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U.S. Department of Energy
Office of the General Counsel
1000 Independence Avenue, SW
Room 6A245
Washington, DC 20585

Re: NBP RFI: Communications Requirements

Pepco Holdings, Inc. (PHI) is pleased to respond to the U.S Department of Energy request for comments regarding the communications requirements of electric utilities deploying the Smart Grid.

PHI is one of the largest energy delivery companies in the Mid-Atlantic region. PHI's three electric distribution companies – Potomac Electric Power Company (Pepco), Delmarva Power (DPL), and Atlantic City Electric (ACE) – provide regulated electricity service to about 1.9 million customers in Delaware (DE), the District of Columbia (DC), Maryland (MD) and New Jersey (NJ).

As a major electric transmission and distribution utility, PHI is heavily dependant on communications services and facilities to reliably operate the electric grid and serve our customers. In addition to routine business communications, we have essential needs that are truly mission-critical and vital in their role in "keeping the lights on." Historically these included communications supporting protective relaying, supervisory control and data acquisition (SCADA), and voice and data dispatch for system operation & restoration. As we move toward Smart Grid utility needs for mission critical communications become substantially more complex. Expanding utility communications needs to areas not previously monitored, controlled or automated, including advanced monitoring & sensing devices, advanced & independently intelligent automation schemes, etc. necessitating the expansion and development of Power Delivery Wide Area Networks (PD-WANs), Substation Local Area Networks (SLANs), Wireless LANs support a wide range of outside plant Smart Grid applications, Automatic Metering Infrastructure (AMI) and customer Home Area Networks (HANs). All of this new communications needs to be built in ways that preserve the security, integrity and reliability of the electric system as well as the data passing across that network including confidential customer information. Meeting the demands of these critical applications requires engineering and design of a telecommunications infrastructure specific to utility needs with regard to reliable, fail-safe operation, network security, etc. that can be counted on under the most difficult conditions. A key attribute of utility communications has always been its ability to be resilient during the worst condition as well as being tailoring to our unique business needs.

When storms occur, our systems need to communicate. A carrier can claim and demonstrate extremely high average levels of reliability, but if their communications do not work during the fraction of seconds needed by utilities during abnormal system conditions (i.e., during storms & regional events), reliability, stability and performance of our systems and applications suffer as well as the success of Smart Grid. Even without Smart Grid utilities are highly dependent on reliable communications specifically when conditions are at their worst. It is for that reason that utilities have built private fiber and microwave systems. Utilities have learned from experience that when it really counts, carrier services are often unavailable or unreliable for many of our applications. Utilities broadly recognize that if we build a Smart Grid and network devices can't rapidly interact to exchange, share, and process information, the vision of Smart Grid will be lost and we will be no better off than when we were using the old grid controls infrastructure with low speed or non-existent communications. Utility networks must be built to withstand the rigors of electrical surges, transients, etc. and remain operational during the worst conditions.

Therefore, what is needed immediately is a regulatory environment that acknowledges utility needs for spectrum. Furthermore we need regulators to support the non-traditional use of some spectrum bands that are presently under used resources. We believe this approach is in line with the recommendations made by the FCC's National Broadband Plan. This approach would help utilities to more quickly meet the needs of the present Smart Grid and improve our ability to secure necessary spectrum as well as forge alliances with spectrum owners.

Existing commercial networks presently provide necessary and reliable communications for both voice and data services. For example, PHI has moved to leased commercial services for its mobile data communications, it outfits field crews with smart phones and uses leased analog lines for critical substation communications & feeder protection. We are also exploring and trialing commercial EVDO services for Smart Grid (i.e., AMI Collectors).

However, it must also be recognized that utility use of private communication networks was born out of a need for greater reliability for mission critical applications. Commercial carrier leased services do not represent the most reliable networks for our use. Restoration times can be very long and impede a utilities ability to serve their customers and restore electric service in a satisfactory manner. Furthermore, Service Level Agreement with carriers are nearly always weak and of little value.

PHI believes that as Smart Grid expands, there will be a rapid infusion of new technologies improving our ability to enhance reliability, provide more granular system monitoring and control, shorten restoration times, provide dynamic system optimization and improve electric system planning while enabling new tools which will allow our customers to maximize the efficiency of their electric consumption. These new applications will place increased demands on our communications networks, many of which are not easily predictable or known at this time.

Background

PHI is implementing one of the nation's most advanced Smart Grid programs. PHI's Smart Grid program will enable customers to move towards energy reduction and improved energy management. It will also enhance grid reliability and optimize asset operations and maintenance. In addition, it lays the groundwork for wide-scale distributed renewable energy generation, electric vehicle adoption, carbon footprint reduction and increased energy security.

PHI's ongoing Smart Grid implementation has been accelerated due to the Smart Grid Investment Grant of $168.1M that PHI was recently awarded[1]. The program includes the implementation of Advanced Metering Infrastructure (AMI), Distribution Automation (DA), Demand Response (including Direct Load Control and Dynamic Pricing) and the enabling Communications Infrastructure (CI).

Specifically, PHI is currently:

[1]PHI's subsidiary companies, the Potomac Electric Power Company (Pepco) and Atlantic City Electric, received $44.6M for the Pepco (District of Columbia) Smart Grid Program, $104.8M for the Pepco (Maryland) Smart Grid Program and $18.7M for the Atlantic City Electric Smart Grid Program.

- Installing over 1 .3 million smart meters equipped with network interface cards;
- Improving demand response capabilities by enabling dynamic pricing programs and installing approximately 300,000 AMI-enabled Direct Load Control (DLC) devices; and
- Deploying DA and CI technologies that will be leveraged by both AMI and DA

PHI's existing Smart Grid program not only delivers early benefits, but also provides the foundation for further expansion and enhancement. The implementation of the Smart Grid is an evolutionary process. The first step is for electric utilities to enhance grid visibility and control by installing intelligent devices (such as smart meters), expanding their communication networks and enhancing their monitoring and control systems. PHI believes that a nation-wide "one-size fits all" Smart Grid design is difficult to attain. Utilities service different electric distribution landscapes, are under different state regulation(s) and have assets capable of varying levels of existing automation – all of which present unique challenges.

As one of the electric utilities that has already moved forward with this first step, PHI understands that its technology choices need to consider the future evolution and interdependency of the nation's Smart Grid. It is important to note that these new smart grid capabilities must be enabled in an environment that respects the physical role of local transmission and distribution companies who, with Independent System Operators, oversee the safe and reliable delivery of energy while instantaneously balancing supply and demand among the stakeholders. PHI's design reflects these needs, using proven technologies to ensure that the Smart Grid is not only secure, but also interoperable and upgradeable in the future.

PHI recognizes the monumental task of understanding the communication needs required for the Smart Grid, and would like to express their appreciation to the DOE for undertaking this effort. Thank you for the consideration of these comments.

To this end, PHI recognizes the criticality of staying at the forefront of not just Smart Grid technology developments in the marketplace, but the progression of Smart Grid-related regulatory, policy and standards as well. PHI welcomes DOE's interest in Smart Grid and appreciates this opportunity to respond to the attached questions.

Sincerely,

William M. Gausman

Pepco Holdings, Inc

PHI RESPONSE:

Federal Register/Vol. 75, No. 90/Tuesday, May 11, 2010/Notice

DEPARTMENT OF ENERGY

Implementing the National Broadband Plan by Studying the Communications Requirements of Electric Utilities to Inform Federal Smart Grid Policy

Agency: Department of Energy

Action: Request for Information (RFI)

Pepco Holdings Inc.[1] appreciates the opportunity to address the questions submitted for comment by the Department of Energy and welcomes any opportunity to further the Nation's drive toward a Clean Energy Economy. We share in the current administration's belief that America must lead the way relative to the use of clean, renewable energy. We believe a Smart Grid is crucial in its ability to achieve this important goal. Ubiquitous reliable communications supporting Critical Infrastructure[i] and Smart Grid will ensure the broad integration of renewables into the grid ensuring the Nation meets or exceeds its Goal of doubling the use of renewable energy by 2012.[2]

PHI agrees with the Obama Administration that Grid Modernization, including the use of Smart Meters, will be both stimulative to the economy as well as ensuring the more efficient use of energy while empowering customers to better monitor and manage their energy consumption. A Smart Grid will also encourage the use and further development of smart energy appliances, electric vehicles, energy storage devices, etc., minimizing the Nation's dependence on foreign oil and empowering energy consumers broadly.

PHI would also like to point out the unique and often misunderstood importance of Utility Communication in ensuring the distribution of reliable energy services. We, as the provider of energy services to the Nation's Capital supporting the vast and diverse needs of the Federal Government, as well as our commercial and residential customers can say with conviction that reliable and secure communications is crucial to ensuring the continuity of operations for both our government and non-governmental customers. It is for this reason, we have moved our core and most critical applications from leased services to private networks that we can monitor, control and tailor to ensure our services meet the reliability needs of our consumers. Few other utilities get the visibility for both their successes and failures.

It is also important to recognize the essential role of the Grid and its significance to the overall continuity of life and stability of government for any nation in this modern era. Without reliable and secure energy service very little functions properly in a modern society. The role of Critical Infrastructure such as the Grid aligns well in importance with Public Safety. Yet, up to this point

[1] Pepco Holdings Inc. (PHI) is one of the largest energy delivery companies in the Mid-Atlantic region, serving 1.9 million customers in Delaware, the District of Columbia, Maryland and New Jersey. PHI subsidiaries Pepco, Delmarva Power, and Atlantic City Electric provide regulated electricity services; Delmarva Power also provides natural gas services.

[2] Memorandum for the President, From the Vice President, Subject: Progress Report: The Transformation to A Clean Energy Economy; dated December 15, 2009, Page 3, Renewable Energy Table

Critical Infrastructure has not been afforded the same consideration as Public Safety relative to their communication/spectrum needs. It is for that reason that we will continue to endorse the UTC's efforts to secure and align Smart Grid spectrum in line with Canada. The US should not lag behind its northern brothers; rather, we should lead the charge to unifying the North American Grid. North America can and should be the model for the world. Demonstrating a unified Grid, unified Smart Grid standards and unified Smart Grid spectrum are the foundation for a strong economy which encourages economic innovation.

Question 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?

PHI Response: As a major electric transmission and distribution utility, PHI is heavily dependant on communications services and facilities to reliably operate the electric grid and serve our customers. In addition to routine business communications, we have essential needs that are truly mission-critical and vital in their role in "keeping the lights on." Historically these included communications supporting protective relaying, supervisory control and data acquisition (SCADA), and voice and data dispatch for system operation & restoration. As utilities move toward Smart Grid our needs for mission critical communications become substantially more complex. Expanding our communications needs to areas not previously monitored, controlled or automated, including advanced monitoring & sensing devices, advanced & independently intelligent automation schemes, etc. necessitating the expansion and development of Power Delivery Wide Area Networks (PD-WANs), Substation Local Area Networks (SLANs), Wireless LANs support a wide range of outside plant Smart Grid applications, Automatic Metering Infrastructure (AMI) and customer Home Area Networks (HANs). All of these new communication needs must to be built in ways that preserve the security, integrity and reliability of the electric system as well as the data passing across that network including confidential customer information. Meeting the demands of these critical applications requires engineering and design of a telecommunications infrastructure specific to our needs with regard to reliable, fail-safe operation, network security, etc. that can be counted on under the most difficult conditions. A key attribute of utility communications has always been its ability to be resilient during the worst conditions as well as being tailored to our unique business needs. Another important factor to consider relative to a utility owned and operated network is the ability to focus restoration of crucial services in-line with its own individual needs rather then the broader needs of a large commercial carrier. PHI has implemented and presently operates its own private telecommunications infrastructure to satisfactorily address many of these demanding needs and is currently in the process of expanding those systems to meet the expanding demands of Smart Grid. To meet these stringent requirements, PHI's has identified some areas where the Federal Government can help us achieve our goals.

Allocation of Smart Grid Spectrum for Wireless Data Communications

Evolving Smart Grid requirements will drive the development of utilities' data communications networks. PHI believes that these networks will be comprised of multiple tiers of communications. At the highest level will be wide-area transport networks utilizing fiber and high-density microwave communications. This level of communications will be the core network tying together our Bulk Electric Substations (BES) and will largely constitute our Power Delivery Wide Area Network (PD-WAN). This core physical layer already exists for many utilities; however, some like PHI are enhancing those backbone networks (typically Synchronous Optical Networks (SONET)) with newer technologies such as Multiple Protocol Label Switched (MPLS) networks to enable true WAN capabilities while providing a network that can facilitate traditional, legacy Telco services. In general, little assistance is needed from the Department of Energy (DOE) regarding this level of communications networks. Fortunately, PHI already has sufficient fiber cable plant and adequate microwave radio spectrum is available for our purposes.

The next two levels of our Power Delivery WAN present challenges. In order for utilities to achieve the vision of Smart Grid, we need ubiquitous IP based communications for a wide range of applications, many of which are only now being envisioned. As communications becomes more available, more value-added applications will be rendered possible/feasible, pushing the network to expand and evolve much the way the Internet and broadband communications have created workplace efficiencies, new businesses, and been transformative to the way we work and live. Smart Grid, with proper planning and implementation, offers similar life changing improvements many of which will come only after a suitable communications infrastructure is in place. Much like the Internet has impacted our modern existence; electrical operations will be transformed by the "Internet-like" communications network that will be created in support of Smart Grid.

At a glance, commercially available wireless services from carriers such as Verizon, AT&T & Sprint appear to be the natural choice to satisfy the needs of the Smart Grid. Their infrastructures represent an enormous investment, already exist, use suitable spectrum and have the ability to spread their capital and expense costs over a large number of customers. All utilities would need to do is to subscribe and share in the use of these networks with other carrier customers. Banks and financial institutions do it, industry does it, and much of the federal government does it.

Possible advantages to use of commercially available wireless services include:

- Simplicity. Utilities have a small number of applications in comparison to the wireless service provider's overall customer base. We could simply plug in our applications to expedite implementation and realize the benefits of Smart Grid now.
- Carrier services represent an opportunity to avoid the expense and complexity of maintaining private networks which is attractive.
- Utility usage of commercial carrier services avoids additional burdens and demands for spectrum.

<u>So why not Public Carriers?</u>

Unfortunately, it's not that easy. When storms occur, our systems need to communicate. A carrier can claim and demonstrate extremely high levels of availability, but if their communications do not work during the fraction of seconds needed by utilities during abnormal system conditions (i.e., during storms and regional events), reliability, stability and performance of our systems and applications suffer as well as the success of Smart Grid. Even without Smart Grid we are highly dependent on time specific reliable communications regardless of prevailing conditions or events. It is for that reason that we have built private fiber and microwave systems. We have learned from experience that when it really counts, carrier services are often unavailable or unreliable during those critical moments when our applications need stable communications most. For most consumers, they would not even notice these minor system glitches nor would these events negatively impact availability statistics for a Commercial Carrier but for an electric grid those fractions of second mean the difference between reliable and unreliable electric service. Utilities broadly recognize that if we build a Smart Grid and network devices can't rapidly interact to exchange, share, and process information during the critical moments surrounding an event, the vision of Smart Grid will be lost and we will be no better off than when we were using the old grid control infrastructure with low speed or non-existent communications. These issues are well understood and routinely applied by Utilities on their transmission systems. Smart Grid should utilize lessons learned from the development of communications for our transmission systems which represents a level of reliability that if applied appropriately to utility distribution systems would yield the desired vision of Smart Grid. That is not to say, communications improvements and upgrades as part of Smart Grid are not equally important to utility transmission systems only that it is easier to provide highly reliable broadband communications at a Transmission system level given necessary infrastructure generally already exists at these locations. So to that end, Utility networks including emerging broadband networks supporting Smart Grid must be built to withstand the rigors of electrical surges, transients, etc. and remain operational during the worst conditions. Nor can the systems utilized by Smart Grid be adversely impacted by non-utility traffic loading during storms or regional events which is often the case with Commercial Carrier Networks. Even if carriers were willing to upgrade their networks to meet our specific needs and standards, use of their networks would only be useful if utilities could obtain tiered priority service over other users of those shared networks. Although some priority routing is possible, it is impractical and isn't even in the best interest of the general public to ask Public Carriers to prioritize our traffic over the needs of public safety or emergency response services . Yet, without Quality of Service tuned to our needs or some kind of user prioritization, our networks are subject to outages and/or latency delays which will result in performance no better than our older systems.

PHI fully supports the UTC's proposal to build the Smart Grid Communications Network on licensed spectrum in the 1.8GHz range harmonizing the US with Canadian Standards. Although we believe that 30MHz[3] of spectrum is not immediately needed, it does provide the necessary spectrum to ensure the long term success of Smart Grid, enabling equipment vendors to build and provide standards based hardware to utilities while ensuring inter-operability between utilities broadly. Unfortunately, our present Smart Grid initiatives mandate we implement suitable communications solutions today.

Therefore, what is needed immediately is a regulatory environment that acknowledges utility needs for spectrum. Furthermore we need regulators to support the non-traditional use of some spectrum bands that are presently under used resources. We believe this approach is in line with the recommendations made by the FCC's National Broadband Plan. This approach would help utilities to more quickly meet the needs of the present Smart Grid and improve our ability to secure necessary spectrum as well as forge alliances with spectrum owners. Implied in this request is an acknowledgement that spectrum that has been previously auctioned and/or left to fallow by spectrum owners and speculators be opened to utilities as part of a spectrum rebanding for Critical Infrastructure.

This situation, the lack of sufficient, suitable spectrum allocated for Smart Grid use, is particularly dire in highly urbanized areas where spectrum is scarce (and where available, extraordinarily

[3] Nation-wide spectrum allocation for Smart Grid would require that various regional entities to coordinate their usage of this spectrum necessitating and justifying our needs for 30MHz of Spectrum.

expensive). Cost to obtain this spectrum places undo burdens on our investors and customers. In urban areas where our traffic requirements are at maximum density, we believe that to successfully provide communications to bridge our core backbone transport networks to our wireless mesh, utilities need 5MHz of spectrum per channel with 10 MHz of contiguous spectrum throughout. Although we believe we could build a network on smaller blocks of spectrum, standards based radio equipment does not presently support lesser channel sizes. This estimate is expected to increase significantly as new applications come on line.

Spectrum for Voice Dispatch Communications

From a voice communications standpoint, the proliferation of both traditional and "smart" cell phones has transformed much of how utilities communicate. Their adaptation and widespread use by utilities is significant and has enhanced our operational efficiency and effectiveness. The enhanced coverage and performance from commercial carrier services from just a few years ago has enabled many utility employees to stay in touch and be more productive performing routine work. Nonetheless utilities' private Land Mobile Radio systems (LMRS) remain a key strategic asset for one simple reason - survivability. Widespread or pocketed communications failures during major storms or regional disasters are not uncommon on commercial carrier systems. These failures are an inconvenience to the general public and can be a major hindrance for utilities trying to restore electric services. For this reason, utilities will never completely abandon their private LMR systems.

Although commercial carriers could prioritize their restorations in cooperation with regional utility needs, it is unlikely it would serve their business or customer needs. Just like utilities, commercial carriers focus their attention where they can restore the most customers first. This approach only helps us when our needs and their needs converge which often is not the case.

As mentioned earlier, PHI is made up of three (3) regional utilities. Ideally, we would like to have an interoperable LMR System. We are working to that end but the lack of allocated protected licensed spectrum much like what has been done for Public Safety does not exist. This places Critical Infrastructure providers like electric utilities in a position where they must fight for spectrum with spectrum speculators, private businesses and anyone seeking to build a commercial wireless service. This situation has in some of our regions proven to be challenging due to a lack of available spectrum. Any assistance in the allocation of spectrum for Critical Infrastructure would be extremely helpful.

Summary: Electric utilities needs for spectrum are not being effectively addressed by the FCC or the Federal Government at large. PHI supports the UTC's efforts to secure 30MHz of spectrum in the 1.8GHz band in harmony with previous Canadian spectrum allocations for Smart Grid. PHI also supports the use of under used spectrum below 1GHz with favorable allocations by the Federal Government which might lead to modification of standards such as WiMAX. That is to say, a commitment of spectrum would likely lead to the modification of the Standard allowing the use of spectrum below 1GHz with channel sizes substantially below the current 3.5 to 5MHz channel sizes. Presently, equipment vendors are unwilling to invest necessary dollars on the development of equipment without some reasonable expectation of a return on that investment. Allocated spectrum for utilities would go a long way to reducing that risk for equipment vendors.

Question 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?

PHI Response: The following specifications are generally used when developing and planning wired and wireless services in support of Smart Grid. PHI believes these are the requirements to meet immediate and future needs of the smart grid. PHI follows industry best practices and NIST standards.

Security:	Application Layer Encryption utilizing AES 256	
Bandwidth:	10MHz Minimum of contiguous spectrum, Long Term 30MHz	
Reliability:	It is unclear as to whether the DOE is looking for Reliability or Availability standards. From a PHI perspective, reliability is far more important than availability for our purposes given it define the likelihood that a component or system will fail during a given period of time. In either case, PHI believes that compliance with appropriate IEEE standards such as 1613 are a far better method of ensuring equipment & system reliability during adverse conditions. It is also recognized that calculations of Network Availability do not always represent the best method of defining the suitability of a network for the intended application.	
Pt-to-Multipt	Network Coverage:	90% with 95% Link Availability (Wireless)
Mesh:	Network Coverage:	95% with 95% Link Availability (Wireless)
Latency:	100ms round trip	
Power Backup:	Communications Towers: 1 Week	
	Communications Hubs at Substations: 24 Hours	
	Substation Batteries: 8 Hours	
	Wireless Field Routers & Access Points: 8 Hours	

Although all of the above specifications could potentially be realized in services furnished by a commercial wireless service provider (carrier), it has been our experience private networks are the only practical way to achieve the following::

- Ability to control and manage asset life
- Necessary agility to make application specific configuration and/or network changes which immediately address operational issues
- Priority restoration of failed services
- Priority tiered routing specific to meet our needs ensuring the highest level of reliability and performance
- The ability to schedule network upgrades and planned outages without negatively impacting critical utility services and applications.

An important factor that should never be lost when evaluating the value of private utility communications is that "Critical Infrastructure", much like public safety, has special and unique communications needs relative to its applications and mission. Like public safety, Critical Infrastructure is required to complete their mission regardless of the situation, weather condition or event. Unlike public safety, Critical Infrastructure lacks Federally allocated spectrum necessary to ensure the success of their mission.

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

PHI Response: Commercial wireless carriers provide services in the same areas PHI provides electric service so there are no special terrain, foliage, customer density and/or size of service territory issues that would stand out for us, except for the following:

- Wireless communications on a distribution pole can be challenging since we can only move our antennae up and down in a straight line. For that reason, uses of technologies such as mesh communications are routinely used for these applications. In the future, some non-traditional spectrum will likely provide additional future improvements enabling improved communications to devices on the distribution system.
- Customer density presents significant challenges, particularly in areas where terrain and foliage further complicate our ability to effectively and broadly provide communications. It should be noted that these same areas are also areas which are the most poorly served by commercial wireless carriers and often are most affected by service interruptions and latency through the network.
- Tree canopies represent significant challenges within the Washington metropolitan area representing some of the highest and densest tree canopies among major metropolitan areas.
- Restriction zones within the Pepco region also present challenges due to the levels of Federal Government agencies operating within the region.

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

PHI Response: The following represents some of the anticipated "Use Cases" for Smart Grid. It is recognized that each utility envisions different early uses for its Smart Grid based on it regional demographics, uniqueness of its business as well as specific customer needs. It is hoped that the work being done by the many Smart Grid initiatives as well as NIST will over time harmonize the best "Use Cases" developed across the industry. This effort is anticipated to reduce application costs and harmonize the efforts currently being undertaken by independent utilities broadly. Proposed PHI identified use cases:

SMART GRID USE CASES
Manage Customer Accounts Use Cases

- Automatic Collect of Meter Consumption Data from Meters
- Control and Manage Customer Accounts (i.e., Adds & Deletions)
- Disconnection of Customer Service for Purposes of Load Control, New or Terminated Accounts
- Detection of Meter Tampering or Energy Theft
- Automatic Detection of Customer Power Loss & Restoration
- Remote Cycling of Customer Load
- Automatic Detection of Customer Power Quality Issues
- Exchange customer data with third party suppliers

Customer Services Use Cases

- Near Real Time Meter Consumption Data & Billing Information on In-home Display and Web Portal
- Customer Load Cycling through Real Time Pricing
- Customer Appliance Control & Cycling through In-home Zigbee Network (Future)
- Improved Customer Support through near Real Time Customer Account Data
- Enable Power Transfer from non-traditional Generation Sources (i.e., Wind, Solar, PHEVs, etc.) to Utility Grid
- Customer Notification of Outage, System Problems and Restoration Times
- Customer override of remote On-Off Cycling of Load

Distribution System Operation & Control Use Cases

- Load Curtailment
- Voltage & VAR Control
- Automatic Feeder Fault Sectionalization & Customer Restoration
- More Granular Fault Detection/location & Crew Dispatch using Substation SCADA, Smart Substation & Field Monitors, IEDs & AMI Data (Future)
- Transformer Saving using Transformer Temperature & Load Data
- Improved System Planning/Optimization through use of AMI Data
- Improved Power Quality Monitoring
- Improved Efficiency of Workforce Response to Outages
- Improved Optimization of Electric System Assets
- Improved Post Mortem Analysis after an Outage leading to System Improvements
- Improved Service Restoration & Feeder Reliability
- Effective Integration of Non-traditional Generation Sources, Wind, Solar, PHEVs, Fuel Cells, etc.

Transmission System Operation & Control Use Cases

- Improved System Protection through Adaptive Transmission Line Protection Settings
- Improved Post Mortem Analysis of Faults and Corrective Action Plans
- Improved Transmission System Optimization, Control and Stability (Synchrophasors)
- Improved Transformer Reliability (Dissolved Gas Analysis and other advanced Equipment Monitors)

Smart Grid Communications

- Remote Application of Device Configurations
- Rapid Password Control, Authorization & User Termination
- Rapid capture & analysis of System Analytics
- Control Network and System Security
- Configuration Control, Network and Device Access, Control & Permissions
- Improved Patch Management
- Improved Communication Network Monitoring, Fault Detection and Remediation
- System Wide Administrative Control of all Electric System Devices
- Improved Network Reliability
- Improved SCADA Communications for Substations
- Provide Communications to a broad range of Distribution System Devices to improve Network Awareness, Efficiency and Reliability (e.g.: Cap Banks Controllers, Voltage Regulators, Sectionalizers, ACRs, Sensors, Fault Indicators, Distribution Transformer Monitors, etc.)
- Diagnose Network Health Issues and Respond in Advance of Network or Circuit Breakdown
- Effectively Detect Unauthorized Network Access Attempts (Hacking/Intrusions Alarms)

OTHER NON SMART GRID UTILITY APPLICATIONS

- Provide Reliable Mission Critical Mobile Voice Communications
- Provide effective and reliable trouble ticketing to Field Workforce
- Provide effective communications for improved Workforce Management
- Provide effective IP-based SCADA Communications for "Off Network" Substations

Question 5

What are the technology options for Smart Grid and other Utility communications?

PHI Response: The following reflects technologies explored or otherwise selected by PHI for Smart Grid use. When PHI initially began its evaluation of Smart Grid communication technologies we engaged IBM to assist us in our broad evaluation of suitable technologies. Since making our technology selections we have secured the assistance of A&E Firms such as Burns & McDonnell[4] to assist in the detail design of those systems. Among the technologies evaluated included commercial carrier services. Note the technologies presently being leveraged by PHI.

Smart Grid Communications

Backbone Network: Fiber/MW utilizing MPLS at the Core

Bridging Technologies: WiMAX using Licensed Spectrum, Pt to Pt MW, Commercial EVDO

Outside Plant/Grid Comms: Unlicensed Wireless Spread Spectrum – Mesh (SSN) and ZigBee for Customer HAN

Other Technologies Tested:

- BPL – Considered but determined to be expensive and not sufficiently reliable for our purposes
- Commercial Services – Broadly used to fill in whenever private networks are unavailable or costs prohibit a private network build. Note: *Service reliability has not yet been fully evaluated for Smart Grid.*

Non-Smart Grid Communications

Core BES Substation Communications: SONET with Channel Banks, DACs, etc.

Relay Protection: Channel Banks off SONET Networks, Direct Fiber, Licensed MW, PLC and/or commercial public carrier services.

BES Substation Communications w/o Fiber: Licensed Point to Point Microwave

Wireless Communications for non-Mission Critical Applications: Unlicensed Radios for a variety of Systems & applications

Small Substations in Rural Areas: Licensed MAS

Voice Communications: Private Land Mobile Radio augmented by Cell Phones

Mobile Data: Commercial EVDO Services

Question 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?

[4] Burns & McDonnell website: http://www.burnsmcd.com/portal/page/portal/Internet/About_Us

PHI Response: PHI believes that providing communications recommendations based on specific use cases will not provide adequate clarity or sufficient specificity to ensure our Smart Grid needs are met. We believe to achieve the vision of Smart Grid, Utilities need to develop high capacity fully integrated communications networks which leverage a variety of communication technologies specifically designed and tailored to meet a variety of applications and needs working together harmoniously. From a user standpoint, the network will feel and operate like a single network much the way high capacity commercial carrier network look and feel to their users. It is our belief that the days of single application communication networks at utilities is over. These networks were inefficient and did not enable broad integration of applications or information sharing. Although these older networks offered a level of security due to the proprietary nature of these networks, they are completely incompatible with a Smart Grid. Rather, utilities need to be more focused on interoperability, integration and security if they are to be successful in the new world of Smart Grid. To that end, the following recommendations based on application needs are offered:

- IP Backbone Networks (Fiber & Licensed MW) utilizing Synchronous Optical Network (SONET), Multiprotocol Label Switched (MPLS) Networks, SONET compliant radio, Licensed and Unlicensed Broadband Radios, etc. **Recommendation:** *Substantial fiber and suitable spectrum for point to point radio applications exist to provide a robust Utility grade Power Delivery Wide Area Network supporting Smart Grid.*
- Bridging Network (Point-to-Multipoint Communications tying PHI's Backbone Transport Network to its AMI/DA Unlicensed Mesh Network):
  - **Long Term Recommendation:** *Allocate spectrum for Critical Infrastructure in sufficient spectrum blocks (i.e., channels) to allow wide area broadband use leveraging existing wireless standards such as WiMAX or possibly LTE. PHI supports the UTC recommendation for Smart Grid Spectrum in the 1.8GHz range aligning the US with Canadian Smart Grid allocations.*
  - **Medium Term Recommendation:** *Spectrum below 1GHz would have great promise for Smart Grid and would substantially lower the cost of deployment for utilities. (i.e., reduce the number of tower sites needed to provide system wide coverage. Additionally, any allocation of licensed spectrum specifically and substantially below 1GHz with sufficient channel sizes to accommodate existing WiMAX chip sets could provide immediate help as it would substantially reduce the time needed by equipment manufacturers to develop and produce equipment suitable for our purposes.*
  - **Short Term Recommendation:** *A favorable environment which encourages Utilities to acquire spectrum previously allocated for other purposes would provide immediate relief in areas where little useable spectrum exists.*
- Wireless Mesh supporting Distribution Automation (DA) & AMI: PHI has tested, contracted and is in the process of building an Unlicensed Wireless Mesh initially supporting AMI but in the process of leveraging the system for DA communications. **Recommendation:** *Our experience is that these systems meet our immediate needs for Smart Grid. As Smart Grid applications grow so will the need for additional spectrum be necessary. It is our belief that licensed spectrum allocated and enabling substantially higher data rates will be necessary in the future if Smart Grid is to achieve its full promise.*
- Home Area Network (HAN) – PHI has tested, contracted and will in the near future deploy unlicensed ZigBee communications in support of customer load control programs. This

infrastructure is being designed as a Utility communications conduit that will be capable of supporting real time usage for our customers thereby providing them with necessary tools to manage their consumption. **Recommendation:** *Given we are using unlicensed spectrum; we see no immediate need for anything beyond what is presently available within the ISM Bands[5]. Relative to the future, we see a need for higher bandwidth networks supporting customer energy efficiency applications. It is our hope that as Smart Grid communication networks expand and are refined there will be greater opportunities to more tightly integrate our communications supporting customer applications with commercial carrier services improving the customer experience while ensuring costs remain low.*

- As with any utility grade network, redundancy and network element carry-over relative to backup power remains a critical part of any utility's communications network design.

Additional Clarifications: *Communication options for Smart Grid, beyond those identified above, PHI envisions the liberal use of commercial carrier services for AMI collectors in areas where our private communication networks and systems do not extend due to prohibitively high deployment costs. To the extent they can be shown to meet our needs for reliability we will expand their use. Finally, we will continue to evaluate new technologies or spectrum opportunities as they become available for our use.*

Question 7

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

PHI Response: Existing commercial networks presently provide necessary and reliable communications for both voice and data services. For example, PHI has moved to leased commercial services for its mobile data communications, it outfits field crews with smart phones and uses leased analog lines for critical substation communications & feeder protection. We are also exploring and trialing commercial EVDO services for Smart Grid (i.e., AMI Collectors).

However, it must also be recognized that our use of private communication networks was born out of a need for greater reliability for mission critical applications. Commercial carrier leased services do not always represent the most reliable networks for our use. We have found restoration times can be very long and impede our ability to serve our customers and restore electric service in a satisfactory manner. Service Level Agreement which carriers are willing to enter into, in general, do not provide the priority and value needed and required by utilities. Commercial carriers often show little interest in providing tiered priority routing through their networks and when they do provide some levels of priority routing it always below public safety, emergency management, and federal, state and local government agencies. To the extent Commercial Carriers would be willing to reconsider or the Federal Government would be willing to mandate Commercial Carriers to address these important needs, Utilities would be willing to reconsider the use of Commercial Carrier networks.

Question 8

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

[5] ISM band is the Industrial, Scientific, and Medical band which are unlicensed frequencies

PHI Response: Commercial Carriers should not be forced to change or modify networks built for other purposes. These networks were built for a different use and serve the customers they were built for very well at a very reasonable cost. Adding new requirements and regulations to these networks will drive up the cost to build and maintain those systems in inefficient and costly ways. For example, Commercial Carrier networks are designed to support heavy bandwidth demands to the subscriber end while utility applications needs are from the subscriber to the head-end. Although this sounds like a synergy, it is not. The result of retuning their networks to our needs would likely create unnecessary congestion for consumers in favor of utility specific needs which are often sporadic (i.e., bursty), more heavily weighted on the upload side and characterized by highly crucial and time sensitive applications. Additionally, if Commercial Carriers restore utility services first it may negatively impact or delay critical life saving emergency services (i.e., 911 services), etc. Utilities also need to have the ability to define and qualify various tiers of network Quality of Service to ensure applications such as network fault identification and restoration, customer outages, electric system physical and cyber security; SCADA, relay protection, etc. are staged to ensure our systems operate as designed and yield the highest level of reliability and security per our needs.

Carriers presently have only a minor Federal mandate to restore Utility services through the provisions set under the Telecommunications Service Priority system.[6] It has been our experience that this service mandate has not yielded the level of priority restoration needed to meet Utility needs. In contrast, whenever we experience an outage on our core private networks we have complete control over restoration thereby ensuring a higher level of reliability. Finally, Commercial Carrier network upgrades and technology changes/improvements to their systems often necessitate the replacement of communications equipment broadly throughout a Utility's network often causing a substantially reduction in asset life.

Question 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?

PHI Response: PHI believes that as Smart Grid expands, there will be a rapid infusion of new technologies improving our ability to enhance reliability, provide more granular system monitoring and control, shorten restoration times, provide dynamic system optimization and improve electric system planning while enabling new tools which will allow our customers to maximize the efficiency of their electric consumption. These new applications will place increased demands on our communications networks, many of which are not easily predictable or known at this time. A similar parallel could be drawn to the Internet. In the earliest phases of the Internet, dial-up access was common. Applications were limited and the demands on available bandwidth were minimal. However, as business and consumers saw the value of information sharing, applications and demands increased exponentially. We believe the same will happen with Smart Grid. Technological improvements to the electric grid have been stymied by the lack of communications. Smart Grid will change all of that but only if adequate communications are made available.

[6] US Department of Homeland Security "Telecommunication Service Priority: see http://tsp.ncs.gov/

PHI sees bandwidth demands for Smart Grid growing rapidly. PHI envisions a time where the interworking of commercial carrier and power system communications networks working seamless together thereby allowing the best of both worlds without negatively impacting security or network performance. PHI believes if done correctly we (i.e., electric utilities & commercial carriers) can and should work together to achieve Smart Grid but we can only do so with necessary protected and available spectrum for utility use. As mentioned earlier, our needs are different then commercial carriers for many applications, however, that does not mean there are not appropriate uses for commercial carrier networks in Smart Grid but at this point and time in the development of Smart Grid we need an environment where we can right size our communications needs for Smart Grid rather then forcing applications onto unsuitable network simply for the sake of avoiding private networks.

Utilities know their needs better than anyone and know how to design and operate highly reliable communications networks for their unique purposes. Embedded in that knowledge is the ability to squeeze reasonable asset life from our investments. It is why electric utilities continue to be safe investments for investors. We have a proven track record of conservative use of investor's funds in ways that benefit both our investors as well as the general public we serve. This trait pushes us to design networks that are forward leaning providing more bandwidth that what would immediately be necessary but sufficient to carry the investment in infrastructure for a 15 year life typically if not longer. This approach ensures that we minimize the impact to our customers while ensuring a reasonable rate of return for our investors.

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[i] Critical Infrastructure in the context of this RFP aligns with the broader definition as defined by DHS which more broadly includes the delivery of "Energy" services rather then the more narrow definition as defined by NERC under its Critical Infrastructure Protection (CIP) standards.