NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1146

In the Matter of:	)	
	)	**DIRECT TESTIMONY OF ROBERT M. SIMPSON, III FOR DUKE ENERGY CAROLINAS, LLC**
Application of Duke Energy Carolinas, LLC	)	
For Adjustment of Rates and Charges	)	
Applicable to Electric Service in North Carolina	)	
	)	

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Robert M. Simpson III. My business address is 411 Fayetteville Street, Raleigh, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Duke Energy Progress, LLC ("DE Progress") as Director, Grid Improvement Plan Integration for Duke Energy Corporation's ("Duke Energy") Regulated Utilities Operations, including Duke Energy Carolinas, LLP ("DE Carolinas" or the "Company").

Q. PLEASE BRIEFLY DESCRIBE YOUR DUTIES AS DIRECTOR, GRID IMPROVEMENT PLAN INTEGRATION, FOR DUKE ENERGY.

A. My duties and responsibilities include ensuring grid improvements and investments are effectively integrated.

Q. PLEASE SUMMARIZE YOUR EDUCATION AND PROFESSIONAL QUALIFICATIONS.

A. I graduated from Clemson University with a Bachelor of Science degree in Electrical Engineering in 1977. I joined the DE Progress' predecessor, Carolina Power & Light, in 1977 as a junior engineer with responsibility for designing electrical distribution systems to serve new customers and for identifying and implementing system improvement and reliability programs. I progressed through various engineering positions and was promoted to project engineer responsible for supervision and oversight of distribution standards in 1987. Since that time I have worked in various management positions in the

distribution and transmission businesses, including engineering and operations manager, district manager, transmission system performance manager, business services manager, director of the distribution control center, major project manager for the Distribution System Demand Response ("DSDR") project.

From 2012 until 2017, I served as Director of Power Quality, Reliability & Integrity Engineering. While in that role my duties and responsibilities included providing management of the electric distribution systems' reliability programs for Duke Energy's regulated utility operations in North Carolina and South Carolina. The organization overlays both the DE Progress and DE Carolinas service areas, with almost 120 employees and dozens of operating centers. On a daily basis, it supports our basic mission of economically providing reliable and safe electricity to our customers. The organization is responsible for jurisdictional implementation of key functions in the areas of Capacity Planning, Power Quality, Reliability, Component Integrity Programs, and Protection & Automation. The organization is accountable for the technical analysis and economic solutions for capacity growth and system additions; including contingency projects, for the complete distribution delivery system infrastructure. This work also includes accountability for performing economic development studies, method of service studies, system protective coordination, automation and control engineering, distributed generation engineering studies and grid automation

asset management. Lastly, my responsibilities also included leading the financial management and prioritization of the operations and maintenance ("O&M") and Capital budgets in order to optimize the reliability program and project requirements. In May 2017, I assumed my current position.

I have held positions in Raleigh, Wilmington and Florence during my 39-year career and have been the designated system storm director on three occasions. I am a registered Professional Engineer in the states of North Carolina, South Carolina and Florida and have served on the IEEE Surge Protective Devices Committee as a member and chairman of Working Group 3.3.11 which developed the standards for metal oxide surge arresters.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THIS COMMISSION OR ANY OTHER REGULATORY BODIES?

A. Yes, I testified in 2009 before this Commission in Docket No. E-2, Sub 926 regarding the DSDR program. I have also appeared before the Public Service Commission of South Carolina ("PSCSC") in DE Progress' recent rate case in Docket 2016-227-E, as well as presented to the PSCSC in an allowable ex parte briefing on DE Progress' restoration efforts following Hurricane Matthew. I have also filed testimony with this Commission in the pending DE Progress rate case in Docket No. E-2, Sub 1142.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to describe and support the DE Carolinas' transmission and distribution ("T&D") system, the operation and performance

of the T&D system and the costs necessary to operate, maintain and improve upon it. I also describe future challenges to our operations, and how we plan to address those challenges.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. Following the introduction above, my testimony is organized as follows:

I. Summary of my testimony;

II. A description of DE Carolinas T&D system, describing notable investments made in our system since the Company's last rate case in North Carolina;

III. An overview of the operational performance of the Company's T&D system;

IV. An explanation of the challenges DE Carolinas is facing with our aging infrastructure and the need to continue to maintain and improve upon system reliability; and

V. A description of the specific Power/Forward Carolinas projects to be recovered by the proposed Grid Reliability and Resiliency Rider ("GRR Rider").

I. SUMMARY OF TESTIMONY

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. DE Carolinas operates an extensive T&D system that has served North Carolina well for quite some time, but like any complex system it requires maintenance and upgrades to continue performing at the level expected by the

Company's customers. At customary funding levels the Company will not be able to meet those expectations. Our grid is challenged by more frequent and severe weather events, aging components, and the addition of distributed generation. Despite the Company's best efforts, we are already beginning to see the results of these challenges in our reliability statistics: we have seen an increase in the frequency of outages, and customers are spending more time without power than they have in the past. As a result, the Company must invest more in vegetation management as well as system upgrades. These system upgrades are part of an initiative called Power/Forward Carolinas, as introduced in this case by Witness Fountain, and this program will transform our T&D system into a more reliable, versatile and cost effective platform over the next ten years.

Through Power/Forward Carolinas, the Company will upgrade the grid via targeted undergrounding of key distribution lines; replacing aging components like transformers, cables and conductors; installing components that will allow the grid to self-optimize, reducing the number of customers affected by an outage; and reducing duration and installing components that will allow the system to backfeed power to areas affected by outages. In addition the Company will upgrade the system from a uni-directional to a digital, two-way, interconnected sensing and monitoring system. Power/Forward Carolinas will have a positive economic impact to the State

of North Carolina, providing thousands of jobs during construction and by minimizing costs to restore power after outages.

To enable the implementation of the Power/Forward Carolinas program, DE Carolinas is proposing the GRR Rider to make these critical investments in the T&D system while ensuring timely recovery of the expenses. The GRR Rider will be subject to annual approval by the Commission. Power/Forward Carolinas will ensure that North Carolina customers will continue to experience reliable service for generations to come.

II. DE CAROLINAS' T&D SYSTEM

Q. PLEASE GENERALLY DESCRIBE DE CAROLINAS' T&D SYSTEM IN THE CAROLINAS.

A. DE Carolinas' T&D system delivers electric service to approximately 2.5 million retail customers located throughout a 24,000 square mile service area in central and western North Carolina and western South Carolina. Approximately 2 million of the Company's retail customers are in North Carolina. In addition to its retail customers, DE Carolinas also sells electricity at wholesale rates to municipal, cooperative, and other investor-owned utilities.

DE Carolinas operates as a single balancing authority to economically manage the Company's integrated electric delivery systems in both North Carolina and South Carolina, collectively. This system interconnects with

nine other balancing authority areas[1] and includes 13,100 circuit miles of transmission lines. The distribution system is comprised of approximately 66,600 miles of overhead distribution lines and 37,100 miles of underground distribution lines. DE Carolinas' T&D system also includes 198 transmission substations, and 1,422 distribution and industrial substations with a combined capacity of approximately 98 million KVA. In addition to power lines and substations, the system includes various other equipment and facilities such as control rooms, computers, poles, transformers, capacitors, street lights, meters, and protective relays. Together, these assets provide the Company considerable operational flexibility with its T&D system and allow DE Carolinas to provide safe, reliable, and economical power to the Company's customers in North Carolina.

Q. HAS DE CAROLINAS' T&D SYSTEM GROWN SINCE THE LAST RATE CASE?

A. Yes, the T&D system has expanded over time to ensure adequate system voltage and capacity, based on projected system loading, and contingency requirements related to providing safe and reliable service to our customers. Transmission system growth has also occurred as a result of new generation and/or decommissioning of existing generation assets. For the distribution system, approximately 2,300 distribution line miles and 18,700 transformers

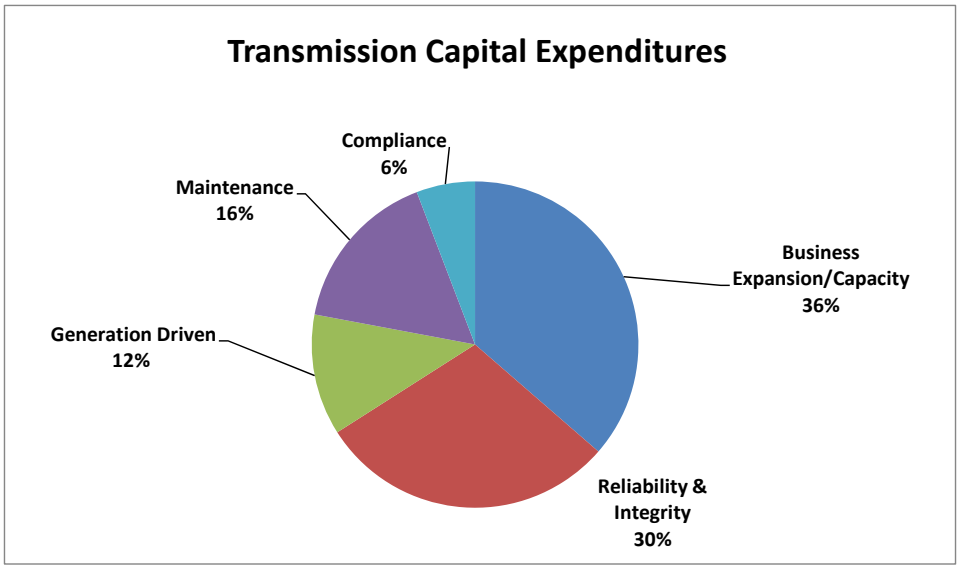
[1] The PJM Regional Transmission Organization, Carolina Power and Light – East, Carolina Power and Light – West, Southern Company, Santee Cooper, Tennessee Valley Authority, Cube Hydro Carolins, SC Electric & Gas and Southeastern Power Authority.

were added over the last four years. Overall, we have added approximately $2.6 billion to electric plant in service for T&D infrastructure in the last four years.

Q. CAN YOU PROVIDE MORE DETAIL ABOUT THE ADDITIONAL INVESTMENTS THE COMPANY HAS MADE IN ITS T&D SYSTEM SINCE THE LAST RATE CASE?

A. Additional investments in the Company's T&D system have been made to provide capacity to serve system growth, ensure adequate system voltage, support new generation and decommissioning, and improve system reliability. Over the past four years, more than $770 million was invested in the transmission system and approximately $1.8 billion in the distribution system.

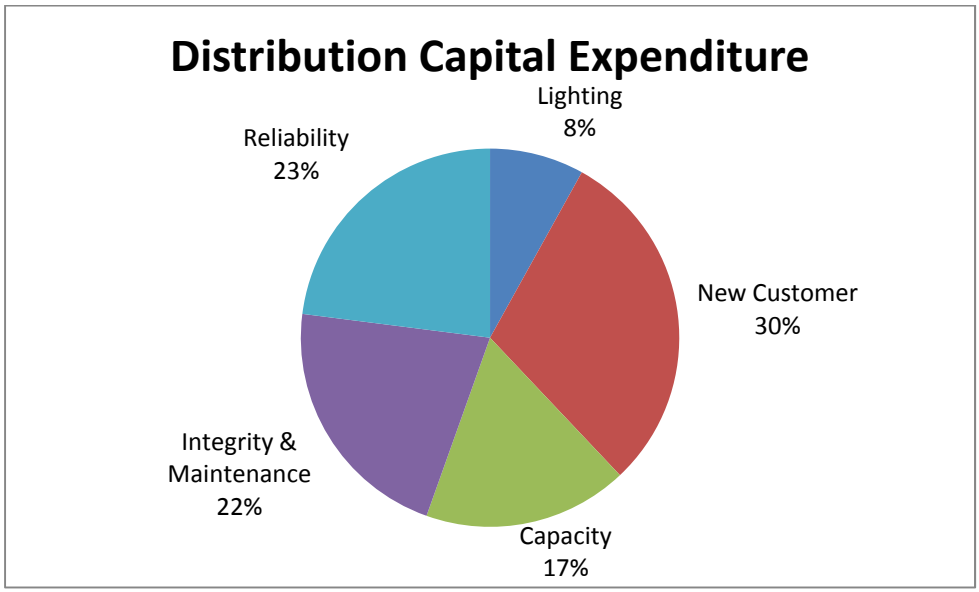
The chart below illustrates the major categories of the transmission system capital investment over the last several years.



In the transmission system, approximately 36 percent of investment was driven by capacity requirements to serve load and to meet the North American Reliability Council ("NERC") Planning Standards. For example, the Company invested in its Parkwood 230-100 kV Tie Station, Hook 100-kV Line, and Elizabeth 100-kV Line Upgrade projects to prevent line and transformer overloads that could occur during certain failure contingencies on the transmission system. The Company also improved Conley and Fourth Creek substations by adding many breakers to reduce the likelihood of customer outages and improve operating flexibility. Approximately 12 percent of investment is driven by generation projects. These include new generator interconnections as well as decommissioning. Examples of these generation driven projects include the decommissioning of Riverbend Station and the addition of the Lee Combined Cycle plant. Approximately 6 percent of the investment was driven by compliance projects, including the Light Detection and Ranging ("LIDAR") program to survey the Transmission Grid using LIDAR technology; identify and resolve physical limitations that might prevent lines from being operated at required capacity; and cyber security and physical security programs driven by requirements defined in NERC CIP Standards CIP-002-5.1 and CIP-014-2. Approximately 46 percent of investment was driven by reliability improvement and maintenance programs. Examples of this type of investment include the replacement of

deteriorated wood poles and replacement of obsolete substation and line equipment.

The chart below illustrates the major categories of the distribution system and the capital expenditures over the last four years.



North Carolina continues to be a desirable place to live and work, as evidenced by the more than 36,400 new retail customer meters added during the 12-month period ending December 31, 2016. Typically, new customers locate in areas where DE Carolinas has to build new distribution facilities to serve them, including expenses for new customer connections or capacity work needed to support overall load growth. Approximately 55 percent of the Company's distribution expenditures over the last four years are for expansion-related work, including serving new customers, lighting installations, and additional capacity.

The remaining investments on the Company's system relate to capital improvements to our existing infrastructure, reliability improvements and other capital maintenance. Approximately 22 percent of the distribution capital expenditures in the last four years were for infrastructure maintenance activities such as pole replacement and underground cable replacement. Approximately 23 percent of expenditures were for targeted reliability improvements. The targeted reliability improvement investments are for the purpose of reducing the number and frequency of power outages on the distribution system and to provide reliable electric service and customer satisfaction. Examples include the transformer retrofit program, the sectionalization program, and self-healing teams that apply state-of-the-art technology to automatically isolate the cause of an outage and restore service to customers. Through the Company's inspection and maintenance programs, DE Carolinas regularly identifies system components that require replacement or refurbishment to ensure the integrity of the system. Inspection and maintenance activities include items such as distribution line inspections to identify and replace wooden poles on a regular cycle, underground primary cable replacement where outage history and cable analysis predict failures, distribution line rebuilds and relocations, as well as programs to replace equipment like house power panels that have reached the end of life.

Capital maintenance spending also includes amounts associated with the replacement of capital units of property during routine outage events, the

relocation of lines to accommodate highway projects, urban renewal projects, and conductor replacements. One particularly large project, referred to as the Carolinas West Primary Control Center will close to service by the cut off period in this case, and has a value of approximately $120 million. This project is part of an enterprise program whereby Duke Energy is updating and consolidating multiple regional centers into purpose-built, highly reliable and hardened facilities. Maintaining the integrity of the electric grid is at the core of what we do and these new facilities will allow us to provide dependable and consistent service for many years into the future.

Q. IN YOUR OPINION, ARE ALL OF THE T&D FACILITIES INCLUDED IN DE CAROLINAS' BASE RATE REQUEST USED AND USEFUL IN PROVIDING SERVICE TO DE CAROLINAS' RETAIL ELECTRIC CUSTOMERS IN NORTH CAROLINA?

A. Yes. Including the projects that will be completed prior to the evidentiary hearing in this case, all additions to DE Carolinas' T&D system requested for recovery in base rates is used and useful to its approximately 2 million customers in North Carolina.

III. OPERATIONAL PERFORMANCE

Q. WHAT ARE DE CAROLINAS' GOALS WITH RESPECT TO OPERATIONAL PERFORMANCE AND CUSTOMER SATISFACTION?

A. DE Carolinas' principal goal is to deliver safe and reliable electric service at reasonable prices. The Company strives to be a leader in electric utility operational performance, measured in terms of customer satisfaction, safety, and reliability of the Company's T&D systems, while managing operational and capital expenditures for the benefit of our customers. However, the problems with our aging grid are escalating, as described below.

Q. PLEASE EXPLAIN THE METRICS THE COMPANY USES TO MEASURE THE EFFECTIVENESS OF ITS T&D OPERATIONS.

A. DE Carolinas utilizes several industry-standard metrics to assess the overall effectiveness of its operations. These metrics include reliability indices to measure the performance of the transmission and distribution system, and customer satisfaction scores to determine how well the Company is meeting the needs of its customers.

DE Carolinas' reliability-related activities are focused on reducing the frequency and duration of customer outages. When outages do occur, we are committed to timely and safe restoration. In addition to outage frequency and duration, the Company also works to reduce other power quality concerns that may arise as part of our commitment to continually improve reliability of

service for customers. DE Carolinas uses customer satisfaction metrics to ensure that reliability and power quality programs are meeting customer expectations.

The Company uses a number of industry-accepted transmission and distribution performance metrics as defined in IEEE Standard 1366-2012.

- **System Average Interruption Frequency Index ("SAIFI")** is a ratio that indicates how often the average customer experiences a sustained interruption over a predefined period of time.
- **System Average Interruption Duration Index ("SAIDI")** is a ratio that indicates the total duration of interruption for the average customer during a predefined period of time.
- **Customers Experiencing Multiple Interruptions ("CEMI 6")** is a measure of the percentage of customers who experience six or more outages in a 12-month period.

Q. HOW HAS DE CAROLINAS' TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMED UNDER THESE METRICS?

A. Over the past eight years, both SAIFI and SAIDI show an unfavorable trend, with the frequency and duration of outages increasing across the DE Carolinas system. Although reliability performance can be influenced by weather, continued investments, such as an integrated vegetation management program and grid improvement programs which reduce customer impact when outages occur, which I discuss later in my testimony, will result in improved customer

experience with respect to the frequency and duration of outages. We continue to invest in reliability programs that reduce the root causes of outages while continuing the reliability programs that mitigate the number of customers impacted when outages do occur. Graphs displaying the trends for these metrics are set forth below:

Figure 1 – Duke Energy Carolinas' Historic System Average Interruption Frequency Index (SAIFI)

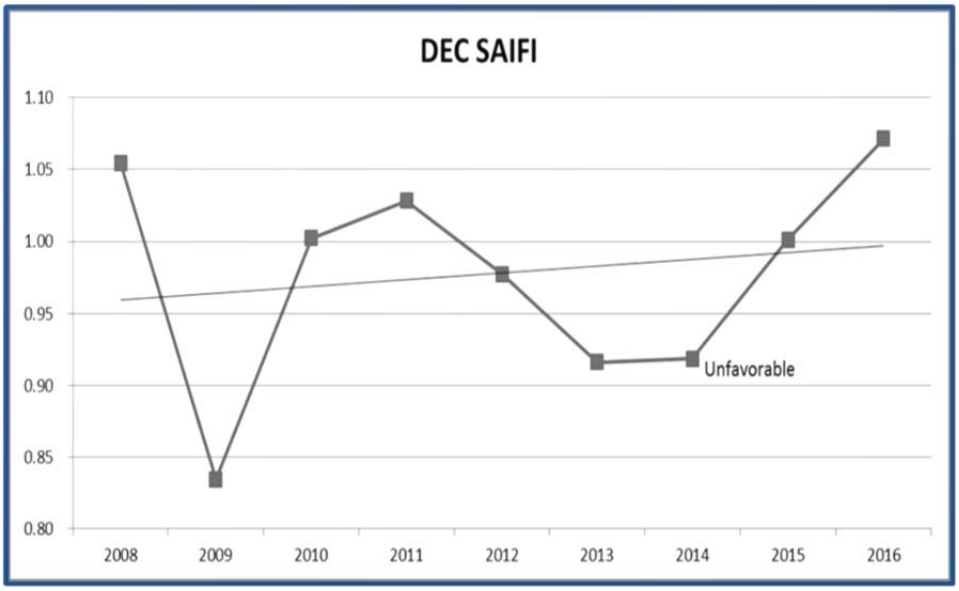
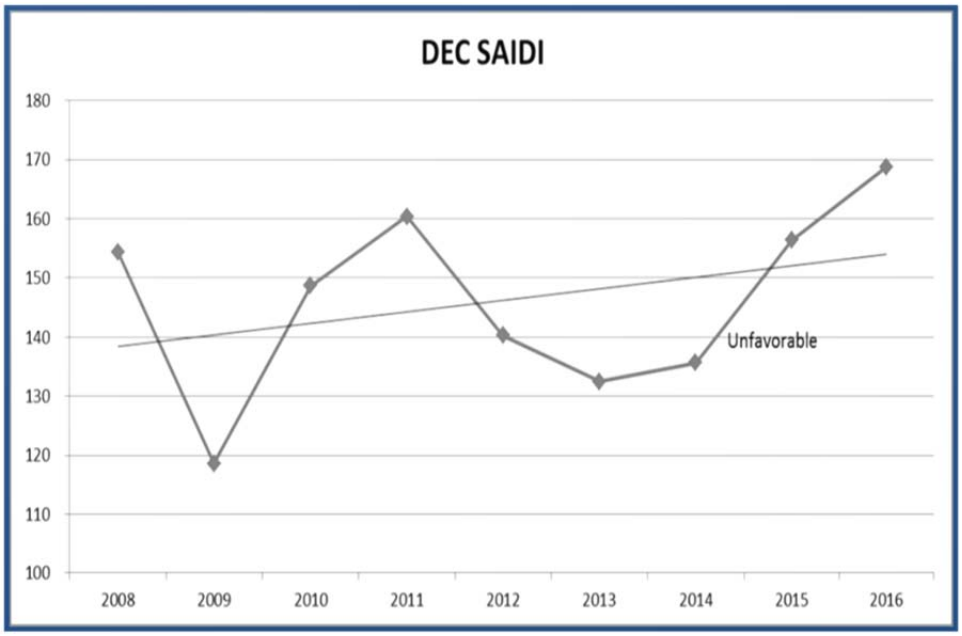


Figure 2 – Duke Energy Carolinas' Historic System Average Interruption Duration Index (SAIDI)



In summary, reliability performance is worsening due to the increase in the number of outage events. While investments have been made to reduce customer impacts, we need to make more investments, including vegetation management and system upgrades, to stop this negative trend in in SAIFI and SAIDI and reduce the frequency and duration of outages on the system.

Q. PLEASE EXPLAIN HOW DE CAROLINAS' APPROACH TO DISTRIBUTION VEGETATION MANAGEMENT AFFECTS OPERATIONS.

A. Vegetation management is a critical component of the Company's power delivery operations and the continued effort to drive performance for customers' benefit. DE Carolinas uses a reliability-based prioritization model to drive its routine integrated vegetation management program. In addition to

routine circuit maintenance, there are four other very important components to the Company's overall vegetation management approach.

(1) Herbicide spraying of the "floor" of the right-of-way is planned on a periodic basis to control the re-growth of incompatible vegetation in non-landscaped areas and where property owners allow us to spray;

(2) Cutting down of "hazard trees" outside of the area normally maintained on a distribution line. The Company implemented this program in 2014 and has been successful in targeting removal of diseased, decayed or dying trees to preserve the integrity and safety of our lines;

(3) Unplanned work performed at the direction of reliability engineering as a result of outage follow-up investigations or by customer-initiated requests; and

(4) Disciplined vegetation management outage follow-up process tied to a formal internal reliability review process.

Overall, SAIDI and SAIFI performance has worsened as shown in Figures 1 and 2 within the Operational Performance section of my testimony. Corresponding with that trend, DE Carolinas has experienced a slight uptick in the frequency of vegetation management-related outages.

In addition, performance expectations of the industry have changed over the past few years primarily as a result of significant damage to power systems caused by the two major east coast events – Hurricane Irene in 2011

and Hurricane Sandy in 2012. Although these storms only had a minimal impact on the DE Carolinas service territory, history indicates that the area is not immune to events of this magnitude. In 2016, Hurricane Matthew caused damage to DE Progress' electric system on a scale similar to Hurricane Hugo in 1989. The total number of customers impacted in the DE Progress service territory during the storm was 1.4 million and the cost was significant. Damage to facilities and service restoration times, from major events, can be lessened through an effective vegetation management program.

Q. DOES THE COMPANY PROPOSE AN INCREASE TO FUNDING FOR VEGETATION MANAGEMENT?

A. Yes. As explained by Witness McManeus we have included a pro forma adjustment related to an expected $15.8 million increase in system expenditures for vegetation management. As a result of the Company's worsening trends in SAIDI and SAIFI and the increased industry focus and the Company's commitment to continue to improve reliability, DE Carolinas is enhancing its vegetation management program through a focus on the following areas, all of which require additional funding:

- An increase in the frequency of trimming to stabilize and improve the vegetation management impact on overall reliability performance.
- Increase frequency of herbicide application where appropriate.

- Evaluate the feasibility of a Tree Growth Regulator program; and
- Continuing other aspects of the current program, such as distribution line "hazard tree" cutting and a disciplined vegetation management outage follow-up process.

This increase in funding will strengthen DE Carolinas' vegetation management plan and help maximize the effectiveness of planned Grid Improvements discussed in more detail later in this testimony. The Company believes that the additional funding and implementation of its plan, with these noted enhancements, will benefit customers.

Q. WILL THE PERFORMANCE OF THE SYSTEM CONTINUE TO DECLINE WITHOUT CAPITAL INVESTMENT ABOVE HISTORIC LEVELS?

A. Yes. While increased funding for vegetation management will help, we still need to invest heavily in capital upgrades to our grid. Over the next ten years approximately 30 percent of the Company's grid infrastructure will be beyond asset life. As a result of the aging grid, outage events and duration are increasing. We are also seeing longer restoration times following major storm events.

At the same time we are faced with replacing our aging assets, new technology has become available which can identify areas of the system that

most need improvement. This technology enables the Company to achieve the highest operational gains at the least cost to customers.

Finally, every degradation in service carries a greater impact to customers than ever before. When you think about how energy-reliant our phones, water systems, communications and economies have become, even momentary pulses can result in damage or lost time that would have not been as impactful decades ago. We must ensure a high quality of service for customers and we must have a near-term, strategic plan for doing so. I discuss our plans to enhance quality of service later in my testimony.

IV. OUTLOOK FOR DE CAROLINAS TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE

Q. WHAT IS THE OUTLOOK FOR DE CAROLINAS' T&D SYSTEMS?

A. We have made excellent use of our existing grid system, but we have come to a point where operational realities, the age of our facilities and equipment, and customer needs are driving us to significant levels of investment over the next several years in our T&D systems infrastructure. As described above in my testimony, we have new technologies that will allow us to efficiently target investment to the areas of our system that need it the most. Below I describe the challenges we are facing and the categories of investment needed to address those challenges.

Q. COULD YOU PLEASE DESCRIBE HOW THE COMPANY SETS ITS PRIORITIES FOR SYSTEM MAINTENANCE AND UPDATES?

A. The Company has historically managed a comprehensive asset maintenance program which is funded, based on the primary root causes of outages and manages risk through specific reliability improvement programs such as: our transformer retrofit program to reduce the number of outages per 100 line miles and reduce the impact on customers due to equipment failure and animal intrusion; and our sectionalization programs designed to reduce the impact of outages on customers. This level of investment has been included in rates, historically. However, we have reached a point where the current level of investment is not enough to address the needs of today and tomorrow.

Like other utilities across the nation, the grid requires substantial investment. Due to the age and dynamic demands on our infrastructure, without significant improvements, frequency and durations of outages will increase. The Company needs to make investments to address grid hardening, cyber and physical security and to accommodate the continued growth of renewables. The good news is that at the same time many components of the system are nearing the end of their useful lives, new technology is available that will allow us to meet many of those needs at the same time we are addressing our primary focus areas in an integrated manner. Even better, we now have data analytics that allow the Company to target investments to get

the best value for every dollar spent to serve customers. This is especially important given the storm activity explained above and experienced in other parts of the country. These improvements can help with restoration time following major events such as ice storms, hurricanes and severe thunderstorms.

Q. PLEASE DESCRIBE THE COMPANY'S CUSTOMARY PROJECTED CAPITAL EXPENDITURES RELATING TO ITS T&D FACILITIES.

A. The Company needs to continue its investments in the T&D system to maintain the grid and add new customers. The Company's current financial plans include expenditures of approximately $4.5 billion on its T&D system in calendar years 2017 through 2021. However, our Power/Forward Carolinas investments are incremental to these amounts, as discussed below.

V. POWER/FORWARD CAROLINAS AND THE GRR RIDER

Q. PLEASE DESCRIBE THE COMPANY'S PLANS FOR CAPITAL AND O&M EXPENDITURES OVER AND ABOVE ITS CUSTOMARY LEVEL OF SPEND.

A. Through the Power/Forward Carolinas initiative introduced by Witness Fountain, DE Carolinas targets spending $2.9 billion in capital and $130 million in O&M over the next five years, from 2017 through 2021, to improve the performance and capacity of the aging grid, making it smarter and more resilient, to better serve our customers. These expenditures are necessary to fulfill the Company's intentions to provide safe and reliable service for our

customers at a time when the aging transmission and distribution system is increasingly asked to adapt to dynamic conditions. The Company's Power/Forward Carolinas initiative will primarily focus on projects that:

- Improve the reliability and hardiness of the system while making it smarter
- Build a foundation for customer-focused innovation and new technologies
- Comply with prescriptive federal transmission reliability and security standards
- Address maintenance requirements for aging assets
- Further integrate and optimize intermittent distributed renewable generation

DE Carolinas has started and intends to continue integrating modernization efforts into the grid to reduce interruptions, provide customers with more information about their energy use, and support the growth of distributed resources. The intention is to create a grid that is customer enabling, sustainable, reliable and smart.

Modernization investments in capacity, grid connectivity and automation seek to improve system performance by replacing technology designed to deliver electricity in an analog world of one-way communication with a variety of digital, two-way, interconnected sensing, monitoring, and communications-related equipment. These technologies can enhance the

resiliency and reliability of the system, improve power quality, help integrate and manage intermittent distributed renewable resources and position the grid for emerging technologies such as battery storage, all while improving situational awareness of the grid. In order to execute on these plans and ensure timely recovery of investments, DE Carolinas proposes the GRR Rider as part of this rate case. Witnesses Pirro and McManeus discuss specifics of the GRR Rider.

Q. WHAT POWER/FORWARD CAROLINAS INVESTMENTS ARE INCLUDED IN THE FIRST YEAR OF THE GRR RIDER?

A. Initiatives such as targeted undergrounding, distribution hardening & resiliency, and the self-optimizing grid are focused on the distribution system which is where the majority of the investment will occur. Investments in the transmission system; and in enterprise systems and communications upgrades will also occur. All are included in the first year of the GRR Rider and in subsequent years.

Q. PLEASE DESCRIBE THE DISTRIBUTION SYSTEM INVESTMENTS THAT WILL BE INCLUDED IN THE GRR RIDER.

A. **Targeted Underground:** Targeted undergrounding significantly reduces outages and momentary interruptions and will quicken restoration times after major events like storms. The targeted undergrounding approach uses data analytics to identify those overhead segments with lower multi-year reliability performance when compared to the remainder of overhead facilities. These

outlier segments drive a disproportionate amount of momentary interruptions (blinks) and outage events that affect customers and burden grid assets with faults that shorten the life of equipment.

Targeted undergrounding is the one program that does the most for stopping outages from occurring altogether, and has the greatest effect on reducing damage from major storms. A typical area that might be a candidate for targeted undergrounding would be an older neighborhood in which it was industry standard at the time to build power lines behind homes in backyards for aesthetic purposes. In that scenario, one tree falling on a segment of line in one person's backyard could interrupt service for the whole neighborhood, and create access issues for crews to repair the line. Undergrounding of power lines wasn't even done at the times many older homes were built. Over time our equipment and industry practice became focused on servicing lines from bucket trucks, but the Company can't get those trucks in backyards to service rear lot line areas. Typically it takes the Company twice as long to do a restoration in these areas because we can't get our equipment to the outage location. Absent being able to use the right equipment, the Company must instead use manual labor and hand-held equipment that can create damage to customers' backyards and add significant time to restoration.

Now that the Company has cost effective undergrounding technology, it is time to modernize the way we service and maintain equipment in these neighborhoods so that customers can maintain high reliability. As an added

benefit, this same program will also reduce not just storm- and tree-related outages, but will also reduce momentary power blinks that can cause equipment to reset or shut down. For example, a blink can require a reboot of a cable box, Wi-Fi router or a server, creating a nuisance for customers and interrupting their work and lives.

In 2018, DE Carolinas' planned targeted underground projects will occur within 37 counties in NC with the majority of overhead line conversions, by line miles, occurring in Mecklenburg, Forsyth, and Iredell counties.

Distribution Hardening & Resiliency: This work helps prevent outages, especially during storms, and provides faster restoration times when outages do occur. There are multiple components in the program as outlined in Simpson Exhibit 2, among these are (1) retrofitting transformers to eliminate common outage causes; (2) replacing aged and/or deteriorating cable and conductors; and (3) providing back feed capability to vulnerable communities.

(1) Transformer Retrofit: We have transformers that were originally purchased as far back as the 1950s. Some of these have been replaced over time, but usually as a result of equipment failure or changes required due to load growth. While we have extracted the value of these assets, the Company now needs to upgrade those transformers as we are increasingly seeing real system impacts – momentary and repeat outages – from this outdated

equipment. Technology exists today that will allow the Company to install or retrofit transformers so that they do not cause repeat outages and provide more reliable service to customers. Our industry has developed solutions for common outage causes such as animal interference with transformers and lighting strikes. We also have technologies to limit fusing issues so that if something does happen with a transformer, it limits the number of customers impacted.

(2) Aged/Deteriorating Cable and Conductors: Underground cable replacement consists of replacing end-of-life and obsolete underground power cables. Deteriorated conductor replacement consists of replacing end-of-life overhead conductors. We have about 2,800 miles of old underground cable in need of replacement and about 3,145 miles of overhead conductor that has corroded over the decades – most of it in rural areas. A lot of the routine investments the Company makes are driven by load growth, so by default, some rural areas have not had the conductor upgrades that more populated areas have had within the context of work to accommodate load growth.

(3) Back feed capability: For long duration outages: For small- and medium-sized towns there are situations when an entire town might lose electricity at one time as a result of a single outage. This is because they are served by long radial lines that the Company cannot backfeed from other sources due to lack of capacity and ties in place to other sources of electricity. This has become a quality-of-life issue for people in these towns. The lack of

electricity can, in cases, literally shut a town and its economy down. Gas stations, stores, restaurants cannot operate without electricity, impacting lives and businesses who depend on electricity for their livelihood. We need to add capacity and build hundreds of miles of line to create ties to provide vulnerable communities with other sources of power when they need it. Simpson Exhibit 3 provides just a few examples of some of the projects that are planned.

In 2018, our focus will be on projects to address aging cable and conductors replacements, and back feed capacity. These overhead cable replacements span 34 counties in NC in the first year with the most projects occurring in Guilford, Mecklenburg, and Rutherford counties. The underground cable replacements span 28 counties in NC, with the most projects occurring in Caswell, Mecklenburg, and Jackson Counties. Back feed projects to eliminate long-duration outages will occur in 30 counties in NC. Notable projects will improve reliability at airports, hospitals and on long-radial distribution lines.

Self-Optimizing Grid: The self-optimizing grid illustrated in Simpson Exhibit 1 is an improved delivery system that enhances reliability and improves system resiliency. This resiliency will enable the system to better recover from major events like storms. Key components of the projects will involve adding capacity to distribution circuits and substation transformers and connecting radial distribution circuits together with

automated switches. The enterprise system upgrades, and communication network upgrades mentioned below and the distribution management system software are also essential to enabling this capability. The self-optimizing grid will automatically reroute power around a problem area, like an outage caused by a car hitting a pole, animal interference, or storm activity. With this automation, the grid can self-identify problems and react to them by isolating affected areas and automatically rerouting power, shortening or even eliminating outages for many customers.

The self-optimizing grid program will limit the number of customers who experience an outage due to a single event to less than 400 customers. Right now that number could be as high as 1,500 or more customers. When completed, the grid will be much more resilient and recovery times will be faster. Any time there is an outage on a distribution feeder line, the system will self-correct, restoring as many customers as possible and leaving only those customers who must be out while the repair work is being done. For example, we have experienced outages caused by a big truck hitting a pole that resulted in thousands of customers being without service all night. Even though many linemen were working the issue, the lack of technology available on the line to isolate the outage and restore customers automatically resulted in an extended outage for many customers who would otherwise have been restored in a self-optimizing situation. This is a good example of how customers could have benefitted from technology that is now available and

ready to be deployed today. The target is to have 80 percent of customers on this technology so that the Company only has 300 to 500 customers on a circuit versus thousands. Once complete, when there is an outage event, fewer customers will be impacted because of the ability to reroute power to them.

The self-optimizing grid program consists of 216 projects spread across the DE Carolinas NC territory in 2018. The top three areas, by number of projects, are areas in and around Burlington, Greensboro, and Charlotte. Projects are also planned in Spindale and Hickory.

Q. PLEASE DESCRIBE THE INVESTMENTS IN THE TRANSMISSION SYSTEM, INCLUDING 2018 INVESTMENT PLANS.

A. The transmission system transports electricity from the power plant to the communities we serve. The transmission upgrades we are targeting will increase reliability by improving the weakest parts of the system, by updating and replacing equipment that is likely to fail in the near future, and by adding systems that will notify the Company of problems before they result in an outage. The improvements will also decrease the Company's environmental footprint and increase defenses against cyber intrusion.

The Company's investments will include substation and transmission facility upgrades, automation, equipment modernization, physical and cyber security, and system intelligence capabilities. This program will result in a system that is more resilient and sets higher design standards that will improve operational flexibility during outage situations. The upgrades will also allow

for proactive health monitoring of substation equipment via continuous diagnostic health data, resulting in reduced outage impacts for customers.

The Company will also upgrade the transmission system so that maintenance can be scheduled based on need, rather than on a set time schedule. The current transmission system relies on outdated manual and analog equipment maintained on a set schedule rather than on need. The scope of this effort is to install digital assets and system analytics—transmission system intelligence—capable of condition-based monitoring, automated switching, and auto-fault location and restoration.

To further increase reliability and ensure the well-being of our employees, customers, and the environment, we are removing breakers and other equipment that can release oil and/or gas during regular operation, maintenance, or when they fail. We are in the process of eliminating all oil-filled breakers, which will increase reliability and reduce environmental risks, and replacing them with the safest equipment possible.

The Company is also mindful of the security of the Company's assets and the need to continue to protect them to ensure we can reliably serve our customers. This program will increase protection from physical attacks to infrastructure, as well as cyber-attacks that affect the way the grid operates. Examples include gunshot and intrusion detection, high-security intruder fencing, security cameras inside the substations, security lighting, and card reader access to substations to control access to the property.

These investments that protect against malevolent forces will also provide protection against everyday occurrences like animal intrusion into substations causing power interruptions. This is a common and recurring problem on our system that will decrease as these investments are put into place.

In 2018, planned transmission projects focus primarily on hardening and resiliency to improve reliability and address environmental issues. This work includes replacing oil-filled and high-volume gas breakers in many substation locations across the system; and improvements on aged and deteriorated components. We will also be installing equipment to enhance the physical security at our substations. Lastly, planning, design, and installation for the system intelligence work will continue in 2018.

Q. PLEASE DESCRIBE THE INVESTMENTS IN THE ENTERPRISE SYSTEM AND COMMUNICATION NETWORK UPGRADE AND SPECIFICS ON THE 2018 INVESTMENT.

A. **Enterprise System Upgrades, and Communication Network Upgrades:** Duke Energy's communications systems are the bridge that connects our control and analytics systems to our devices in the field (e.g., automated switches and controllers, sensors, smart meters, and computers in trucks). Staying up to date with necessary communications capability is fundamental to enabling and maintaining a real-time view of grid conditions in the field and for our customers. The Company will be increasing the amount of

automated restoration capability on the system by installing automated switches and grid sensors. In addition, the increase in grid complexity will result in an increased amount of data collected at a higher frequency than ever before. Improving the communications capabilities to these devices will enable the Company to better manage the system's increasingly complex and dynamic nature with automated real-time response.

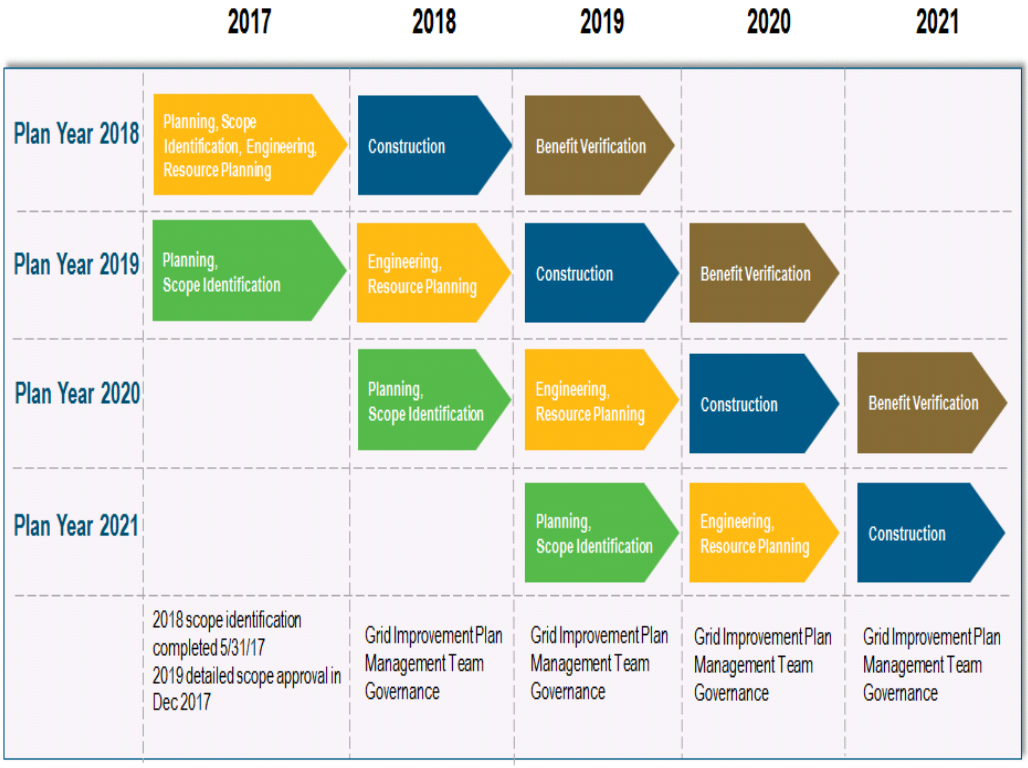
These systems are key to enabling the Self-optimizing Grid functionality mentioned previously to monitor, manage and control the grid remotely in near real-time rather than relying on our employees to provide manual updates at problem areas. For example, these systems will enable the ability to proactively identify issues between two poles where, historically, this required linemen patrolling or responding to customer calls to identify the location of the problem.

A key component of Duke Energy's communications work is focused on strategic communication fiber installations and replacements. The Company will install high-speed fiber connections on existing transmission and distribution infrastructure across key strategic locations. This will improve the reliability, speed and accuracy of transmitting electric system data to our control centers. The Company currently polls systems in 15 minute increments, but higher speed connections to substations and system components will allow the Company to better manage the system in real time. The Enterprise Systems Upgrades include essential upgrades to the back-

office systems needed to operate and manage the many new devices (automated switches, sensors, voltage management devices) on the grid. This includes upgrades to the Outage Management System (OMS), Distribution Management System (DMS), Volt/VAR Management System, Supervisory Control and Data Acquisition (SCADA) system and many others, enabling advanced analytics and control of the distribution grid. These are just some examples of the work we need to accomplish on our grid over the next five years.

Q. WILL THESE POWER/FORWARD CAROLINAS INVESTMENTS CONTINUE THROUGH THE LIFE OF THE PROGRAM?

A. Yes. The Power/Forward Carolinas program represents a ten-year commitment in North Carolina. The investments made in year one will continue. Every year, our work plans will be defined and will be able to be reviewed within the context of the GRR Rider. For example, the Company's detailed Transmission and Distribution planning cycle consists of a two-year detailed plan. Detailed work identification for plan year 2019 will be complete in November 2017. The graphic below explains the work planning cycle by plan year.



Q. HOW MUCH OF THE POWER/FORWARD CAROLINAS INVESTMENT IS REQUIRED TO MAINTAIN THE GRID AND HOW MUCH IS TO MODERNIZE THE GRID?

A. Approximately 90 percent of this investment is to modernize the grid. Specifically, Targeted Undergrounding, Self-Optimizing Grid, and Backfeed Capability are programs that are entirely designed to modernize the grid. The portion of the Hardening & Resiliency program which involves retrofitting transformers to eliminate common outage causes and replacing aged and/or deteriorating cable and conductors represents approximately 10 percent of the investment. The reason these are included in this request is because they have been clearly identified as major causes of outages and our customary

investment rate is not adequate to expeditiously remove these causes. Of the $2.9 billion that DE Carolinas targets in spending over the next five years, from 2017 through 2021 in North Carolina for the Power/Forward Carolinas program, $334 million is for retrofitting transformers to eliminate common outage causes, and for replacing aged and/or deteriorating cable and conductors.

Q. WILL DEC NORTH CAROLINA CUSTOMERS SEE ANY OBVIOUS IMPROVEMENTS IN THE QUALITY OF THEIR SERVICE?

A. Yes, DE Carolinas' North Carolina customers will experience less frequent outages and momentary interruptions (blinks), shorter outage durations when outages do occur, and faster restoration times during major storms.

Q. WILL THESE INVESTMENTS DRIVE SAVINGS FOR CUSTOMERS DOWN THE ROAD?

A. Yes, these investment in the grid should lead to savings in outage restoration costs over the life of the project. These savings will be used to offset rising costs in other areas.

Q. CAN YOU PROVIDE VISIBILTY AS TO THE UPCOMING YEARS OF THE POWER/FORWARD CAROLINAS INITIATIVE AND ASSOCIATED COSTS EXPECTED TO BE ALLOCATED TO DEC NORTH CAROLINA RETAIL CUSTOMERS.

A. The DE Carolinas NC investment per program for the next five years (2017-2021) is included in the table below. Dollar figures in the table are in millions. Yearly totals are in the bottom row.

DEC Grid Improvement Plan
($ MM)

	Capital				
Program Name	2017	2018	2019	2020	2021
Enterprise Systems	13	30	28	18	19
Communication Total	0	25	32	33	30
Transmission Total	46	120	138	165	165
Self-Optimizing Grid	10	59	94	94	94
Targeted UG	-	19	158	258	435
Distribution Hardening & Resiliency	**21**	**157**	**201**	**198**	**245**
Total	**90**	**410**	**651**	**765**	**987**

Q. COULD THERE BE COST CHANGES IN THE FUTURE BASED ON OPERATIONAL EXPERIENCE AND TIMING?

A. Yes, that is possible. Although our ten-year plan is well thought out, we have built in processes for annual scope approvals that will enable the Company to leverage lessons learned throughout the program. These governance processes will also assure any such changes do not materially raise overall program costs or lower projected customer benefits.

Q. WHAT ARE THE ECONOMIC BENEFITS TO THE STATE OF NORTH CAROLINA FROM THE POWER FORWARD INVESTMENTS?

A. Yes, as explained by Witness Fountain, we believe that the Power/Forward Carolinas initiative will greatly enhance the economy of the State of North Carolina.

Q. WILL THESE INVESTMENTS IMPROVE STORM RESTORATION TIMES AND HOW WILL THEY ACCOMPLISH THIS?

A. Yes, Power/Forward Carolinas will improve storm restoration times. First, the overhead lines included in the Targeted Undergrounding program are typically those that sustain the most damage during storms. Undergrounding these areas will greatly reduce that damage and improve restoration times. Second, the Self-optimizing Grid program significantly increases the resiliency of the distribution grid. This technology enables remote detection and isolation of faults on distribution circuits, enabling the system to automatically reroute power to restore service to as many customers as possible within a few a minutes or less. Finally, the Distribution and Transmission Hardening & Resiliency programs reduce the risk of damage during storms by replacing aged equipment with new and more modern equipment, and by building in resiliency options that allow faster recovery when damage does occur.

Q. WILL ANY OF THESE INVESTMENTS REDUCE COSTS FOR STORM RESTORATION IN THE FUTURE?

A. Yes, Power/Forward Carolinas is expected to reduce storm costs over time. This is especially important when you look at the severity of storms experienced in the Carolinas over the last few years. The reason for the reduction in storm costs is simple: as the Power/Forward Carolinas programs are implemented, the power grid will experience less damage when major storms do occur. Storm durations and costs are driven by the extent of system damage.

Q. PLEASE SUMMARIZE WHY THESE INVESTMENTS ARE NECESSARY TO SERVE CUSTOMERS IN NORTH CAROLINA?

A. The problems with our aging grid are escalating and will worsen over time unless we take a proactive approach. Making the right improvements now is critical; we are reaching the limits of performance of the existing system and now we need to address the next phase of modern operations. Customer needs are changing and service interruptions are become more disruptive in a technology-driven world. Even momentary interruptions can be disruptive to lives and businesses, and extended restoration times can have a very real impact on communities and the economy. As explained by Witness Fountain, the Company is very conscious of the economic impact to our State when customers, hospitals, employers, manufacturers and schools do not have power, even if the outage is momentary or resulting from a storm event.

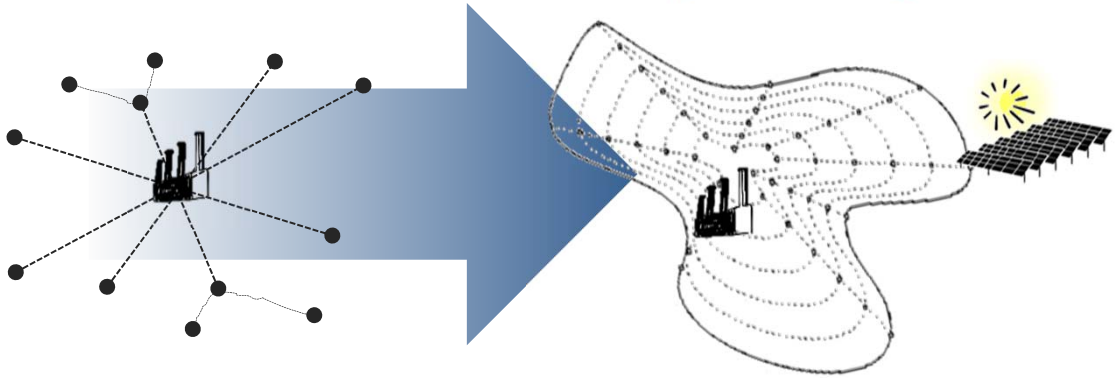
While we have been investing appropriately and reasonably in our grid, the infrastructure is reaching the natural end of its useful life. Infrastructure replacement in the past has been primarily driven by load growth. As our growth flattens (or in some cases declines), the replacement rate of older equipment will slow, thereby increasing older equipment on the system. Our urban areas are seeing most of the growth while rural areas are flat. Therefore, more rural infrastructure is likely to stay in service longer than urban.

The dynamic demands on our system such as the penetration of renewables is already exposing the limits of the legacy grid. Extreme weather events stress older equipment and lead to higher failure rates. Physical and cyber security requirements are tightening to protect energy independence. We need to ensure investment in our grid can support these new requirements. New technology is now available to address these concerns. For all these reasons, we are implementing the Power/Forward Carolinas initiative.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

Our Vision for a Self-Optimizing Grid



The Goal: Customers experience less interruptions due to a dynamic self-optimizing grid which automatically reacts to & mitigates failures and accepts & effectively manages renewable energy.

The Self Optimizing Grid is transforming our radial distribution system to an automated distribution network that provides:

- ✓ ***Connectivity*** *with automated devices between our circuits.*
- ✓ ***Capacity*** on our circuits and substation banks to allow dynamic switching.
- ✓ ***Automated Control*** *to manage our grid, control field devices and provide two-way communications.*
- ✓ **Segmentation** such that our circuits have much smaller line segments, thus reducing the number of customers that are affected by outages.

Distribution Hardening & Resiliency Programs

Hardening- Investments that lower system risk and prevent outage events from occurring:

Grid Integrity and Event Elimination

- Transformer Retrofit
- Deteriorated Conductor / UG Cable Replacement
- Physical & Cyber Security
- Urban UG uplift
- Oil filled equipment replacement

Resiliency- Investments that minimize impacts of events and improve ability to recover rapidly:

Event Impact Reduction & Recovery

- Sectionalization
- Convert UG radials to loop
- Rural circuit ties
- High impact sites
- Capacity margin
- System Intelligence

NC GIP Hardening & Resiliency Examples

Charlotte Douglas Airport

Critical infrastructure project to provide back-feed options

Robbins-ville Circuits

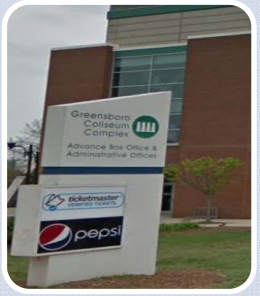
Long duration outages and high maintenance costs due to inaccessible ridgetop facilities

Lake Lure

Long radial feed with no alternative back feed, high repeat and long duration outages

High Point

Long duration outages due to inaccessible rear exiting substation feeder lines



Greensboro Coliseum

Critical infra-structure project to provide back-feed options and automated self-healing

Bryan Park

Industrial Park with long duration outages due to inaccessible overhead backline will be converted to under-ground