FPL

July 12, 2010

U.S. Department of Energy
Office of the General Counsel
ATTN: NBP RFI: Communications Requirements
1000 Independence Avenue, SW
Room 6A245
Washington, DC 20585

Re: DOE Request for Information – Implementing the National Broadband Plan by Studying the Communications Requirements of Electric Utilities to Inform Federal Smart Grid Policy

Introduction

A wholly-owned subsidiary of NextEra Energy, Inc., Florida Power & Light Company (FPL) is a public utility incorporated in the State of Florida that provides wholesale and retail electric service. It is one of the largest and best-performing electric utilities in the nation. In 2008, FPL served 4.5 million customer accounts over a 27,000 square mile service territory, delivering electricity to more than 8.8 million people. FPL owns and maintains 73,700 miles of transmission and distribution lines in Florida. As a vertically integrated utility, FPL requires communication capability across the entire service territory to support generation, transmission, distribution and customer service business operations.

FPL customers expect affordable, reliable, clean-energy solutions now and in the future, and FPL is committed to meeting this expectation by investing to make its infrastructure stronger, smarter, cleaner, and more efficient. The utility currently has the lowest residential rates of all 55 utilities in the state of Florida and service reliability significantly better than the national average. Investing in Smart Grid technologies will help FPL keep service reliability high over the long term and give customers more information to better manage their energy use.

FPL strongly supports national smart grid deployment. FPL was awarded a $200 Million American Recovery and Reinvestment (ARRA) Smart Grid Investment Grant from the Department of Energy to help support the “Energy Smart Florida” deployment of smart grid technology. Smart Grid technologies will help FPL achieve greater energy efficiency and integrate cleaner, alternative energy sources – such as wind and solar – while enabling innovation and helping to reduce Florida’s emissions and carbon footprint.

FPL hereby respectfully submits the following comments in response to the request by the Department of Energy for comments to <u>Implementing the National Broadband Plan by Studying the Communications Requirements of Electric Utilities To Inform Federal Smart Grid Policy</u> (Federal Register/Vol.75, No.90/Tuesday May 11, 2010).

Summary

The National Institute of Technology and Standards (NIST) define Smart Grid as the "two-way flow of electricity and information to create an automated, widely distributed energy delivery network". FPL strongly supports the Department of Energy Smart Grid vision that enables energy efficiency and the widespread use of renewable power and electric vehicles to reduce the country's dependence on fossil fuels and foreign oil.

Smart Grid, the two-way flow of electricity and information between utility and customer, relies on the underlying communications infrastructure. Communications must be:

- **Two-way** to interact with customers, intelligent devices within the home, and integrate emerging consumer technologies such as roof-top solar and electric vehicles
- **Pervasive** to reach all utility infrastructure, FPL field workers, and customers (wherever they consume power and access information about their power use and its impact on the environment)
- **Cost effective** to enable consumers to benefit economically from Smart Grid investments
- **Scalable** to accommodate large volumes of data from smart meters, grid sensors and intelligent homes
- **Near-Real Time** to ensure safety, allow for outage management, and protect/control the power grid
- **Resilient** to support utility operations during and after natural disasters such as hurricanes
- **Hardened** to protect against cyber-attack and unauthorized access of confidential information
- **Flexible** to accommodate increasingly complex use cases that involve utilities, commercial carriers, customers and their in-home devices
- **Standards-Based** to enable utilities to use best of breed solutions and drive equipment cost toward commodity level pricing

Utilities must weave cyber security into the fabric of Smart Grid infrastructure using a layered architecture and defense in depth. Digital certificates, public key infrastructure, encrypted network communications, and role based access control are among the technologies and processes that will protect grid integrity and privacy of customer data. Integrated, end-to-end smart grid security will include access, authentication, encryption and physical security to identify and mitigate potential risks to smart grid assets and information. Also, utilities must be aware of and constantly mitigating the constantly changing threat and new vulnerabilities.

No single communications technology or carrier can reliably and cost-effectively deliver the diverse communications needs of Smart Grid. Just as the Smart Grid is a 'system of systems', the supporting communication infrastructure will be a 'network of networks'. Grid

command and control systems demand near real-time capability with <u>certainty of delivery</u>. Intelligent devices on the grid will generate volumes of data which the utility will analyze with predictive analytics to improve efficiencies, reliability and equipment service life. Two-way communication with customers and their intelligent devices in the home demand pervasive connectivity throughout the entire service territory. Adoption of electric vehicles will drive fundamental changes in where and how customers access power – introducing a mobile element to the two way flow of information and power.

Utilities rely on a blended solution of utility and commercial, wired and wireless networks. Blended networks are the best solution to meet the diverse utility requirements for coverage, capabilities and cost**.** There are actionable ways commercial carriers can move toward hardening and improving their networks for utility use (e.g. providing robust communications with no single point of failure in remote geographical areas with low customer density).

Utilities require dedicated spectrum, or spectrum with preferential rights, to conduct core business operations in life-critical situations and during restoration from hurricanes and other disasters. 'Can you hear me now' is not good enough for a field crew facing a potentially life threatening situation while working with high voltage power**.** In these situations instantaneous 2-way communications is a must. Following hurricanes and natural disasters, utilities require a core foundation of voice dispatch to begin initial restoration work; this demands priority service comparable to first responders.

Florida's weather is a major driver for FPL's use of a private, utility network. FPL maintains a utility voice radio network to ensure business continuity during hurricanes and severe weather. FPL tested commercial "push-to-talk" service with field crews in 1998. After an extensive six-month pilot, all participants agreed commercial service was not a viable alternative to FPL's private radio system. This was validated in the 2004/2005 hurricane restoration, where FPL private radio was consistently the most reliable service throughout the devastated areas. FPL continues to monitor the maturity of commercial wireless services – FPL most recently validated these conclusions in a 2010 test of 'push to talk' commercial service.

Utilities cannot rely on the Internet as the sole path to deliver mission critical utility services which require certainty of delivery. Internet and broadband connections are not available to all customers**;** Connections are owned and operated by the customer with no certainty of availability. Utilities will continue to use the Internet for 'value added' utility services.

FCC and DOE should strongly consider a dedicated wireless network (with common spectrum and equipment) for mission critical utility operations, first responders and public safety, consistent across the utility industry. Initial storm restoration is comparable to first responders such as police and fire. A base level of voice dispatch is the utilities lifeline to connect power to critical public facilities (including the commercial carrier facilities)**.** Common spectrum and equipment would also improve utility interaction with police, fire and other public safety agencies, improve overall system security, improve utilities' ability to utilize crews from other states in the case of widespread restoration such as hurricanes, and drive equipment toward commodity pricing through economies of scale.

Detailed Response

Question One: 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?

Smart Metering

Current State
FPL will deploy 4.5M smart meters over the next 3 years to measure power use for billing, deliver usage data to customers via an Internet portal, identify power quality issues, and identify anomalies occurring at the meter that require action (failures, theft, etc.). In addition to scheduled data reported to FPL every four hours, there will also be condition-based events including:

- Commands to remotely connect or disconnect the meter
- Outage notification / power loss notification at the meter
- Restoration notification
- Meter registration to the network
- Firmware upgrades and configuration

FPL will leverage the metering communications framework to test advanced energy efficiency and demand response functionality. These functions require additional devices in the home and will be deployed in limited scale to:

- Deliver 'real time information' from meter to in-home devices
- Communicate changes in price of power for specific time intervals
- Commands to turn on/off devices or change settings on devices such thermostats

Future State
Smart Metering is a technology, legislative and regulatory work in progress. Until consensus on Smart Grid policy is reached at the national and state levels, FPL's approach is to understand how to best utilize the existing metering communications infrastructure to determine how best to provide new customer services, increase efficiencies for the utility, and support new energy efficiency directives and regulations.

Functionality under investigation includes:

- Mass market rate structures based on time of use coupled with in-home price notification (supported through the utility metering infrastructure or Internet)

- Capture meter data at smaller intervals (e.g. 15 minute intervals)
- Implement advanced billing options (e.g. usage notification, bill forecasting, customer selected bill day, pay as you go billing)

This functionality will require additional investment and FPL will move forward only where there is value to customers and shareholders – with clear mechanisms to ensure cost recovery.

Communication Technologies

FPL is implementing a 900 MHz mesh utility network to support smart metering (the Neighborhood Area Network or NAN). Devices communicate on the ISM bands, 902-928 MHz. FPL incorporates the use of Frequency Hopping Spread Spectrum (FHSS) in all communications occurring on the NAN. FHSS is a mechanism of transmitting and receiving radio signals, where these signals are transmitted over frequency channels in a random sequence that is known only to the transmitter and receiver. FHSS are typically resistant to narrowband interference, by hopping or changing to different frequencies as a means to mitigate interference. The random nature of the frequency hopping algorithm makes intercepting FHSS signals difficult, offering an additional layer of security. In addition, spread-spectrum transmissions can coexist in a given frequency band with many types of conventional transmissions with minimal interference.

AMI Network Components	
Comm Module	Communications module necessary for gaining access to a wireless mesh network. Device can reside with in a meter, be installed as a meter collar or an ancillary device for establishing communication with distribution assets. For the most part these communication modules are the most pervasive component of the Wireless Mesh network.
Neighborhood Area Network (NAN)	A group of customer premises and/or distribution automation equipment that is interconnected through the use of a Wireless Mesh network.
Relay	Serves as lower tier distributed control point for local mesh network. Provides redundancy through meshing with other relays. Acts as an intemidary point for communicating with a Gateway.
Access Point	Serves as top tier distributed control point for local mesh network. Provides redundancy through meshing with other gateways. Supports a number of backhaul communication alternatives; Ethernet, UMTS, cellular, etc.
Mesh Network Management	Open, IP-based network management platform for utility information and control networks.

The mesh network aggregates data to collection points where meter data is transferred to back office utility applications. FPL owns and operates the mesh network to the collection points, then uses commercial carriers to move meter data to the utility data center. FPL is using or investigating the following options for backhaul communications to the data center: Cellular (GPRS, 3G), DSL, and Satellite. This blended network leverages the utility and commercial communication networks to deliver a reliable, cost effective solution that can reach all FPL customers.

Due to the scale of the mesh network, FPL is implementing IPv6 which provides a 128bit address space – enabling significantly larger volume of available addresses than IPv4. The use of TCP/IP provides standards based approach for communication and encryption of NAN traffic. IPv6 provides inherent benefits in the areas of spoofing and administration.

FPL Smart Meters support 2.4GHz ZigBee communications to enable future connectivity to in-home devices, although this functionality is not active and will require additional investment.

Distribution Automation & Intelligence

Current State

Current Distribution Automation (DA) is focused on obtaining real-time status and telemetry from field devices such as breakers, switches and capacitor banks. FPL monitors device status and analog data via periodic polling with reporting by exception status change or exceeding pre-determined thresholds. Diagnostic data is derived from Supervisory Control and Data Acquisition (SCADA) data and applied in limited fashion to determine health metrics for distribution power components.

Future State

FPL is leveraging the AMI mesh network to enable self-healing automation and remote monitoring of distribution components. The improvements increase power system reliability with fewer interruptions, faster restoration, improve power quality and enable more efficient use of distribution assets.

FPL will implement a host of new field devices to enable new smart grid functionality:

- Automated Feeder Switches (AFS) improve power reliability and reduce the frequency of customer outages by improving fault detection, isolation and restoration (FDIR) capabilities
- Two-Way Capacitor Controls (TWCC) reduce energy losses on the distribution system and improve voltage quality on the grid
- Monitoring equipment for Throw-Over Switches communicate important information about switch operations to improve power reliability and reduce service restoration time
- Voltage and Current Sensors improve power quality by optimizing voltage and preventing overload conditions over the grid
- Remote Fault indicators (RFI) enable faster restoration during sustained interruptions and assist in investigation of momentary interruptions
- Remote Monitors for Transformers enhance power reliability for customers and improve asset utilization through better performance monitoring of distribution substation monitoring, large vault transformers and step-down transformers
- Other grid devices, backed with advanced analytics to enable faster and more accurate fault detection, isolation and restoration

Communication Technologies

Currently the main data sources are in substations and use the substation frame relay network. As part of the Energy Smart Florida implementation, FPL will leverage the AMI Mesh Network to enable outage detection and grid self-healing. In addition, the increased flow of information will enable detections of deviations from normal system performance and implement predictive and proactive maintenance and outage prevention.

Transmission / Substation Automation & Intelligence

Current State

The primary driver for Transmission/Substation communications is the need for operational data to determine the real-time status of the power. Substation equipment data provides device status, power system parameter modeling, and supervisory control/dispatch for system operators to:

- Monitor device status and power flows through polling, with reporting by exception on status change or exceeding predetermined thresholds
- Poll Phasor Measurement Unit (PMU) data for regional data collection
- Selectively retrieve Digital Fault Recorder (DFR) data for system events
- Interpret SCADA data to determine health of key power system components

Future State

Remote monitoring of additional power system parameters at higher rates and greater resolution will improve analytics and dynamic system modeling. In addition to operational data, remote condition assessment and asset health monitoring will improve reliability and extend the service life of key power system components. Increased telemetry improves detection of deviations from normal operating performance and the implementation of predictive maintenance and outage prevention.

Device status updates will be faster, the amount of power flow data will increase due to the sophistication of enhanced applications (contingency & security analysis etc…), and to the increased distributed generation affects

- Phasor Measurement data will flow at a constant rate regardless of deviations in the system – it is a continuous, rather than exception based system. The number of units may increase as applications evolve and intermittent distributed generation emerges as a mainstream technology

- Digital Fault Recorders (DFR) and Digital Disturbance Recorder (DDR) data will trigger analysis applications associated with the diagnostic centers

- Substation and device access will be monitored & controlled from a remote secure application system

- Diagnostic data will be a significant proportion of the scanned data in order to increase the reliability of the installed infrastructure

- Engineering, real-time, diagnostic & historical data will be available to field personnel through a secure network allowing for prints, data and records to be worked & updated as we migrate to a paperless environment

- Wireless voice communications with a GPS system for vehicle location will be standard throughout the field organizations

Communication Technologies

FPL Transmission sites are connected using carrier provided frame relay circuits, utilizing EVDO wireless for redundancy. Major substation and other transmission sites operate under NERC/CIP standards to protect the bulk power supply. FPL maintains utility local networks within substations and other major transmission facilities.

Source	Destination	Interface	Bandwidth
Carrier	Substation router	Ethernet / Serial	56 - 128 kbps
Substation router	Substation Ethernet Switch	Ethernet / Fiber	10 / 100 / 1000 Mbps
Substation Ethernet Switch	Substation Controller	Ethernet	10 / 100 Mbps
Substation Controller	DA Radio	Serial	9600 bps

FPL Substation Communication Interfaces and Bandwidth

Generation

Current State

FPL operates 24,530 megawatts (MW) of generating capacity in the State of Florida. Communication networks in each fossil plant are segregated into control and business segments. Control segments operate within the plant boundaries and interconnect sensor/control nodes that actively control and monitor plant operations. Plant control segments operate under NERC/CIP standards to protect the bulk power supply.

Business segments carry all other plant communications and connect plants to other FPL corporate locations. Business segments are not under NERC/CIP standards and carry information that support the business functions of the plant and provide telemetry data to FPL's centralized Fleet Performance & Diagnostic Center (FPDC) to improve plant efficiencies and reliability.

Future State

FPL does not anticipate smart grid deployment will drive significant changes in plant communication requirements. Business functions such as videoconferencing, video training and video surveillance will demand additional bandwidth to the plants over the next ten years. One potential driver for additional bandwidth is the projected growth in solar generation. FPL has undertaken three renewable generation projects, totaling 110MW of solar capacity – Desoto, Space Coast, and Martin. Due to the decentralized structure of solar generation, these plants contain more telemetry points than traditional fossil plants - current sensor count for Martin is 80,000 nodes. As FPL and other utilities deploy more solar and other renewables, there will be a corresponding increase in plant telemetry used to optimize plant operations. This will increase the communication requirements to move data to centralized FPL performance and diagnostic systems.

Communication Technologies

FPL power plants and all FPL facilities are connected using carrier provided networks. Depending upon the criticality of the site, FPL uses multiple carriers to achieve diverse paths to the facility. FPL nuclear plants utilize fully redundant DS3 commercial circuits. FPL does not anticipate migrating from commercial networks for plant and facility connectivity.

Enhanced Performance and Diagnostic Centers (EPDCs)

Current State

Analytics are a key enabler for driving the maximum value from smart grid investments. Functionality such as self-healing and predictive maintenance rely upon the processing of smart grid data. In many cases, applying analytics and modeling can leverage existing data and reduce the need to add additional grid sensors and communications.

As part of Energy Smart Florida (ESF), FPL will leverage and increase the utilization of existing performance and diagnostic centers through increased telemetry from grid sensors and the development of advanced analytics that leverage an end-to-end grid view.

Key functions include:

- Enhance Statistical Diagnostics to anticipate and prevent equipment failure
- Expand Data Historian to include Transmission and Distribution grid data
- Enable Early Detection of System Anomalies
- Deliver Consolidated Operation Risk & Reliability Views

Future State

Performance and Diagnostic Centers communication needs will increase as FPL deploys additional intelligent devices on the grid. Several factors could significantly increase data volumes – including intelligent home devices, distributed generation, electric vehicles and other emerging technologies.

Communication Technologies

FPL Performance and Diagnostic Centers are located at major FPL facilities connected using carrier provided networks.

Voice Radio Communications

Current State

FPL utilizes 2-way land mobile radio communications to voice dispatch workers maintaining and restoring the electric grid (generation, transmission and distribution systems). The Analog EDACS Trunking System operates at 900 MHz. FPL engineers and constructs these systems to withstand hurricanes and the harsh Florida environment. FPL builds Radio Towers to survive significant category 4 hurricanes, with commercial power backed up with generators and battery systems. Tall tower coverage design limits service interruptions in the harshest conditions, with a recovery rate much faster than commercial services. The FPL system is a network of over 75 locations providing service to over 7000 utility workers/users.

Current functions include:

- Dispatch field crews for restoration and routine maintenance
- Enable field crews to coordinate to a common dispatch point to ensure actions taken to maintain and restore electrical service are performed in a safe and efficient manner
- Enable field crews to declare an emergency based on risk to workers or the public
- Ensures a foundation level of mission critical communications following a significant (Category 4 and higher) hurricane

Future State

FPL is reviewing options for the next voice radio communication system. FPL will evaluate commercial providers of 2-way land mobile systems; however there is significant concern these systems are not designed to recover as rapidly as the private utility system to support initial storm restoration.

FPL is interested in exploring options to combine voice radio systems and resources with public safety and other first responder entities. At this time the regulations that govern Public Safety and Utility Spectrum do not promote this convergence, despite the potential value to all parties.

Mobile Data Communications

Current State

Historically, FPL relied on a private data radio system to service the mobile computing needs for field crews. This system operates at 450 MHz on 25 KHz channels. With the growth of business systems requiring additional bandwidth, FPL's direction is to provide the field workforce with commercial cellular data, while relying on the private data network as a backup system in case of hurricanes and other disasters. At this time 80% of the field workforce depends on commercial systems as their primary means of receiving data in the field.

Future State

As FPL continues to automate the field workforce with additional computing and communication capabilities, our direction is to increase the use of the commercial wireless systems. Providing mobile workers with detailed engineering drawings, maps and videos of work processes will enable a more productive workforce to provide safe, reliable power.

To increase FPL's use of commercial systems, carriers should harden the systems to ensure reliability in storms and other disasters. The DOE should require carriers to provide utilities with reliability data, agree to meet performance SLAs, and share their detailed disaster recovery plans. These measures will significantly improve the ability of commercial systems to meet utility communication requirements.

Messaging Communications

Current State

FPL utilizes messaging/paging to address many critical utility services. The system that FPL has in place is built around two private messaging switches that provide message delivery to both private and commercial systems. The private system operates at 150 MHz and operates on three different frequencies across the service territory. By delivering messages to both private and commercial systems FPL has the option of providing redundant service for mission critical functions. These services include:

- Notification to Nuclear personnel for events that require immediate actions or mobilizations to take place
- Alerting key service restoration personnel in the field to improve awareness or communicate work assignments
- Control of grid devices to regulate the delivery of power
- Communicate alerts on equipment outages of various types to field personnel responsible for restoring service
- Communicate to FPL customers power related events like outages and restoration updates

Future State

FPL private system is comprised of a 45 site system that delivers traditional 1-way status or control messages to devices. The core of this system is impacted by the FCC Narrowbanding of Spectrum below 512 MHz. FPL is reviewing alternatives to address the narrowbanding requirements. This will include but not be limited to:

- Replacement of messaging transmitters and receivers to address narrowband requirements
- Review and consideration of which forms of notification are not mission critical and can be migrated to commercial services

- Integration of some of the current customer notification systems with the Smart Grid technology offerings
- Integration of some of the electrical system device control into the Smart Grid technology offerings

Nuclear Siren Notification System

Current State

FPL utilizes privately held radio licenses and infrastructure to control emergency siren systems and to deliver recorded messages to the communities surrounding a nuclear plant to provide alerts and emergency notifications. These messages provide critical information to the entire population for ten miles surrounding the nuclear plants in the event of a plant emergency as mandated by the NRC. These are robust systems built to withstand the harsh Florida environment and must be available with high reliability night and day. These systems use the same Radio Towers used in our voice radio infrastructure and are built to survive significant category 4 hurricanes. Commercial power is backed up with generators and battery systems, and a tall tower coverage design is used to provide a system that will limit outages in the harshest conditions while being able to recover much faster than commercial services. The FPL nuclear siren system is a network of two locations for each plant providing diverse geographic locations and redundant infrastructure for critical emergency plant information to residents and FPL customers in the local area. By law the Nuclear plant cannot be in operation if this system is not available. The current functions of this technology:

- Provides a means to notify the community local to the nuclear plants of emergency conditions
- Provides the nuclear plant a means to communicate possible evacuation and travel routes dispatch to masses immediately to insure that correct information of health and safely are sent to the public
- Assures that the system operates with very high availability and reliability
- Assures that a minimum level of mission critical capability is available following a significant hurricane (category 4) and that the system can be restored quickly

Future State

This system is critical to nuclear plant operations. Testing and performance data are required by the NRC as a part of the license to operate the plant. No commercial providers of this service are in this business and it is doubtful that FPL would be willing to rely on a third party's ability or capability to provide this service and reliability.

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?

Smart Grid, the two-way flow of electricity and information between utility and customer, relies on the underlying communications infrastructure. Communications must be:

- **Two-way** to interact with customers, intelligent devices within the home, and integrate emerging consumer technologies such as roof-top solar and electric vehicles
- **Pervasive** to reach all utility infrastructure, FPL field workers, and customers (wherever they consume power and access information about their power use and its impact on the environment)
- **Cost effective** to enable consumers to benefit economically from Smart Grid investments
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- **Near-Real Time** to ensure safety, allow for outage management, and protect/control the power grid
- **Resilient** to support utility operations during and after natural disasters such as hurricanes
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- **Flexible** to accommodate increasingly complex use cases that involve utilities, commercial carriers, customers and their in-home devices
- **Standards-Based** to enable utilities to use best of breed solutions and drive equipment cost toward commodity level pricing

Utilities must weave cyber security into the fabric of Smart Grid infrastructure using a layered architecture and defense in depth. Digital certificates, public key infrastructure, encrypted network communications, and role based access control are among the technologies and processes that will protect grid integrity and privacy of customer data. Integrated, end-to-end smart grid security will include access, authentication, encryption and physical security to identify and mitigate potential risks to smart grid assets and information. Also utilities must be aware of and mitigating the constantly changing threat of new vulnerabilities.

To define smart grid communication functional requirements, the National Institute of Standards and Technology utilizes use cases – a system engineering methodology that captures functional requirements by breaking business outcomes into a sequence of detailed steps. At each step, the methodology identifies the specific communication requirements.

The United Telecom Council (UTC) uses the following characteristics to map communication technology to business functional requirements:

- **AC Independence** – Backup power (in hours) following loss of electric service
- **Bandwidth** – Data rate required by application during normal & emergency operations
- **Coverage** – Percentage of utility service territory network must operate
- **Latency** – Summation of processing and network time from origination to destination
- **Reliability** – Probability an operation will complete without error over a specific interval of time (e.g. 99.999%)
- **Security** – Level of network security from cyber and physical attacks

Using a set of preset values (e.g. subsecond, seconds, minutes) for each communication characteristic (e.g. latency), utilities can profile the communication functional requirements for smart grid applications. FPL uses this methodology in Question 4 to profile the communication needs for smart grid use cases.

High Level Smart Grid Communication Characteristics

Characteristic	Values				
Coverage (Service Territory)	Ubiquitous	Targeted			
Latency	Subsecond	Seconds	Minutes	Hours	Days
Bandwidth	bps	Kbps	Mbps	Gbps	
Availability (Routine)	< 99.9%	99.9%	99.999%		
Availability (Storm)	< 99.9%	99.9%	99.999%		
Security	NERC/CIP	< NERC/CIP			
Safety	Life-Critical	< Life Critical			
Endpoints	< 10	< 100	< 1,000	< 10,000	1,000,000+

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

Florida's unique geography and climate pose significant challenges to FPL's communication needs. FPL's service territory covers 27,000 square miles – ranging from major metropolitan areas such as Miami to broad tracts of agricultural and wilderness areas such as the Everglades. While multiple commercial carriers provide service in cities and suburban areas, no single commercial wireless carrier covers the entire FPL service territory.

Power Plants and FPL's transmission infrastructure are located in areas with very limited population. There are actionable ways commercial carriers could improve their networks in remote areas – hardening, eliminating single points of failure, and providing battery and backup generators for extended outages during hurricane restoration.

Hurricane restoration drives FPL's most stringent communication requirements. The table below illustrates the impact of hurricanes during the 2004 and 2005 storm seasons.

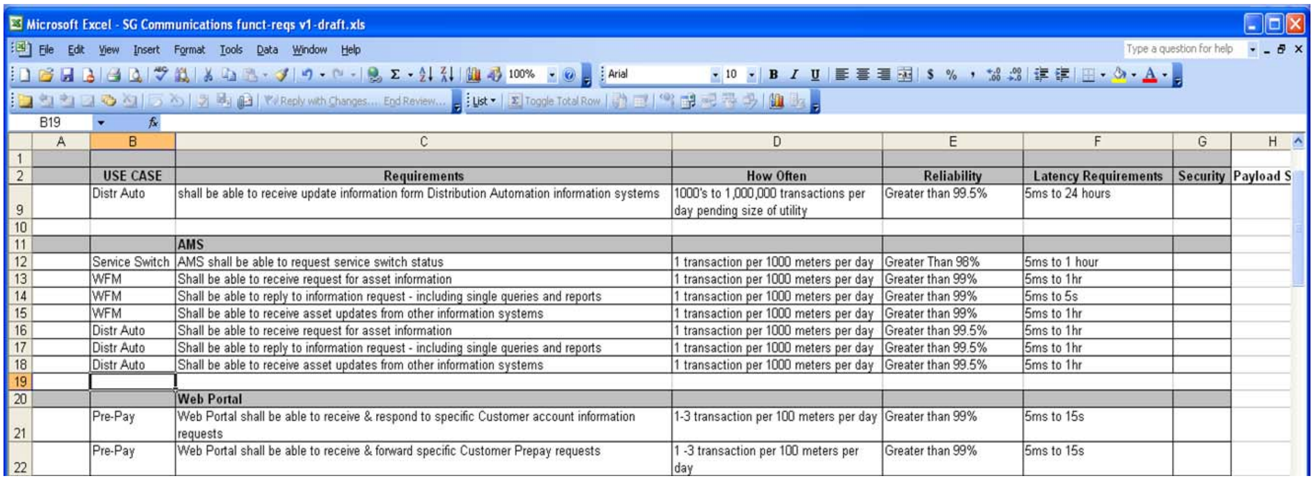
Year	Name	Wind Speed	Customers Impacted
2004	Charley	145MPH	874,000
2004	Francis	105MPH	2.8 Million
2004	Jeanne	120MPH	1.7 Million
2005	Wilma	125MPH	3.2 Million

Storm events damage the underlying communications infrastructure, while public demand for wireless and other communication services peaks. Commercial systems experience extended outages and capacity overloads. During major storm events, cellular towers and sites can be without power for extended periods. Since dispatch radio is mission critical for storm restoration, FPL private radio sites are hardened for 120MPH winds and supplied with backup batteries and generators. Batteries maintain FPL radio sites up to 24 hours, and then backup generators provide power for extended periods.

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

FPL strongly supports UCA International Users Group Open Smart Grid (OpenSG) and other industry efforts to develop common smart grid use cases and their network functional requirements. FPL recognizes this is a detailed, time consuming process. Interim Release 3 of the OpenSG Network Systems Requirements Specification, still a work in progress, identifies over 30 use cases and 300 functional requirements and should serve as the foundation for developing smart grid communication use cases.

Figure 1: Extract of OpenSG Communications Functional Requirements Matrix



Microsoft Excel - SG Communications funct-reqs v1-draft.xls

	A	B	C	D	E	F	G	H
1								
2		USE CASE	Requirements	How Often	Reliability	Latency Requirements	Security	Payload S
9		Distr Auto	shall be able to receive update information form Distribution Automation information systems	1000's to 1,000,000 transactions per day pending size of utility	Greater than 99.5%	5ms to 24 hours		
10								
11			**AMS**					
12		Service Switch	AMS shall be able to request service switch status	1 transaction per 1000 meters per day	Greater Than 98%	5ms to 1 hour		
13		WFM	Shall be able to receive request for asset information	1 transaction per 1000 meters per day	Greater than 99%	5ms to 1hr		
14		WFM	Shall be able to reply to information request - including single queries and reports	1 transaction per 1000 meters per day	Greater than 99%	5ms to 5s		
15		WFM	Shall be able to receive asset updates from other information systems	1 transaction per 1000 meters per day	Greater than 99%	5ms to 1hr		
16		Distr Auto	Shall be able to receive request for asset information	1 transaction per 1000 meters per day	Greater than 99.5%	5ms to 1hr		
17		Distr Auto	Shall be able to reply to information request - including single queries and reports	1 transaction per 1000 meters per day	Greater than 99.5%	5ms to 1hr		
18		Distr Auto	Shall be able to receive asset updates from other information systems	1 transaction per 1000 meters per day	Greater than 99.5%	5ms to 1hr		
19								
20			**Web Portal**					
21		Pre-Pay	Web Portal shall be able to receive & respond to specific Customer account information requests	1-3 transaction per 100 meters per day	Greater than 99%	5ms to 15s		
22		Pre-Pay	Web Portal shall be able to receive & forward specific Customer Prepay requests	1 -3 transaction per 100 meters per day	Greater than 99%	5ms to 15s		

Souce: Open Smart Grid (OpenSG) 2010

FPL recommends the Department of Energy leverage the OpenSG work to expedite development of an industry standard set of use cases with common terminology. This work will improve the ability of utilities and commercial carriers to determine the best communication solution across a diverse range of use cases with very different functional requirements.

In this response, FPL selected 5 representative use cases that demonstrate current and future smart grid communication requirements

1. **Storm Restoration** – Radio dispatch of crews for initial hurricane restoration
2. **Routine Meter Read** – Scheduled meter read of customer power consumption
3. **Customer Web Portal** – Deliver customer consumption data through Internet portal
4. **Volt/Var Control** – Optimize distribution grid efficiencies
5. **Transmission Grid Intelligence -** Integrate asset health and diagnostic data

Question 5: What are the technology options for smart grid and other utility communications?

The following table summarizes the technology options available for Smart Grid and other utility communications:

Technology	Description
Licensed Wireless Radio	Private licensed wireless radio networks operating under Part 90 of the FCC rules
Licensed Wireless Microwave	Private licensed wireless microwave networks operating under Part 101 of the FCC rules
Unlicensed Wireless	Private unlicensed wireless radio networks operating under Part 15 of the FCC rules (e.g. Wi-Fi, ZigBee)

Fiber	Private fiber networks owned or controlled by a utility
Other Private Network	Private networks that are neither fiber nor wireless, such as powerline carrier
Commercial Wireless Network (Licensed)	Commercial networks that operate using licensed radio under Part 22 of the FCC rules (e.g. Verizon, AT&T, Sprint, etc.)
Commercial Wireless Network (Unlicensed)	Commercial networks that operate using unlicensed radio under Part 15 of the FCC rules (e.g. wireless internet service providers (WISPs))
Commercial Wireline Network	Commercial networks that use any wire line technology, including fiber, Cable, DSL, coax or traditional twisted pair copper circuits)
Satellite	Satellite includes all types of fixed and mobile satellite services, including Very Small Aperture Terminals (VSATs)

Source: United Telecom Council (UTC) 2010

Regardless of the communication technology, a fundamental guiding principle is the use of a layered communications stack that separates the physical (PHY) and media access control (MAC) to future proof smart grid deployments. This architecture empowers utilities and commercial carriers to leverage future communication technologies that offer improved coverage, capabilities and cost. FPL strongly backs the use of Internet Protocol (IP) to achieve this result.

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?

No single communication technology or carrier can reliably and cost effectively satisfy the needs of Smart Grid – there is no 'one size fits all' solution. The period of time required for a routine meter read is significantly different than an on-demand meter read where the customer is working over the phone with a call center representative – even though both business processes may operate across the same network.

FPL and utilities have historically deployed blended telecommunication networks based on coverage, capabilities and cost. The emergence of the Internet and pervasive broadband communications provides utilities with another path to the consumer. However**, the utility cannot rely on the Internet as the sole path to deliver mission critical utility services** – broadband connections are not available to all customers; connections are owned and operated by the customer with no certainty of availability.

Use Case 1: Storm Restoration – Radio dispatch of crews for initial hurricane restoration

Storm Restoration (Voice Radio Dispatch) Communication Profile	
Characteristic	**Values**
Coverage (Service Territory)	Ubiquitous
Latency	Seconds
Bandwidth	N/A
Availability (Routine)	99.99%
Availability (Storm)	95+%
Security	< NERC/CIP
Safety	Life Critical
Endpoints	Thousands

Coverage: Ubiquitous – Entire FPL Service Territory

Latency: Seconds – Delays during normal work decreases efficiency, delays during a life-critical situation involving high-voltage lines is unacceptable

Bandwidth: Voice

Availability: 95%+ during initial storm work – commercial carriers have not proven this performance level

Security: Less than NERC/CIP for protection of bulk power system

Endpoints: 7,000+ Users

Safety: Life Critical

Solution: Blended Network (Utility Radio Network with Commercial Backhaul)

Following hurricanes and other widespread disasters, utilities require a core foundation of voice dispatch to begin initial restoration work. This demands priority of service comparable to first responders; commercial carriers have not proven this performance during the 2004/2005 hurricane seasons.

Use Case 2: Routine Meter Read

Routine Meter Read Communication Profile	
Characteristic	**Values**
Coverage (Service Territory)	Ubiquitous
Latency	Seconds
Bandwidth	< 100 Kbps
Availability (Routine)	> 99.9%
Availability (Storm)	< 99.9%
Security	< NERC/CIP
Safety	< Life Critical
Endpoints	1,000,000+

Cost: Competitive Information – No commercial carrier could meet required cost point

Coverage: Ubiquitous – Required for all FPL customers

Latency: Seconds – Routine meter reads are latency tolerant, although on-demand reads (potentially involving customers on phone with a call center rep) would require latency times in seconds

Bandwidth: Kbps – Less than 100Kbps, reads conducted on timed intervals

Availability: Under normal operating conditions, the end-to-end communications path to the meter – including the FPL mesh network and the commercial backhaul should exceed 99.9%.availability

Security: Utmost importance, although less than NERC/CIP

Endpoints: FPL will deploy Smart Meters to 4.5 million homes

Solution: Blended Network (Utility AMI Network with Commercial Backhaul)

No commercial vendor could deliver an end-to-end solution that met a price point required by the business. FPL is implementing a 900MHz mesh network to support smart metering. The mesh network aggregates data to collection points where meter data is transferred to FPL back office systems. FPL owns and operates the mesh network up to the collection points, then uses commercial carriers to move meter data to the data center. FPL utilizes, or is investigating cellular (GPRS, 3G), DSL, & commercial satellite carriers.

Use Case 3: Customer Web Portal

Customer Web Portal *Communication Profile*	
Characteristic	**Values**
Coverage (Service Territory)	Ubiquitous
Latency	Seconds
Bandwidth	Kbps
Availability (Routine)	99.999%
Availability (Storm)	<99.9%
Security	< NERC/CIP
Safety	< Life Critical
Endpoints	1,000,000+

Coverage: Ubiquitous – Available to all FPL customers with a smart meter and Internet access

Latency: Seconds

Bandwidth: Kbps – Long term this will increase as FPL deploys advanced analytic tools and supporting videos to the portal.

Availability: 99.999%

Security: Utmost importance to protect confidential and private customer information, although less than NERC/CIP for protection of bulk power

Endpoints: Ultimately could expand to all 4.5 million customers

Solution: Commercial Networks (e.g. Cable, DSL)

Customers access the Internet through their commercial broadband (e.g. DSL, Cable) while information is hosted on web servers in FPL Data Centers.

Use Case 4: Distribution - Volt/Var Control

Volt/Var Control Communication Profile	
Characteristic	**Values**

Coverage (Service Territory)	Ubiquitous
Latency	Seconds
Bandwidth	128 Kbps min
Availability (Routine)	> 99.99%
Availability (Storm)	>95%
Security	NERC/CIP
Safety	Life Critical
Endpoints	<100,000

Coverage: Ubiquitous – Required for all FPL Distribution Circuits

Latency: Seconds

Bandwidth: Kbps – 128Kbps or better, data reads are conducted on minutes or sub minute intervals.

Availability: Under normal operating conditions, the end-to-end communications path between DMS, SCADA, DA, and Devices should exceed 99.99%.availability

Security: NERC/CIP for protection of bulk power

Endpoints: 600 Stations with up to 150 points per station

Solution: DA Communication, Mesh Network, and SCADA
The application calculates the optimal settings of voltage controller of LTCs, voltage regulators, Distributed Energy Resources, power electronic devices, capacitor statuses, and may enable demand response means for optimizing the operations following current objectives. The application takes into account operational constraints if both distribution and transmission operations, and, if so opted, it takes into account real-time energy prices, when the objective is cost minimization - Main Objectives of VVC:

- Reduce load while respecting given voltage tolerance (normal and emergency)
- Conserve energy via voltage reduction
- Provide reactive power support for transmission/distribution bus
- Provide spinning reserve support
- Minimize cost of energy

Use Case 5: Transmission Grid Intelligence - Integrating high levels of asset health and diagnostic data

Transmission Grid Intelligence Communication Profile	
Characteristic	**Values**
Coverage (Service Territory)	Ubiquitous
Latency	Seconds
Bandwidth	min 128kbps
Availability (Routine)	99.99%
Availability (Storm)	95+%
Security	NERC/CIP
Safety	Life Critical
Endpoints	Hundreds of Thousands

Coverage: Ubiquitous – Entire FPL Service Territory with node at each FPL Transmission and Distribution Substation

Latency: Seconds – Grid monitoring and Supervisory Control and Data Acquisition information available on an exception reporting basis. Delays during normal work reduces grid situational awareness and control, delays during a life-critical situation involving high-voltage lines is unacceptable.

Bandwidth: min. 128kbps

Availability: 99.9% for system control and dispatch. May allow for data prioritization to ensure control and dispatch data available while holding device diagnostic data during periods of high traffic and coincident reporting due to system events.

Security: NERC/CIP required for protection of bulk power system critical cyber systems

Endpoints: 600+ stations with 100s to 1000s of points depending on device implementation

Safety: Life Critical, System Reliability and Stability, Public Safety

Solution: Blended Utility and Commercial Network with Redundancy

Implementation of Intelligent Electronic Devices such as asset critical operating parameter monitors, phasor measurement units, digital disturbance recorders and micro-processor based relay protection equipment at Transmission substations will provide an exponential growth in data traffic requirement from grid substations to system control centers and utility diagnostic systems. This greatly increased data traffic must be managed and protocols established to parse legacy control and dispatch information from new asset diagnostic and remote condition assessment data. Utilities must work with private and public communication network providers to provision reliable, secure, communications media to properly integrate new data sources with traditional station communication and data requirements.

Question 7: To what extent can existing commercial networks satisfy the utilities' communications needs?

Utilities rely on a blended solution of utility and commercial networks today. Blended networks are the best solution to reliably and cost effectively meet the diverse utility requirements for coverage, capabilities and cost. The relative mix of utility and commercial networks depends on the unique characteristics of each utility's service territory and will vary over time as smart grid communication technology matures. There are actionable ways commercial carriers can move toward hardening and improving their networks for utility use (e.g. providing robust communications with no single point of failure in remote geographical areas with low customer density).

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

Faced with a significant investment to update aging private voice and data networks, FPL piloted commercial 'push-to-talk' service with field crews in 1998. After an extensive 6-month pilot, all participants agreed that the commercial service was not a viable alternative to FPL's private system:

- Commercial carrier depended on public electric service and could not provide reliable service during electric service disruption
- Commercial carrier could not provide consistent and sufficient radio coverage throughout the FPL service territory

FPL confirmed this conclusion during the 2004 and 2005 hurricane restoration work. FPL private radio was consistently the most robust and reliable service throughout the devastated areas. Where FPL relied on commercial carriers to coordinate contractors and suppliers, FPL experienced significant variations in service levels; as the restoration efforts proceeded – a carrier would perform adequately one day, then experience extended outages and capacity overloads the following day. FPL established the daily processes to monitor cellular service throughout the impacted areas to avoid disruption in storm restoration. This was not acceptable for primary restoration work and FPL relied solely on private radio for this critical business function.

To become a viable alternative to FPL private radio systems, commercial carriers should:

- Deliver consistent and pervasive coverage across the entire utility service territory
- Introduce flexible rate structures enabling utilities to cost effectively reach all customers
- Deliver more cost-effective high-bandwidth connections to transmission and other sites
- Provide public safety and utilities with priority of service over the general public
- Offer wireless service level agreements with meaningful penalties for non-compliance
- Provide generator and backup power to address multi-day power outages during hurricanes and natural disasters; at minimum this should include 12 hours of battery

backup and 48 hours of generator backup (with processes in place to begin regular refueling after 12 hours of generator use)

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?

The proliferation of intelligent grid devices and consumer devices in the home will drive exponential growth in smart grid data – and the networks that move that data between utilities, customers and their authorized third parties.

The Electric Power Research Institute (EPRI) estimates intelligent grid devices and intelligent consumer devices in the home will drive exponential growth in utility data volumes. Emerging consumer technologies: rooftop solar, local energy storage, smart appliances and electric vehicles –will make the bidirectional flow of both information and power much more common. In addition to larger data volumes, this will drive utilities toward more real-time communications between utility and customer to ensure safety and grid reliability.

The adoption of electric vehicles will change the traditional assumption that the consumer is in a fixed location – similar to the change that cellular phones introduced in the phone market. Consumer's will charge their vehicles at multiple locations and require the communications (and back office systems) to support a billing model much closer to today's cellular roaming billing than the traditional utility monthly billing.

With the proliferation of consumer energy devices, the customer will own the in-home devices and the communication path (e.g. Internet Connection, Home Network). FPL's believes a discussion on future smart grid communications requirements must include the utility, commercial telecom vendors, and the consumer (and their designated third parties such as energy services companies).

Different utility applications have different communication requirements – no single communications technology or carrier can reliably and cost-effectively deliver the diverse communication needs of smart grid.

A comprehensive view of smart grid and other utility communication requirements segments into 5 tiers – based on mission criticality, security, cost, coverage and capabilities:

Tier 1 – Initial Storm Restoration and Life-Critical Crew Dispatch

Following hurricanes and other disasters, utilities require a core foundation of voice dispatch and control data networks to begin initial restoration work (including power restoration to the commercial communications infrastructure). On a daily basis, 'can you hear me now' is not good enough for field crews facing potentially life-threatening conditions while working with high voltage. In both cases, utilities require dedicated spectrum, or spectrum with preferential rights, to conduct core utility operations – this demands priority of service comparable to first responders and public safety.

FCC and DOE should strongly consider a dedicated wireless network (with common spectrum and equipment) for mission critical utility operations, first responders and public safety, consistent across the utility industry. Initial storm restoration is comparable to first responders such as police and fire. A base level of voice dispatch and control data is the utilities lifeline to connect power to critical public facilities (including the commercial carrier facilities). Common spectrum and equipment would also improve utilities interaction with police, fire and other public safety agencies, improve utilities' ability to utilize crews from other states in the case of widespread restoration such as hurricanes, and drive equipment toward commodity pricing through economies of scale.

Tier 2 – Mission Critical Command and Control of the Power Grid

This tier consists of core telemetry and control points on the grid to ensure safety and reliability of the power grid. This communication tier requires certainty of delivery, high reliability and stringent levels of services. FPL uses carrier based communications for this communication tier today, but regulatory and legislative initiatives are moving toward physically segregated communications networks for critical infrastructure protection. FPL recommends the DOE and FCC work closely to implement Recommendation 12.3 of the National Broadband Plan:

The North American Electric Reliability Corporation (NERC) should clarify its Critical Infrastructure Protection (CIP) security requirements. NERC, the organization under FERC's authority responsible for the reliability of the bulk power system, should revise its security requirement to provide more explicit guidelines about the use of commercial and other shared networks for critical communications. In future versions of the CIP standard, NERC should clarify whether such networks are suitable for grid control communications. (Source: National Broadband Plan, Page 270)

Tier 3 – Grid Telemetry and Diagnostic Data

Additional telemetry points on the grid that enables the utility to optimize efficiencies and improve grid reliability through predictive and reactive analytics. FPL uses carrier based communication networks for this function today, although there are actionable ways commercial carriers can improve their networks:

- Deliver consistent and pervasive coverage across the entire utility service territory
- Deliver more cost-effective high-bandwidth connections to transmission and other sites
- Provide utilities with priority of service over the general public for disaster response
- Offer wireless service level agreements with meaningful penalties for non-compliance

- Provide generator and backup power to address multi-day power outages during hurricanes and natural disasters

Tier 4 – Core Customer Service Functions
Communications to the customer premise to enable core utility functions such as meter reading, outage notification and remote connect/disconnect. FPL uses a blend of utility and commercial networks for this function today. To improve their viability for this function, commercial carriers should:

- Deliver consistent and pervasive coverage across the entire utility service territory
- Introduce flexible rate structures to enable utilities to cost effectively reach all customers
- Offer wireless service level agreements with meaningful penalties for non-compliance

Tier 5 - Value-Add Customer Services
Information services, such as web-based portals that empower customers to better understand and manage their power use and the impact on the environment. The Internet offers a rich set of features to deliver innovative energy services. However, broadband Internet is not available or affordable to a significant segment of FPL customers. FPL strongly supports the National Broadband Plan and other national initiatives to ensure all Americans have access to affordable broadband service.

Utilities and commercial networks must weave cyber security into the fabric of Smart Grid using a layered architecture, intense system segmentation and defense in depth.
A complete discussion of future smart grid communication requirements must include cyber security, privacy and the protection of customer information. While the DOE is addressing these issues in other forums, a layered, defense in depth approach to cyber security must integrate the intrinsic security of the communication systems – whether owned by the utility, commercial telecom or the consumer.

CONCLUSION

FPL respectfully requests that the DOE consider these comments and ensure that any DOE recommendations regarding Smart Grid communications requirements are consistent with them.

Respectfully submitted,

Thomas C. Orvald Senior Attorney Florida Power & Light Company 801 Pennsylvania Ave., NW, Suite 220 Washington, DC 20004 202-349-3497 Thomas.orvald@fpl.com	Chris Bennett Executive Vice President Business Strategy & Policy NextEra Energy, Inc. 700 Universe Blvd Juno Beach, FL 33408 561-691-7460 Chris. Bennett@fpl.com