meet their communications needs. As previously stated, electric utilities will use commercial wire-line and wireless technology where it is cost effective and meets functional requirements. However, there are issues with these communications technologies.

Utility communications technology must be able to survive hurricanes, snow, ice and other impacts of storms. This includes remaining operational for at least 72 hours; some utilities have suggested at least a week would be necessary, in the event of a power outage. At present, carrier networks do not possess that level of reliability. During and after hurricane events, a communications carrier network can be out for long periods of time.

During emergencies utilities need reliable communications. According to reports, during emergencies carrier networks can overload and jam. As a critical part of the emergency response to such events, electric utilities cannot afford to wait to start service restoration until communications again become available. However, both priority access and priority restoration is not available on wireless networks. As a result, electric utilities primarily use commercial carrier networks for non-critical communications, if at all.

Utilities need to have strong coverage in their service territory. This includes remote areas that are not served by commercial carriers. In addition, there is no evidence that carriers intend to deploy 4G networks beyond their current 3G areas. Carrier networks typically have 150 milliseconds of latency; this supports adequate voice communications, but does not serve monitoring equipment well. Since utilities need low-latency communications, especially for important systems, this makes commercial carrier networks unsuited to utilities' needed functions.

(9) As the Smart Grid grows and expands, how do the electric utilities foresee their communications requirements as growing and adapting along with the expansion of Smart Grid applications?

To make communications services usable by electric utilities, data speeds and transport capacities will have to expand to meet functional needs. Since those needs have not yet been determined, it is appropriate for a utility to field the most scalable equipment within a reasonable cost. Fiber-optic technologies have been suggested to allow for scalability.

IV. CONCLUSION

APPA would again like to thank the Department for initiating this study into the communications needs of electric utilities. We believe there is a valuable role for the implementation of "Smart Grid" technologies as long as they are proven and cost-effective. That role is going to be defined in part by the capabilities of the communications systems that will carry the essential data to maintain critical reliability, durability and speed.

APPA appreciates the Department's efforts in bringing in experts from both the communications sector and the electric utility sector in search of these answers and looks forward to working with the Department to meet these needs.

Respectfully submitted,

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