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June 11, 2021

VIA ELECTRONIC FILING

The Honorable Jocelyn G. Boyd
Chief Clerk and Executive Director
Public Service Commission of South Carolina
101 Executive Center Drive, Suite 100
Columbia, South Carolina 29210

RE: South Carolina Office of Regulatory Staff's Motion to Solicit Comments from Utilities and Other Interested Stakeholders Regarding Measures to Be Taken to Mitigate Impact of Threats to Safe and Reliable Utility Service
Docket No.: 2021-66-A

Dear Ms. Boyd:

On March 10, 2021, the Public Service Commission of South Carolina (the "Commission") issued Order No. 2021-163 instructing all regulated jurisdictions utilities to submit initial comments on the following topics on or before June 11, 2021:

1. Identification of Threats to Utility Service.
2. Identification of the Impacts to Utility Service.
3. Assessment of Vulnerabilities.
4. Assessment of Risks to Utility Service.
5. Identification of Resiliency Solutions.
6. Identification of Other Federal and State Reliability Requirements.
7. An Assessment of Current Utility Processes and Systems to Withstand Potential Ice Storms and other Winter Weather Conditions.
8. Identification of Best Practices, Lessons Learned, and Challenges to Utility Service.

Accordingly, please find enclosed for filing the Initial Response of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC (the "Companies") pursuant to Order No. 2021-163. The Companies' Response includes information regarding measures that have been, or will be taken, to: 1) mitigate the negative impacts of ice storms and other dangerous weather conditions to the provision of safe and reliable utility service, and 2) ensure peak customer demands on the utility system can be met during extreme weather scenarios.

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By copy of this letter, I am serving all parties of record via electronic mail.

Sincerely,

Heather Shirley Smith

Heather Shirley Smith

Enclosure

cc: Parties of Record (via email w/attachment)

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EXECUTIVE SUMMARY

As one of the largest investor-owned utilities in the country, Duke Energy has a strong history of delivering affordable, reliable and increasingly cleaner energy to its customers. Duke Energy's history stems back to the early 1900s, when visionaries harnessed the natural resource of the Catawba River to develop an integrated system of hydropower plants that provided the electricity to attract new industries to the region. As the population in the Carolinas has grown and energy demand has increased, Duke Energy invested in a diverse portfolio of generation resources, enabled by an increasingly resilient grid, to respond to the region's growing energy needs and economic growth, with a focus on stakeholder involvement and input as Duke Energy advances the energy transition in the Carolinas. Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC ("DEP") (together, the "Companies") have robust processes to proactively plan, monitor, identify, and respond to extreme weather and other potential disruptions to electric service. As the broader environment and systems evolve, continued regulatory and policy support and collaboration is important to ensure sufficient, reliable, and affordable electricity.

On March 10, 2021, the Public Service Commission of South Carolina (the "Commission") issued Order No. 2021-163 in Docket No. 2021-66-A (the "Order"). The Order detailed eight wide-ranging topics asking for utilities to comment on various threats—not limited to weather—and attendant impacts to utility service in this State in light of the Central United States Cold Weather Event of February 2021 causing blackouts in Texas (the "Texas Blackout"). To provide a thorough response to the Commission's Order, the Companies assembled a team of subject matter experts from within the Companies which included, but was not limited to, experts from the following operating departments:

- Customer Delivery and Distribution;
- Transmission;
- Fuels;
- Nuclear/Non-Nuclear Generation; and
- Support function such as Supply Chain, Enterprise Security and Cyber Security.

These team members work seamlessly on a day-to-day basis to support the safe and reliable utility service to the Carolinas. The response illustrates the integrated nature of the Companies' operations that benefit South Carolina customers. The response also illustrates the collaboration within the Companies, across the industry, and with regulators (as appropriate) and policy makers to ensure we are working together to plan, prepare, learn, improve, respond, and support the

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communities and customers served by DEC and DEP in South Carolina under a variety of conditions.

Diversity of Resources and System Scale

The DEC and DEP system is large and complex. As vertically integrated utilities, the Companies are accountable to meet customer obligations from generating stations located in both South and North Carolina to customer meters. The Companies understand their accountability to serve customers in all conditions in the Carolinas and the integrity of integrated operations for ensuring a sufficient and diverse mix of generation sources, a secure and dependable fuel supply, weatherizing generating plant facilities, and making the grid more resilient. The current regulatory construct and market structure has resulted in an electricity system with rates consistently below the national average and an excellent track record of reliable service and responsiveness to extreme weather events including drought, ice storms, tornadoes, floods, and hurricanes. Competitive electric rates help attract new business to South Carolina, and the Companies are called upon to serve an increasing residential population.

DEC, a public utility subsidiary of Duke Energy, owns nuclear, coal, natural gas, renewables and hydroelectric generation, including pumped storage. That diverse fuel mix provides about 23,200 megawatts ("MW") of electricity capacity to serve 2.7 million customers in a 24,000 square-mile service area of South Carolina and North Carolina. DEP, a public utility subsidiary of Duke Energy, owns nuclear, coal, natural gas, renewables and hydroelectric generation, providing about 13,700 MW of electricity capacity to serve 1.6 million customers in a 29,000 square-mile service area of North Carolina and South Carolina. DEC and DEP each operate across both states and as such, the nuclear/non-nuclear generation and transmission in each utility's service territory serves customers in both states. This diversity of resources and economies of scale provide service to South Carolina customers in a more resilient and cost-effective manner than could be done in a disaggregated manner. Additionally, the Companies provide wholesale energy, regulated by the Federal Energy Regulatory Commission ("FERC"), to various wholesale customers in this State.

Planning for the Future

Over the past decade, the Companies have worked to retire coal units, incorporate more renewables and flexible gas resources onto the system, reduce emissions and provide customers with cleaner energy. Making this transition requires participation from all aspects of the Companies' electric service: integrated resource planning ("IRP"), generation, transmission, distribution, and customer delivery and services. The Companies plan for adequate resources through IRP processes to make sure the system has enough supply to sustain customer demand when it is needed the most, particularly during winter peak cold periods when some system resources may be constrained. The

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Companies serve as Distribution Grid Operators and Generation and Transmission System Operators across the Carolinas that monitor and control the real-time operations of the integrated grid, dispatch services and maintenance critical to customers, and oversee local and regional grid reliability. Equally as important as the supply side, sustained maintenance, weatherization, and improvements to the grid have enabled faster outage restoration and enhanced storm resiliency. As the Companies continue the generation transition and integrate more distributed energy resources, investment in the grid and enhanced grid operations will be vital to ensuring continued reliability and resiliency in the face of extreme weather and emergent conditions. The ability for the system to be resilient to extreme weather, to be resilient to changing demand and customer use patterns, to defend against physical and cyber threats, and to defend against other risks is a function of multiple factors – sustained, targeted system investments, a regulatory model that inherently requires accountability from electric providers, appropriate planning and coordination on restoration and continued risk assessment and integration of lessons learned from events throughout the country, and sustainable mechanisms to address the costs arising from these activities.

Lessons Learned

In deregulated and restructured utility models, such as in Texas and California, system operations are not integrated across many of the functions outlined above as they are in South Carolina. This means that system planning functions, grid operators, generators, electric transmission, and distribution functions are separate entities in many cases, which presents different challenges for coordination, resiliency planning, and accountability. As was seen in the Texas Blackout and the August 2020 Western Heatwave Event (the "California Blackout"), the consequences of not planning, investing, and operating as an integrated electric system with a high degree of accountability can be significant and have devastating impacts on customers. Texas has an independent grid operator, ERCOT, that does not conduct an integrated resource planning process, but rather uses scarcity pricing and market dynamics to ensure adequate generation resources. During February 2021, the energy market dynamics did not incent hundreds of independent generators to weatherize for extreme cold in order to "show up" and generate when customers needed the electricity the most, despite several widespread prior cold weather events occurring in the Southwest and Texas since the 1980s. Following the 2011 Southwest cold weather event affecting millions of customers across Texas, Arizona and New Mexico, federal energy regulators issued a joint report stating that a failure to winterize generation plants and fuel supply caused the outages and referenced several cold weather events since 1983, noting that such are events are not

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without precedent in the region.[1] In addition, critical gas and fuel-oil units used for restart if the grid in Texas had collapsed were only partially available during the cold weather event, creating more potential resiliency risks in Texas. Furthermore, the ERCOT electricity market is not incentivizing those critical restart units to be available, as many of these generators are not able to cover their basic compliance costs through the ERCOT market pricing. Texas is an example that resiliency is not achieved by chance or merely by market forces, rather there must be intentional prioritization, planning, and investment driven by utilities, regulators, and policy makers to ensure resilience.

In California, a state entity coordinates with the independent grid operator, California ISO, and independent operating utilities to ensure sufficient resources for summer. California's rotating blackouts in August 2020 highlight challenges of having enough generation to meet customers' electricity needs during the heat wave in the early evening when the sun set. The solar panels that replaced much of the retired dispatchable and baseload gas (and soon nuclear) resources could not meet customer needs while the sun was setting, as imports were constrained due to the widespread nature of the heatwave. The North American Electric Reliability Corporation ("NERC"), the organization responsible for electric reliability in North America through the development and enforcement of NERC Reliability Standards with oversight from the FERC, identified California to be at risk of meeting summer peaks in 2021,[2] noting its reliance on special capacity procurements and imports from independent or out of state generators to meet peak demand customer needs. California is an example of vulnerabilities created through generation resource choices being exposed by an extreme and prolonged heatwave. In the Texas Blackout and California Blackout, customers bore the burden of these disaggregated utility industry model accountability gaps through electric and water utility service disruption, higher prices, and ongoing uncertainty of having reliable and affordable electric supply when needed the most. As was seen in the February 2021 Texas Blackout and the August 2020 California Blackout, the consequences of not planning and investing in a resilient electric system can be catastrophic.

[1] FEDERAL ENERGY REGULATORY COMMISSION AND NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION STAFFS, REPORT ON OUTAGES AND CURTAILMENTS DURING THE SOUTHWEST COLD WEATHER EVENT OF FEBRUARY I – 5, 2011 – CAUSES AND RECOMMENDATIONS (AUGUST 2011), https://www.nerc.com/pa/rrm/ea/February%202011%20Southwest%20Cold%20Weather%20Event/SW_Cold_Weather_Event_Final.pdf.

[2] NERC's 2021 Summer Reliability Assessment report placed California in the "high risk" category, relying on large energy imports during peak demand when solar resources retreat in the evening hours. NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION, 2021 SUMMER RELIABILITY ASSESSMENT (MAY 2021), HTTPS://WWW.NERC.COM/PA/RAPA/RA/RELIABILITY%20ASSESSMENTS%20DL/NERC%20SRA%202021.PDF.

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The Importance of Constructive Regulation and Policy

The Companies are currently well positioned to address the various threats which exist to operations and service to South Carolina customers. This is not circumstantial, but rather the result of a history of strong regulatory support for integrated utility operations – and the prudent cost recovery for the expenses of those operations. Equally important are the historic policies in place that have been supportive of storm cost recovery, and deferred accounting of expenses for activities that preserve and advance service and reliability including advanced metering, grid improvements for resiliency and reliability, and cybersecurity. These practices have afforded the Companies the ability to appropriately invest in operations, infrastructure, and people—and to attract and retain employees which are very much in demand in not only the electric industry, but also other industries that execute the work as discussed in the comments below. Historic constructive regulations in the current vertically integrated utility structure in the Carolinas has allowed the Companies to conduct resource planning that appropriately balances reliability, cost, fuel diversity, and increasingly clean energy as the Companies invest in their assets and operations for reliable electric operations.

Maintaining current levels of service and reliability for the future will require continuing constructive regulation, particularly as the electric energy industry—and Duke Energy—continues to transform its fleet and grid to meet customer, investor, regulatory, and legislative expectations. Customers and communities are top priority as the Companies deliver safe, reliable, increasingly clean energy 24x7x365. The Companies have collectively been good stewards of the systems providing electric service to the Carolinas. The Companies have a strong reliability track record of weather response and reliability with no rotating outages in recent history (last 30+ years). The Companies' employees live and work here—thousands in South Carolina alone—and take seriously this obligation to serve their communities and customers. The Companies have worked with industry peers, and stakeholders under a strong federal and state regulatory framework to implement policies and practices that continuously address threats to electric service disruption. The Companies learn from events, inside and beyond the Carolinas, and proactively make improvements to mitigate risks. The Companies' culture of operational excellence demands self-criticality, proactive planning and monitoring, root cause analysis, and lessons learned to inform actions to make improvements. Threats to electric service disruption continue to change and evolve and are by no means limited to weather.

The Companies are Positioned to Address Threats

Providing reliable electricity is a complicated business and one that has become increasingly complex. Threats to the South Carolina electric utility system are diverse, complex and dynamic

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and include extreme weather and other natural events, cyber and physical security, and cross-sector impacts such as fuel supply workforce and supply chain disruptions. Threats are often multifaceted and occur in causal combinations. For example, a physical or cyber threat may target telecommunications or transportation systems that impact the Companies' utility systems and processes. A seismic event may impact dam integrity. Many threats such as dam safety, fuel supply or bulk electric system disruptions may have an extreme weather relationship. Table 1 below summarizes the threats the Companies identified that may destroy, damage, or disrupt electric utility service and the relative potential for disruption for an extended period, similar to a multi-day Texas Blackout. Extreme weather events are in bold, as that was the primary impetus of the Order.

While threats are always evolving and may be broader than the Companies' jurisdictional borders, the Companies recognize their role and responsibility to be proactive in evaluating, preparing for, mitigating, and responding to these threats to minimize the potential for extended disruption for South Carolina customers. The Companies do this important work in collaboration with industry partners, regulatory agencies, and policy makers. This collaboration is important to ensure they are considering what is in the Companies' control to mitigate, appropriate levels of investments, and costs to customers for such mitigations and responses, as well as layering federal, state, and local regulations that address these threats. The subsequent chapters of this response illustrate how the Companies are positioned to address these threats, organized by the Order's specific requests.

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Table 1: Summary of identified threats that may destroy, damage, or disrupt utility service

Threat	*Examples*	*Breadth*	*Potential for extended disruption**
1. Extreme weather events and seismic activity that disrupt electric service	**Storm Systems, Derechos, Tornadoes, Lightening, Hurricanes, Coastal Surge, Flooding, Winter Storms and Icing, and Earthquakes**	**Localized or widespread**	**Typically derive from wide-spread events** **Proactively reduced risks through:** **- mitigations implemented based on past events** **- existing utility and industry processes** **- investments in infrastructure and resiliency**
2. Extreme weather events that challenge the ability to serve peak loads	**Heat Wave, Polar Vortex, Winter Storms, and Ice Storms**	**Typically widespread**	
3. Physical and cybersecurity threats	Coordinated attack, malware, ransomware	Localized or widespread	Depends on specific disruption or threat May be related to extreme weather events
4. Fuel supply disruptions	Rail or pipeline disruption, supply shortages		
5. Workforce disruptions	Pandemic, civil unrest		
6. Supply chain interruptions	Pandemic, geopolitical barriers		
7. Telecommunication system disruptions	Weather-related equipment damage, cyber threat		
8. Bulk electric system threats	System instability and outages due to variable resources, regional generation outages, constraints on transmission or supply (e.g., California Blackout)	Typically widespread, may be locally contained	Proactively mitigated through utility and industry engineering standards, processes, systems, and regulation (federal and state)
9. Vegetation challenges	Trees falling on power lines	Typically localized	Often related to extreme weather events
10. Dam safety or integrity issues	Dam breach due to extreme rainfall amounts		Often related to extreme weather events, but may be security related

*Extended disruption is a multi-day event similar to the extended electricity and water utility outages that occurred in Texas during the February 2021 Central United States Cold Weather Event

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Chapter 1, Identification of Threats to Utility Service, responds to Order Item 1 by providing details on each of the Companies' identified threats. An introduction to mitigation strategies for each are provided. Chapter 2 provides specific details on how core utility processes provide integrated mitigation strategies across all utility functions for the breadth of threats.

Chapter 2, Identification of Impacts to Utility Service, responds to Order Item 2 by assessing the extent to which the threat could impact the utility processes, systems, infrastructure, and end-user customers. Disruptions to utility service based on the identified threats are assessed for impacts based on the following integrated mitigation strategies and processes proactively used across the Companies:

1. Forecasting and Planning;
2. Active and Real-Time Threat Monitoring;
3. Asset Inspection and Maintenance Programs; and
4. Emergency Response and Business Continuity Plans.

Chapter 3, Assessment of Vulnerability, responds to Order Item 3 providing details on the degree to which systems and infrastructure may be impacted. An assessment of vulnerabilities and the impact identified threats can have on utility systems and infrastructure can be evaluated by reviewing the past performance of the Companies' utility systems when faced with realized threats. Additionally, assessment of vulnerabilities is accomplished through evaluating the performance of the broader utility industry systems and events to draw conclusions about potential vulnerabilities of the Companies' utility systems, as discussed in Chapter 7.

Chapter 4, Assessment of Risks to Utility Service, responds to Order Item 4 including an evaluation of the potential for loss, damage or destruction of key assets and resources and factors that could limit the supply of generation over an extended period of extreme weather conditions. The Companies provide service to South Carolina customers from a diverse mix of generation sources located in South and North Carolina. While periods of extreme weather conditions can impact generation supply, diversity in the generation mix as well as weather hardening efforts have allowed the Companies to successfully supply reliable power to South Carolina through the 2014 and 2015 Polar Vortices. Lessons learned from these weather events, as well as from the recent Texas Blackout have been acted on to mitigate future weather event impacts to generation supply. The Companies have provided an evaluation of the potential for loss, damage or destruction of key assets and resources as well as factors that could limit the supply of generation over an extended period of extreme weather conditions. Additionally, the Companies have provided weather

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hardening tactics used to ensure each of the diverse generation sources serving South Carolina customers can withstand future weather events and provide reliable service.

Chapter 5, Identification of Resiliency Solutions, responds to Order Item 5 detailing how the Companies identify resiliency solutions. The Companies place significant focus on preventing service disruptions to South Carolina customers. The Companies focus on forecasting, planning, monitoring, and inspection programs to prevent or mitigate service disruptions. However, there are times when service disruptions occur based on the identified threats to utility service. When these disruptions occur, the Companies' top priority is to safely restore service to South Carolina customers in an efficient, systematic way. DEC and DEP accomplish this by leveraging specific integrated plans and resources across the entire Carolinas system, as detailed in this section for the following:

1. Emergency response and business continuity plans;
2. Black start system plans;
3. Supply chain interruption plans;
4. Vegetation management program;
5. Bulk electric system plans; and
6. Fuel supply interruption and cost management plans.

Chapter 6, Other Federal & State Reliability Requirements, responds to Order Item 6, identifying how the Companies comply with a number of federal, state and local regulatory reliability and resilience requirements. These requirements impact operations in nuclear/non-nuclear generation, transmission, and security organizations. Compliance with these requirements further support and benefit reliable utility service for South Carolina customers.

Chapter 7, Assessment of Current Utility Processes & Systems to Withstand Potential Ice Storms and other Winter Weather Conditions, responds to Order Item 7 and is central to the core interest of the Order in detailing how the Companies are prepared to manage extreme weather events similar to the one that lead to the Texas Blackout. The Companies engage in winter storm preparation and readiness activities and leverage formal processes to ensure reliable service to South Carolina customers during winter weather conditions. Because of the regulated structure in South Carolina, the Companies are well positioned to effectively meet their obligations to provide service to customers from generator to meter, levering the integrated nature of operations to coordinate activities across multiple functions to effectively meet such obligations. The current regulatory structure has multiple touchpoints and processes that are crucial in the Companies' reliability and resiliency in facing the types of threats discussed in this response. This structure

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provides for single point accountability and ongoing regulatory oversight to ensure both customer affordability and service reliability and helps to guard against the distributed performance concerns exacerbated in the Texas Blackout.

Chapter 8, Identification of Best Practices, Lessons Learned and Challenges to Utility Service, responds to Order Item 8 including information related to reliability, lessons learned from similar experiences, and challenges of the provision of safe and reliable utility service under extreme weather conditions and other threats. The Companies actively engage in the identification of best practices, lessons learned and learning from all challenges to utility service. Continuous improvement is a foundational element of Duke Energy's operational excellence culture and critical to the Companies' success. Employees at the Companies excel at both internal learning across a diverse operations portfolio and external learning through industry engagement and leadership. This overview is presented by the operational group within Duke Energy: Distribution, Generation, Transmission, Fuels, Supply Chain, and Security.

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CHAPTER 1: IDENTIFICATION OF THREATS TO UTILITY SERVICE

Order Item 1: Assessment of the potential threats to the utility system and evaluation of the risks to safe and reliable utility service. Threats are defined as anything that may destroy, damage, or disrupt utility service.

Overview

Threats to the South Carolina electric utility system are diverse, complex, and dynamic. Such threats include extreme weather events that disrupt electric service and challenge the ability to serve peak loads. In addition, third parties seek to cause intentional physical and cyber asset damage that can disrupt electric service. The Companies also face threats from disruption of their workforce, supply chain, and telecommunication systems. Beyond these broad utility system threats, there are several targeted threats specific to segments of the utility system. Hydro power dam safety and integrity, Bulk Electric System ("BES") stability, and distribution system vegetation challenges are all examples of utility system segment threats to reliable service. The threats identified align with risks to the reliable operations of the bulk power system as identified by NERC, the organization responsible for the electric reliability in North America:

- Grid transformation: introduction of risks in long-term and short-term planning and real-time operations due to changes in generating resources and fuel sources, such as retirement of nuclear and coal and growth in variable energy resources and reliance on gas;
- Extreme natural events: events often regional in nature that can cause significant or widespread outages such as hurricanes, tornadoes and derechos, extreme heat and drought, wildfires, flooding, and extreme cold (polar vortices), seismic activity, and geomagnetic disturbances;
- Security risks: physical and cyber security risks; and
- Critical infrastructure dependencies: risks due to electric sector reliance on other sectors such as communications, water, and fuel transport (e.g., pipelines).[3]

In this section, the Companies have identified threats that may destroy, damage, or disrupt utility service. An assessment of the potential threats as well as an evaluation of the risks to service are detailed below.

[3] NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION, 2019 ERO RELIABILITY RISK PRIORITIES REPORT (NOVEMBER 2019), HTTPS://WWW.NERC.COM/COMM/RISC/RELATED%20FILES%20DL/RISC%20ERO%20PRIORITIES%20REPORT_BOARD_ACCPETED_NOVEMBER_5_2019.PDF.

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Threats that may destroy, damage, or disrupt utility service for customers in South Carolina include:

1. Extreme weather events and seismic activities that disrupt electric service;
2. Extreme weather events that challenge the ability to serve peak loads;
3. Physical and cyber threats;
4. Fuel supply disruptions;
5. Workforce disruptions;
6. Supply chain interruptions;
7. Telecommunication system disruptions;
8. Bulk electric system threats;
9. Vegetation challenges; and
10. Dam safety and integrity issues.

Detailed Narrative

1. Extreme weather events and seismic activity that disrupt electric service

Threat description

Extreme weather events pose a threat to the Companies' electric utility systems in the Carolinas. Extreme weather can occur with little warning and last for just minutes, as in the case of thunderstorms and tornadoes, as well as extreme natural events (solar eclipse and earthquakes). Other weather events, such as tropical storms, hurricanes, flooding, and ice storms, allow for better forecasting but may last from hours to days.

Extreme weather events – including ice storms, hurricanes, tropical storms, tornadoes, flooding, and extreme thunderstorms – pose a threat to the Companies' distribution systems in South Carolina. South Carolina's moderate climate also contributes to threats from ice storms, as temperatures may be cold enough to cause ice accumulation on power lines or trees near power lines, but not cold enough to simply cause snowfall. High winds and fallen trees can bring down distribution and transmission lines, poles, and devices, while flooding can damage equipment in substations or in the field in low-lying areas. These weather events can also pose challenges to getting crews on site for repairs when roadways may be hard to access due to the weather conditions.

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The Companies' transmission system can also be impacted by multiple types of severe and extreme weather events that can cause service disruptions to customers. Most events, such as thunderstorms and winter storms are generally localized and do not cause large extended outages—however, any outage can be impactful to customers experiencing a lack of service, particularly in severe weather. Events such as tropical storms, hurricanes, flooding, and ice storms where precipitation accumulations are above 0.25 inches have the potential to cause widespread damage to the system, possibly causing extended customer outages.

The Companies' nuclear/non-nuclear generation fleet is also susceptible to extreme weather events that can disrupt service. Extreme weather with the potential to disrupt nuclear/non-nuclear generation includes lightning, extreme high wind, heavy rain, storm surges, hail, heavy snowfall, and freezing rain, as well as seismic activity. Each of these events can exhibit damaging effects that can disrupt or reduce power generation output.

Lightning strikes have the energy to cause both electrical disruption and physical damage to plant equipment. Extreme high winds as seen in tornadoes and major hurricanes can cause damage to both plant structures and equipment. Damaging water intrusion into plant electrical systems can be caused by both heavy rain and storm surges. Sustained heavy rainfall can saturate the coal pile at coal-fired stations making it difficult or impossible to combust in the boiler. Flooding from a storm surge can also damage mechanical plant equipment. Larger diameter hail from powerful thunderstorms can damage sensitive instrumentation and electrical installations. Heavy snowfall and freezing rain can accumulate on both plant structures and equipment causing a substantial increase in weight that must be supported. While small earthquakes occurring in the Carolinas territory have not yet been sufficient to cause substantial damage, larger magnitude earthquakes could cause catastrophic damage to nuclear/non-nuclear generating and transmission equipment and structures.

Introduction to mitigation strategies

The Companies have robust prevention and mitigation tools for such events. For example, the Companies leverage forecasting and planning strategies to mitigate the impacts of extreme weather events that disrupt service. The Companies leverage plans to bring line personnel from across the Duke Energy service territory (7 states) to respond to severe weather threats and impacts. Active and real-time monitoring are employed to provide a quick response to changes in extreme weather and rigorous asset maintenance programs are used to ensure the system is prepared to withstand extreme weather. The Companies' storm and emergency response plans ensure DEC and DEP have the right resources engaged at the right times to recover from extreme weather events. These mitigation strategies are detailed in Chapter 2 of this response.

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2. Extreme weather events that challenge the ability to serve peak loads

Threat description

Other extreme natural events like extreme cold, extreme heat, or extended drought pose a threat to the utility system's power supply resources and thus its ability to serve peak load. Generally speaking, peak load is the maximum electrical power demand of the system consisting of the expected sum of retail and wholesale loads. The maximum demand netted for Energy Efficiency and Behind-the-Meter Generation is referred to as net peak load. Peak loads reflect the highest electrical demand over a given period. Peak loads are typically characterized as the highest hourly loads the system serves during the course of a year, season, month or day depending on the context of the analysis. Longer term resource and transmission planning primarily considers seasonal peak loads for winter and summer periods since high customer demand usually occurs during these seasons and the Companies must ensure sufficient resources and transmission capacity are available to meet these peak loads. Peak loads are often described as winter peak loads and summer peak loads because of the time of day they occur, the duration of the peak, and the resources available to meet loads.

For operations planning, peak load is important because a system operator must plan its system to ensure enough generating capacity to meet the peak load with the resources that are available for the planning period. Ensuring the system has enough capacity during these peak demand periods often reflects the system's ability to reliably serve electric generation year around. Peak load conditions are often expressed as "Weather Normal" peak loads for planning purposes. This definition calculates seasonal peak demand based on average peak load conditions over the last thirty years. "Extreme peak loads" such as those seen during the Texas Blackout can occur when weather is much warmer or colder than the average peak conditions. In addition, the duration of such extreme events can be prolonged compared to weather normal forecasts.

Overloading of distribution lines or transformers during system peak events could damage equipment and cause outages. Peak events are incurred in either very hot summer afternoons or very cold winter mornings. Extreme weather or extended periods of unseasonable weather—such as three or four days of extreme low temperatures or extended drought conditions—can create above normal peak demands and put stress on generation resources and on the transmission system needed to deliver the increased power output of the generation resources to the elevated customer loads. This creates an issue because the reserves of electric generation diminish each day as peak load increases and creates challenges if there is a sudden loss of electric generation. If the loss of

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electric generation is too great due to diminished reserves, then a utility will need to shed load to maintain balance of resources and demand to ensure continued reliability of the system.
For the Companies' nuclear/non-nuclear generation facilities, extended periods of below freezing temperatures can freeze unprotected exposed service water piping, condensate piping, and instrumentation lines that do not maintain flow. Frozen piping can disrupt control and operation at a generating station causing reduced output or forcing whole generating units offline. Frozen piping can also be damaged and leak as it thaws creating more operational challenges to maintaining nuclear/non-nuclear generation.

The electrical and mechanical equipment at a generating station produces significant amounts of heat during operation. To maintain reliability, plant equipment must be maintained within operating temperature limits. To maintain temperature limits, heat must be removed from plant equipment. The Companies accomplish heat removal by ensuring air flow around equipment or by cooling water through heat exchangers. Sustained high temperatures can challenge the operating temperature limits for some nuclear/non-nuclear generating equipment resulting in reduced electric generation output.

Steam generating stations (coal, combined cycle, and oil-fired steam generation) require a source of cooling water for condenser operation. Many nuclear/non-nuclear generation sites are permitted to withdraw water from the local waterbody for the purpose of cooling and then return the water back to its source. Each of these stations have a National Pollutant Discharge Elimination System permit that regulates the maximum average temperature that can be discharged by the facility.

During periods of extreme heat, these withdrawal/discharge water bodies increase in temperature which decreases the amount of heat that can be absorbed during the condensation process without exceeding the permitted discharge temperature limit. This requires the generating station to reduce the thermal load of the condenser which also reduces net electrical production.

While extreme cold weather does not typically jeopardize peak net electricity output for the Companies' nuclear generation fleet, the impact of extreme heat on cooling water sources does have the potential to limit nuclear generation as well. Each of the Companies' nuclear units utilize a large body of water, a lake or a river, to remove excess heat and these cooling sources are resilient to even extreme drought conditions. During extreme hot weather conditions, water source temperatures rise and a slight decrease in nuclear generating unit efficiency can occur.

When sustained hot weather is coupled with drought, the effects are compounded as less cool water is flowing through the waterbody, reducing the rate that the warmer water is replaced by cooler

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inflow. Further, these conditions often result in decreased lake levels. If sustained droughts were to occur, lake levels could fall below the intake of non-nuclear generation facilities, forcing them into an outage as a result of insufficient makeup water for steam production and/or makeup to cooling towers.

Extreme weather can also play a significant role in the availability of natural gas needed to serve peak electric generation loads. Significant periods of extreme cold weather, hurricanes, and other natural disasters could cause natural gas well production to be shut down. If these conditions overwhelm production centers (Appalachia or Gulf Coast) then significant supply shortages could occur and drastically impact prices. Extreme weather conditions can also contribute to constrained or curtailed pipeline operations which then limit gas supply to the Companies' generating units.

For their gas supply, the Companies currently rely on a single source interstate pipeline, Transco, within which they hold an inadequate amount of firm transportation rights. To save customer fuel costs, the Companies purchase 50% to 70% of their firm delivered supply from third parties. With the onset of sustained extreme cold weather, firm delivered gas supply can become extremely expensive due to competing demand. The lack of adequate gas infrastructure into the Carolinas increases price volatility risk and increases fuel security risks.

Introduction to mitigation strategies

The Companies leverage forecasting and planning strategies to mitigate the impacts of these types of extreme weather events which challenge the Companies' ability to serve peak loads. The Companies' employees and systems actively monitor—in real time—changes in extreme weather so that employees can take actions and respond accordingly. The Companies also execute rigorous asset maintenance programs to ensure the system is prepared for extreme weather and the associated load demands. The Companies' storm and emergency response plans ensure DEC and DEP have the right resources engaged at the right times to manage through and recover from extreme weather events. These mitigation strategies are detailed in Chapter 2 of this response.

3. Physical and cyber threats

Threat description

From a physical security perspective, the top physical threat to safe and reliable utility service is intentional damage to critical equipment via coordinated attacks on infrastructure. Many times, this is conducted through one of the following methods: valve turning, sabotage, theft, and resulting equipment damage. Recent examples that had significant impacts on operations include: the 2013 PG&E Metcalf Substation attack in California; the 2013 downing of an Entergy 500kV

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tower and burning of a substation control house in Arkansas; the 2016 manual shutdown of five interstate oil pipelines along the U.S/Canada border; the 2019 manual shutdown of an interstate oil pipeline in Minnesota; and the 2020 manual shutdown of three natural gas pipelines in Colorado. Nuclear/non-nuclear generation and transmission facilities face several physical threat categories that include theft, vandalism, and sabotage. Thieves attempting to steal expensive equipment and materials from critical sites risk seriously damaging infrastructure and impacting operations. An intentional coordinated attack on critical infrastructure or equipment is the greatest physical threat to Duke Energy's assets.

From a cybersecurity perspective, the top threats include compromised remote connections used by vendors, negligent and/or malicious use of removable media, and supply chain compromise. Cyber threats to reliable service can also be coupled with physical threats to utility service. For example, one threat that includes both physical and cybersecurity is the advanced persistent threat ("APT"). Traditionally, APT has been characterized as highly trained cyber criminals or nation-state-sponsored cyber teams. Behind these sophisticated groups would be a less sophisticated adversary using a combination of physical and cyber-attack to breach a physical boundary to facilitate a deeper cyber campaign. A nation-state-sponsored adversary may utilize more advanced techniques if there are geopolitical motivations.

Additionally, the deployment of ransomware has become an increasingly appealing objective for malicious actors. The Companies protect against this attack type and many others with a multi-faceted approach. The foundation of our defense posture is the MITRE Adversarial Tactics, Techniques, and Common Knowledge ("ATT&CK®") framework. This is used to continuously evaluate adversary capabilities and position our defenses to interrupt before they can achieve action on objectives. Duke Energy utilizes a nexus of intelligence partners to keep defensive capabilities sharp and emerging vulnerabilities mitigated. Our partners include private sector intelligence firms, the federal government, law enforcement, industry intelligence sharing hubs, and open source intelligence. The Companies have a robust incident response policy and procedures built within the National Institute of Standards and Technology ("NIST") Cybersecurity Framework ("CSF"). It is important to note that many of the Companies' actions are confidential in nature to ensure bad actors have no more information available or tools in their toolbox than they currently have, and as such, limited information is included in this response.[4]

[4] Given the very recent nature of the Colonial Pipeline ransomware incident widely reported in the media, the Companies have declined to comment on this incident in this response given current investigations. The Companies expect more information to be made available on those investigations in the coming weeks and are following the matter closely.

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Introduction to mitigation strategies

The Companies leverage forecasting and planning strategies to mitigate the threats of physical and cyber security threats. The Companies actively monitor and employ real-time actions to prevent and identify attempted harm to the Companies' physical and cyber assets and provide quick response. The Companies also utilize asset inspection programs to ensure the system is prepared for physical and cyber threats. Further, the Duke Energy emergency response and business continuity plans ensure the Companies have the right resources engaged and can successfully manage through physical and cyber security threats throughout enterprise systems which could affect the operations in the Carolinas. These mitigation strategies are detailed in Chapter 2 of this response.

4. Fuel supply disruptions

Threat description

Fuel supply disruptions are a threat with the potential to impact utility service. Fuel supply disruptions include interruptions to the coal supply chain, loss of natural gas supply, and fuel oil replacement interruptions.

Continued growth in competitively priced natural gas generation, the development of dual fuel (coal or gas) operations in the Carolinas, and the increase in new solar generation has moved the Companies' coal fleet from its traditional role of baseload generation to cycling resources. Meanwhile, the coal industry supply chain is not designed to have assets, (e.g., rail equipment, coal mines, engineers, and miners) sitting idle waiting for spikes in demand. Because of this, the coal supply chain can take weeks to respond to changes in market conditions or supply/demand disruptions. This mismatch increases the risk of volatility during periods of peak demand (e.g., extremely cold or hot weather) which can result in depleting inventory to unreliable levels for coal generation.

The majority of the Companies' coal fleet is served by only one railroad. As a result, disruptions in rail service due to weather, maintenance, rail system demand, or derailments can significantly impact on-time deliveries, resulting in declining inventories to unreliable levels for coal generation. Lastly, as domestic electric coal generation declines coal suppliers and related vendors are under increasing financial pressures and tightening access to investor financing coupled with deteriorating credit quality. This situation is increasing the overall costs of financing for coal producers and putting increasing pressure on coal supplies.

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Based on location, the Companies currently do not have an interstate gas pipeline alternative that is in-service, nor does Transco currently have unsubscribed gas capacity for the Companies to contract for additional long-term firm transportation to manage the supply deliverability needed for current gas demand.

As the Companies continue to transition from coal fired assets to lower carbon generation, the fuel diversity of the system is reduced. Traditionally, fuel diversity benefitted customers through optimization of the lowest cost power generation while improving system reliability against fuel interruptions/shortages. Since 2010, numerous coal-fired facilities have been replaced with intermittent renewables, most without energy storage to store and shift energy, and natural gas combined cycle sites, of which most do not have fuel oil capabilities. Most solar sites currently only provide output when the sun is shining, and gas facilities require a real-time supply of natural gas as there is no onsite fuel storage. Each additional coal retirement increases the likelihood of customer disruption in the event of low irradiance for solar or gas curtailment as a result of having insufficient coal generation to back-up renewables and gas generation without onsite fuel or long duration energy storage.

Other pipeline events that can cause service disruptions to the gas transportation system, as outlined in the Transco FERC Gas Tariff, Section 11 – Force Majeure Provision and Contract Entitlements include explosions, breakage or accidents to machinery or pipelines including the necessity of making modifications, and tests or repairs to the pipeline system beyond routine maintenance.

Low-cost natural gas has become a reality and has benefitted customers by providing lower fuel costs ever since the introduction of hydraulic fracturing. Extreme weather can also play a role in the availability of gas. Significant periods of cold weather, hurricanes and other natural disasters could affect natural gas well production and transportation. If these conditions overwhelm production regions (Appalachia or Gulf Coast) then significant supply shortages could occur. This could result in load shed and could have drastic impacts on spot prices.

When gas requirements for generation exceed the Companies' firm interstate transportation rights, delivered supply must be purchased from third parties. While buying required spot delivered gas has historically been effective during non-extreme cold weather, delivered market supply availability is reduced with the onset of cold weather which increases retail gas consumer demand.

During periods of extreme weather, the Companies' gas combustion turbines and some gas combined cycles can rely on fuel oil backup in the case of high gas prices and/or low natural gas

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supply. However, there is a risk of not being able to obtain fuel oil deliveries to supplement the Companies' on-site fuel oil storage as trucks may not be able to transport due to road conditions or there may be limitations on trucks and delivered supply due to competing market needs and delivery priorities.

Introduction to mitigation strategies

The Companies utilize validated third-party propriety models for detailed forecasting and planning to mitigate fuel supply interruptions. Real-time monitoring of potential interruptions to the Companies' fuel supplies allows the Companies to make quick adjustments as the threats evolve. These mitigation strategies for fuel supply interruption threats are detailed in Chapter 2 of this response.

5. Workforce disruptions

Threat description

The Companies are reliant on a highly skilled workforce for day-to-day work activities and for managing emergencies. The workforce is susceptible to several potential threats that could ultimately impact reliable utility service. These threats include a pandemic, limited labor pools, or civil unrest.

A global pandemic represents a broader challenge to the workforce that could affect widespread locations across the Companies' systems. The current COVID-19 pandemic has emerged as a risk to being able to keep employees healthy and able to operate the Companies' facilities. Work crews must work closely together in the field or in transit to job sites which increases risk of exposure to COVID-19.

Duke Energy and many other electric utilities are competing for a limited pool of trained, highly skilled technical utility workers, which threatens the Companies' ability to hire or contract the skilled workforce needed to maintain service. This has become an increasingly important issue company-wide as the industry competes for workers, both internal to South Carolina and nationally. Keeping employees is as important as finding and hiring them. The challenges to maintaining a knowledgeable and skilled workforce are even more exacerbated when there are multiple major outage events across the United States simultaneously, causing affected utilities in different regions to simultaneously ensure they have sufficient outside labor resources available for restorations.

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Civil unrest is a local, external threat to the Companies' infrastructure that could impact multiple locations simultaneously. A larger risk is associated with civil unrest and activists that could challenge fuel, material, or employee transportation. Past incidents have occurred where activists have blocked fuel and material deliveries to sites. These instances were counteracted by local police departments as they were small in number and isolated to a small portion of Duke Energy facilities. Similar incidents could impact our employees' ability to access the Companies' facilities without law enforcement response.

Introduction to mitigation strategies

The Companies leverage active and real-time monitoring to stay ahead of workforce disruptions that may impact utility service, and the Companies work very hard to hire, engage and retain a qualified and active workforce in a challenging national labor market. The Companies work to ensure they have the staff necessary to continue both "back office" and field operations to ensure service to customers. The Companies' emergency response and business continuity plans also support mitigation of potential disruptions in the workforce and the resulting impacts to reliable utility service. These mitigation strategies are detailed in Chapter 2 of this response.

6. Supply chain interruptions

Threat description

The threat of supply chain disruptions can impact the reliability of the Companies' service to utility customers. Supply chain disruptions come in many forms, some of which are driven by industry events like widespread storms. Additionally, disruptions in Duke Energy's supply chain supporting the Companies can be triggered based on seemingly unrelated events in the world including supplier performance, geo-political activity, regulations, market conditions, supplier financial trouble, labor strikes, material shortages, and transportation threats.

Suppliers that provide services or products can experience industry-wide labor shortages which could impact the Companies' ability to recover from power generation outages or recover from storm events in the expected timeframe. Manufacturers can also be impacted by internal labor strikes resulting in disruptions to materials or equipment being available.

Suppliers relied upon and utilized by the Companies can suffer internal supply chain disruptions which could potentially cause a shortage of available materials. Examples include raw material shortages which impact the supplier's ability to meet quantity or schedule commitments for Duke Energy, labor strikes through the supply chain that may impact mining operations for raw

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materials, and regulatory changes that may indirectly impact raw material or component usage in the market place.

Large scale regional storm events can create a shortage of utility strategic supplies and materials (wire & cable, wood poles, transformers, etc.). In turn, a shortage of those supplies could slow down or disrupt the Companies' ability to recover and repair or rebuild infrastructure damaged in a hurricane or ice storm or other large storm event.

Supplier financial health is another very real threat to the supply chain. If a supplier of materials or services to DEC or DEP experiences financial difficulties or bankruptcy, the supplier's ability to provide committed products or services may be delayed or canceled depending on the nature and severity of the financial issues, and no contract can fully mitigate these risks.

Supply chain disruptions can be caused by transportation risks to rail, trucking, shipping, and air freight supply channels. These risks can be caused by several different problems in the transportation supply chain including labor strikes, capacity shortages, wars, shipping permits, or blocked shipping routes. A recent example of this is the Suez Canal crisis in 2021.[5]

Introduction to mitigation strategies

The Companies manage and mitigate supply chain interruptions by detailed forecasting and planning for supply needs and supply chain system health. Real-time monitoring of the external forces that can impact the supply chain help the Companies quickly respond to changing threats. Business continuity plans provide a means of mitigating threats to the supply chain that have the ability to impact reliable utility service. These mitigation strategies are detailed in Chapter 2 of this response.

7. Telecommunication system disruptions

Threat description

The Companies are heavily reliant on telecommunications technology for communication with and between their equipment, workers, and customers. Disruptions to telecommunication systems can impact reliable utility service via planned work as well as customer interfaces.

[5] In March 2021, the Suez Canal was blocked for six days after the grounding of a 1,300-foot vessel, halting all shipping traffic. As one of the world's busiest trade routes, the canal obstruction had a significant negative impact on trade between Europe, Asia and the Middle East, preventing an estimated $9.6 billion worth of trade.

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Disruptions to telecommunications infrastructure pose significant work management process risks, such as the ability of field employees to receive work on mobile data terminals. Various systems needed for visibility and control of distribution devices rely on robust communications infrastructure.

The Companies' non-nuclear generation fleet is heavily reliant on technology for work management processes. Some field employees receive work instruction on mobile devices and control systems rely on robust communications infrastructure. If these telecommunications were disrupted, the plant would need to conduct operations through manual readings of sensors and equipment gauges. Work would be entered in the application when network connectivity is restored. Communications with non-nuclear generation dispatchers could also be impacted preventing the dispatch locations from seeing operations remotely and preventing the primary forms of communication with the station. The communication would then occur through other means including plant radio systems, cellular phone, or satellite phone systems.

The Companies' advanced metering infrastructure also has its own telecommunications dependencies, and disruptions could impact both customer billing communications and the Companies' internal outage assessment tools such as smart meters integrated into outage management systems.

Introduction to mitigation strategies

The Companies actively monitor potential interruptions of the telecommunication systems that support reliable service. Business continuity plans ensure the Companies can manage through telecommunication system interruptions with the right resources engaged. These mitigation strategies are detailed in Chapter 2 of this response.

8. Bulk electric system threats

Threat description

The Bulk Electric System refers to the transmission elements or devices that are operated at 100 kV or higher on the electrical grid. The transmission BES is analogous to the interconnection of interstate and other major highways. The BES can be impacted by the growing penetration of variable and intermittent output from distributed energy resources. As seen in the Texas Blackout, variable and intermittent resources often do not produce energy at normal levels or near their MW rating levels. For instance, on a cloudy day or if the solar panels are covered with snow and ice, the output of a 100 MW rated solar facility may only generate 2 to 5 MW at its peak output for the day. This limited energy output can occur for several consecutive days, as occurred during the

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Texas Blackout and as has also occurred in the Carolinas. If this solar output is being relied upon for charging battery storage, it can be insufficient during extreme cold weather, thus preventing the battery storage from delivering sufficient energy during the winter peak hours. If rotating outages result, battery storage could not be charged at all until the rotating outages cease and more electricity than is demanded is available to charge the battery storage. Battery storage is useful for managing increasing penetrations of variable generation; however, the pace of change of resources and effective and well-engineered resource planning must occur to ensure reliability of the system.

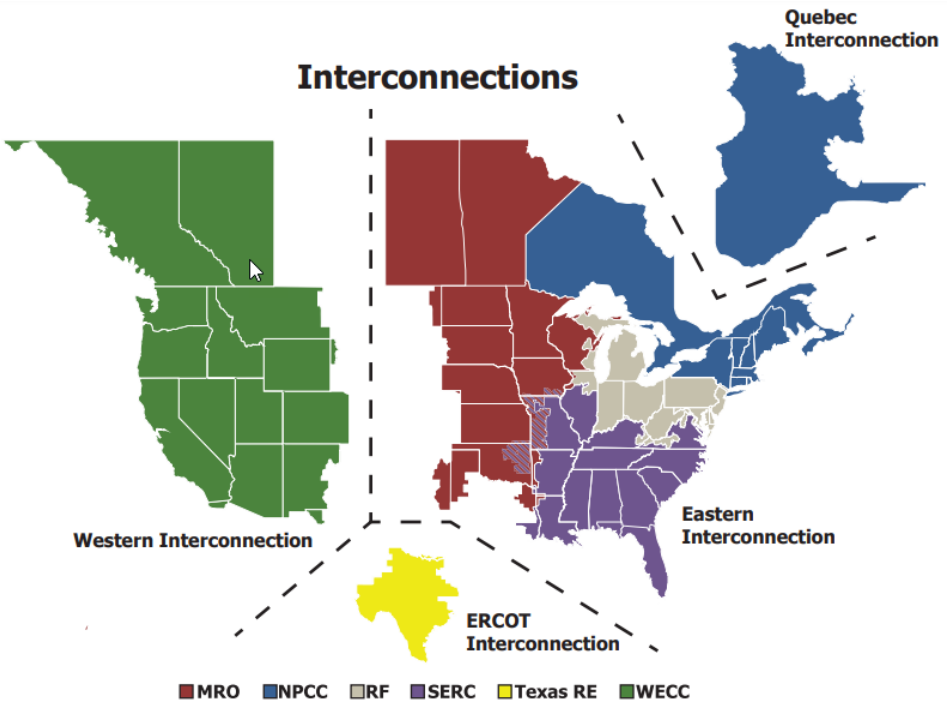
Notably, longer term changes to the transmission grid are required to accommodate transition to increased solar generation and storage resources. These changes may include flexible alternating current ("AC") systems such as static Volt-Amperes Reactive compensators to provide voltage support and new transmission lines to transport energy resources from rural solar or wind farms to battery storage facilities for charging and population centers for serving customer demand. Traditional transmission line protection and control will also have to adapt to the evolving mix of overall generation resources as short circuit ratios decline due to the increase in inverter-based resources. In addition, islanding and load shedding become greater considerations with a more variable generation mix on the grid, especially in the form of distributed energy resources.

As the distribution system hosts more and more distributed energy resource sites (for example, residential solar and battery storage), it becomes important that Duke Energy's engineering protections factor into grid stability considerations. Bulk electric system events have the potential to impact reliable utility service. The ability for distributed energy resources to stay on-line during unstable grid conditions is important. Without such capabilities created through the engineering schemes, distributed energy resource sites could become disconnected from the distribution grid in significant numbers due to temporary changes in the grid. This could result in significant loss of renewable generation that results in a significant imbalance between generation resources, creating potentially widespread outages.

The Eastern Interconnection is a vast network of AC high voltage transmission lines and substations that allows synchronous 60Hz frequency power to flow across this interconnected network reaching from just east of the Rockies to Maine and parts of Canada down to Florida and the gulf coast, excluding Texas.

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Source: NERC.com

While the interconnected nature of Eastern Interconnection allows utilities to import power from other utilities, the ability can be impacted due to transmission constraints or nuclear/non-nuclear generation outages. Because a real-time system is dynamic, these outages change the physics of the system and can create the potential for overloading. Utilities preemptively analyze these conditions and may reduce the levels to export or import power to prevent possible line or system overloads from occurring. These actions would be put in place to reliably meet the customers' demand. With the changing resource mix whereby greater amounts of solar and wind are integrated into the system, more transmission lines may be needed to move this energy to customer loads or battery storage. Without sufficient transmission, flexible power generation, and storage infrastructure, outages or overloads can occur.

Contractual control of power generation through power purchases does not provide the same real-time system control as ownership of power generation. This was seen during the Texas Blackout. Without utility ownership and control of the assets serving customers, customers can expect to see contractual control, which can result in extended litigation and perhaps recovery of financial penalties as the best remedy for non-performance—but all of this occurs after the fact and does not help avoid the crisis—nor does it provide the same real-time electric service customers expect.

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The Companies consider their obligation to serve retail and wholesale customers paramount and require operational control of generation to fulfill this responsibility.

In transparency, the Companies have certain long-term purchases of on-system power generation (e.g., Anson Plant, Broad River Plant, etc.) and near-term purchases that may not be available in extreme weather. As with any contractual purchase, these contracts carry the risk of these resources not being available at critical points such as during extreme weather. Contractual obligations for non-performance often result in extended litigation and financial penalties.

Introduction to mitigation strategies

Duke Energy actively monitors real-time performance and threats to the bulk electric system. This allows for quick response to evolving conditions. Rigorous asset inspection and maintenance programs support Duke Energy's ability to withstand bulk electric system threats and continue to provide reliable service. Emergency response and business continuity plans ensure the right resources are engaged and the right actions are taken in the face of a bulk electric system threat to support reliable service. These mitigation strategies are detailed in Chapter 2 of this response.

9. Vegetation challenges

Threat description

Vegetation outside of the transmission and distribution right-of-way poses a threat to reliable utility service. During storms, this vegetation could fall into the lines and create outages and hamper the ability of grid operators to restore the system.

Introduction to mitigation strategies

Duke Energy's vegetation management maintains rights-of-way via planned and spot tree trimming and removal. The transmission vegetation management program includes removing off right-of-way danger trees that present threats to transmission circuits. All transmission circuits are inspected via aerial flight patrols twice per year to look for threats to the system, and issues that pose a system threat are promptly addressed. These mitigation strategies are detailed in Chapter 2 of this response.

10. Dam safety and integrity issues

Threat description

Critical dam and embankment structures are associated with hydro generation. Dams are robust and resilient structures. The main threats to dams are flooding associated with hurricanes/tropical

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storms and earthquake loading. If the integrity of a dam is compromised, it could render the associated hydro station and any nuclear or fossil stations located on that reservoir unavailable to support reliable hydro generation.

Introduction to mitigation strategies

Rigorous planning, asset inspection, dam modernization projects and maintenance programs are used to mitigate these risks to dam safety. Details about these threat mitigation programs are covered in Chapter 2 of this response.

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CHAPTER 2: IDENTIFICATION OF IMPACTS TO UTILITY SERVICE

Order Item 2: Assessment of the extent to which the threat could impact the utility processes, systems, infrastructure, and end-user customers.

Overview

Each of the threats listed in the previous section have the potential to disrupt reliable electric service to the customers in South Carolina from assets located in either North or South Carolina. Realization of these threats could result in a range of impacts – from disruption to a single utility process or system to broad based infrastructure and end-user customer impacts. The Companies employ multi-layered, integrated threat mitigation strategies for each of the threats identified above to reduce and/or eliminate the impacts to reliable service for South Carolina customers.

Mitigation strategies for the identified threats begin with forecasting and planning methods across the utility system. Active and real-time threat monitoring are employed to provide quick responses and adjustments based on changes impacting the Companies' system. Effective programs are employed to ensure systems and infrastructure are prepared to withstand threats. Finally, the Companies leverage holistic emergency response and business continuity plans to limit realized impacts to South Carolina customers.

In this Chapter, the Companies provide an assessment of the extent to which each of the identified threats could impact utility processes, systems, infrastructure, and customers and the mitigation strategies employed to mitigate or eliminate those impacts.

Disruptions to utility service based on the identified threats are assessed for impacts based on the following integrated mitigation strategies:

1. Forecasting and Planning;
2. Active and Real-Time Threat Monitoring;
3. Asset Inspection and Maintenance Programs; and
4. Emergency Response and Business Continuity Plans.

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Detailed Narrative

1. Forecasting and Planning

Forecasting and planning mitigation strategies are used to prepare for possible scenarios, outcomes, and events in the future. The Companies leverage these strategies to mitigate or eliminate impacts to South Carolina customers from the threats of extreme weather, fuel supply disruptions, and physical and cyber threats.

The Companies leverage forecasting and planning strategies across the transmission, distribution, fuels, and nuclear/non-nuclear generation systems to mitigate the threat of extreme weather. To effectively manage and respond to extreme weather threats, Duke Energy maintains a meteorology staff that provides both short and long-term weather forecasts and weather statements specific to each of the Companies and to its affiliates in other states. Based on these weather reports, a daily assessment of weather, load forecasts, system conditions, generating unit availability with capacity reductions, power generation reserves, energy sales, and energy purchases is performed for the next three days. In addition, each day a seven-day commitment model is generated that produces a security-constrained economic unit commitment plan. Similarly, a 31-day unit commitment model is generated once weekly. These models aid in ensuring that adequate and appropriate generating units are committed so that reliability is maintained with the lowest production cost. Transmission develops a Daily Grid Status report that is sent throughout the Companies to allow for awareness of the current and future concerns. The Companies' Distribution Control Centers receive a Daily Grid Status Report and use this information to determine risk on a rolling 7-day window and daily outlook.

Duke Energy's meteorological team also monitors severe weather threats that could lead to damage to infrastructure and challenge the ability of the system to serve peak loads due to extreme cold, extreme heat, or a solar eclipse. As severe weather threats emerge (e.g., hurricanes, ice storms, and high wind events), the meteorological team develops predictions of storm impacts using regression models that are trained using historical storm activity. These models predict the peak outage events, customers impacted, and resource requirements by operating area with low, medium, and high impacts defined. DEC and DEP use this predictive modeling to generate situational awareness and to begin proactively preparing resource plans, pre-deploying resources (line technicians, vegetation workers, logistics, damage assessment, etc.) as necessary, validating inventories of critical materials/equipment, developing messages for customer awareness, reviewing critical customer lists and initiating communications with county or state emergency management.

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Based on Duke Energy's meteorological team's forecasting, nuclear/non-nuclear generation planning provides adequate capacity reserve margin in the case of reasonably expected forced outages. Customers expect to have electricity available during all times of the year but especially during extreme weather conditions such as cold winter or hot summer days when resource adequacy is at risk. Adequate reserve capacity must be available to account for unplanned outages of generating equipment, economic load forecast uncertainty, and higher than projected peak demand due to extreme weather. The Companies conduct probabilistic reliability assessments to ensure resource adequacy during peak demand periods. Based on these probabilistic assessments, the Companies determine the appropriate reserve margin target to use in the IRP process to ensure resource adequacy. Reserve margin is defined as total resources minus peak demand, divided by peak demand.

Planning for extreme weather is one of the best methods a power generating station has to ensure continuous reliable operation. The Companies' generating stations utilize a cold weather preparedness checklist each fall and a hot weather preparedness checklist each spring to accomplish this. These checklists include items such as heat trace operational checks for cold weather and establishing correct powerhouse ventilation for hot weather.

Nuclear/non-Nuclear generation utilizes an electronic work management system to track and schedule preventative maintenance work in preparation for extreme weather. This helps ensure the timely completion of work that is related to cold or hot weather preparedness. As an example, the system schedules work such as cleaning heat exchangers in the winter months to allow this equipment to function at peak efficiency in the hotter months of the year.

Major work on non-nuclear generation equipment that occurs offline in the more temperate periods of the spring and fall is optimized for reliability. Non-nuclear generating stations utilize the Companies' Optimized Planning and Tracking of Interval Based Maintenance tool. This tool contains the recommended maintenance intervals of major equipment such as turbines and generators given from the original equipment manufacturer or experience base and ensures work is prioritized to provide the optimal level of system reliability. Major offline work is also purposely divided between the spring and fall to provide reliability and system reserves for summer as well as winter peak load demands.

As nuclear generation site personnel develop their weekly schedule for maintenance activities, one of the major considerations is extreme weather risk. Schedule development starts at least 16 weeks out with identification of work and concludes with a commitment for completion two weeks prior to execution. The risk profile generated for that week includes evaluation of grid stability, as well

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as for weather conditions. As environmental conditions change or the available electricity reserve changes, the risk profile changes. Should the risk profile fall below a certain established threshold, operations evaluates the remaining work activities and makes decisions about which activities remain on the schedule and which are removed.

Forecasting and planning mitigation strategies are also employed for the fuel system needs to support reliable service. These mitigation strategies involve short-, mid- and long-term planning. The process for natural gas and coal supply procurement begins with a forecast of projected usage for the Companies' non-nuclear generation facilities. The Duke Energy fuels organization uses a forecast from the Fleet Analytics Stochastics Tool for natural gas and coal procurement planning in the Carolinas.

The stochastic model uses historic weather to simulate numerous scenarios of future weather and commodity prices. For each of these scenarios, system load and commodity prices (gas, coal, oil, and power) are all calculated in a correlated manner using historical correlations with each other and with weather. For example, if in a simulated iteration, winter is particularly cold, then that iteration would have higher load and corresponding higher gas and power prices which resembles historical data. The resulting forecast of this stochastic model gives the Companies not only expected fuel burns, but also the range of fuel burns and the probability associated with each range.

Prior to the 2014 Polar Vortex, the Companies purchased 100 percent of the firm physical natural gas forecasted to be needed to supply the average daily natural gas burn of their combined cycle generation for the months of November to March. After the 2014 Polar Vortex, the Companies adjusted their physical natural gas procurement practices to purchase greater than 100 percent of the firm physical natural gas forecasted to be needed to supply their combined cycle generation, with a particular focus on procuring additional firm physical gas supply during the months of December through February in order to be prepared for higher than forecasted combined cycle generation. Given the greater variability in natural gas burn at the Companies' Combustion Turbine ("CT") facilities, the Companies purchase the rights to call on daily firm natural gas supply that can be utilized when the natural gas combustion turbines are needed to meet system demand or run for economics. In addition, in periods where actual gas prices exceed fuel oil prices, the Companies will utilize more fuel oil for CTs for economic and reliability reasons to reduce exposure to extreme natural gas prices. Going into each month, Duke Energy makes additional procurement decisions as needed based on monthly fuel forecast updates. The procurement adjustments after the 2014 winter were made to further mitigate the price and cost exposure to spot daily prices for Transco Zone 5 delivered gas supply for its combined cycle generation.

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The Companies execute a strategy of purchasing coal at approximately 80 percent of the forecasted coal generation need for the next 12-month period and 100 percent for the next quarter. This includes purchasing 100 percent of the forecasted Central Appalachian coal supply needed in order to offset the risk of supply availability. The Companies make short term coal purchases as inventory levels show a need for additional coal to fulfill forecasted burns. The ability to make spot purchases and contract for the right to call on more coal as needed provides for greater flexibility in maintaining target inventories and building station coal inventories going into periods of high demand, such as winter (January-February) and summer (June-August), to mitigate intermittent coal supply disruptions. The Companies also increase coal inventories going into peak demand periods as transportation difficulties can increase in the winter. Finally, during the winter, the Companies treat coal to prevent freezing as it is loaded into the rail cars to minimize disruptions in the supply chain. This ability to store on-site coal inventory at each of the coal stations allows for reliable coal supply for generation while minimizing the impacts of intermittent supply disruptions.

The Companies' fuel oil inventory purchasing targets have been developed based on maintaining system reliability needs, meeting coal generation start-up needs, and allowing for an immediate response should a forecasted event require a ramp up of fuel oil deliveries.

Each year the Companies review, and as needed, update their emergency plan to maintain system stability and continuity of service during periods of severe capacity shortages caused by unscheduled outages of generating units, fuel shortages, equipment failures, unit startup delays, or transmission system limitations. For fuel shortages, the plan links shortages to coal inventory levels with conservation and shortage measures considered when inventories have dropped below a predetermined level with no expected increase in the near future. This includes the possibility of switching fuels to conserve the fuel that is in short supply or using the power markets to displace owned non-nuclear generation to meet load demand.

Neither of the Companies have experienced a situation in South Carolina or North Carolina where either DEC or DEP was unable to serve peak loads during an extreme weather event. In extreme circumstances, however, the Companies have the ability through their Energy Control Center to initiate various actions that could reduce the demand for energy. These plans will call upon all available non-nuclear generation to be brought online. The Energy Control Center could request that wholesale customers and municipalities reduce load through demand side management programs. During the summer, residential customers who have voluntarily signed up for air conditioning load shed programs would be activated. The Energy Control Center would have the ability to implement voltage reduction programs that can reduce the load on the system for a short

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period of time during the peak. If these measures are insufficient, the Companies would take steps to shed load. The Companies' load reduction plan is updated annually and would be used during a system emergency when reduction of load is required to stabilize the electric grid.

The feeder rotation plan, sometimes referred to as rolling blackouts, also exposes the system to cold load pickup challenges from extreme hot or cold conditions and long outage times requiring circuits to be restored in sections to prevent overloading. Cold load pickup is the phenomenon that takes place when a distribution or transmission circuit is reenergized following an extended outage of that circuit. After load has been reduced on the circuit, the next major sectionalized device on the circuit backbone can be restored. The magnitude of cold load pickup current is a combination of non-diverse cyclic load current, continuously operating load current, transformer magnetizing current, capacitor inrush current, etc. The combination can result in current levels that are significantly higher than normal peak load levels making it difficult to restore service.

As a last resort the Energy Control Center can institute an Emergency Relief Plan that will systematically reduce load at the transmission level to avoid degradation of the Bulk Electric System. Neither the feeder rotation plan nor the Emergency Relief Plan have been used by the Companies.

Finally, forecasting and planning mitigation strategies are also employed to plan and mitigate the physical and cyber threats that can impact reliable service to South Carolina. Risk assessments are an imperative component for organizational planning and mitigation. The Companies leverage several standards and frameworks to develop and implement expectations, processes, and requirements to assist in identifying critical facilities and assets and deployment of the physical and cyber security systems to protect those assets.

The Companies model the approach to tier assets based off impact considerations such as disruption in service to critical national defense, public critical infrastructure, and to government's essential services as well as their customer base.

The Security Risk Assessment Program utilizes a two-pronged approach to evaluate physical security at the most critical facilities: 1) A risk-based approach to determine a facility's *Facility Security Risk Level* classification, and 2) A Design Basis Threat approach, which evaluates the vulnerability of Physical Protection Systems against physical threats. Methodologies utilize Deter, Detect, Delay, Deny, and Communicate security principles.

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The physical security team classifies impacts in a range of low to catastrophic. Those criteria are provided below.

- Low Impact: Impact localized to asset's immediate vicinity (< 5 miles); operational redundancies available; no brand or regulatory impacts.
- Medium Impact: Impact extends into zone or region level operational area (< 75 miles); some operational redundancy exists; minimal brand or regulatory impacts.
- High Impact: Impact extends to major portion of state or state-wide; impacts multiple other business units / operations; limited or no redundancy available; regional brand impacts, significant regulatory impacts.
- Catastrophic Impact: Impact extends across all organizations; impacts to multiple states or beyond service territories; national brand impacts, severe regulatory impacts.

The Security Risk Assessment Program models the approach of defining facility criticality and deployment of appropriate physical protection systems. The program leverages a range of public and industry security resources. Some examples include:

- Department of Homeland Security / Transportation Security Administration's "Pipeline Security Guidelines," which is in place to develop and implement both baseline and enhanced security measures for applicable natural gas facilities;
- Electricity Information Sharing and Analysis Center "Electricity Sector Design Basis Threat," which looks to the attributes and characteristics of potential insider and/or external adversaries;
- Unified Facilities Criteria 4-010-01, Minimum Antiterrorism Standards for Buildings, which is a Department of Defense document used for identifying protective measures to facilities; and
- Best Practices for Anti-Terrorism Security, which is a Department of Homeland Security / Science and Technology assessment tool, for commercial facilities, used for the evaluation of building security systems.

The Duke Energy cybersecurity team leverages the NIST CSF, which includes five elements: Identify, Protect, Detect, Respond, and Recover. Additionally, Duke Energy uses the ATT&CK® framework, which is a model for cyber adversary behavior, reflecting the various phases of an adversary's lifecycle and the platforms they are known to target. Lastly, two key guidance publications are the NIST SP 800-39 *Managing Information Security Risk: Organization, Mission, and Information System View* and NIST SP 800-30 *Guide for Conducting Risk Assessments*.

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Without mitigation, extreme weather, fuel supply interruptions, and physical and cyber threats can result in impacts to utility service ranging from localized to broader system outages. Planning and forecasting ensure that the Companies are adequately prepared for, and in many cases, able to mitigate or eliminate these threats to utility service. However, these threats are not static, and the risk landscape is constantly evolving. For this reason, the Companies employ active and real-time threat monitoring to adjust to dynamic threats.

2. Active and Real-Time Threat Monitoring

Active and real-time threat monitoring strategies are employed to provide quick responses and adjustments to mitigation strategies based on the evolving threats to the Duke Energy system. These strategies are leveraged to mitigate extreme weather, bulk electric system, cyber and physical, and fuel supply threats.

Extreme weather threats to reliable utility service require active and real-time monitoring to ensure the Companies are prepared. As mentioned, Duke Energy has a staff of meteorologists that provide daily weather forecasts and a color-coded threat index out to three days with extended discussion beyond the three-day window. Duke Energy meteorologists communicate weather threats across the system prior to and during the extreme weather event. This active monitoring and communications allow each part of the business to take proactive measures to mitigate impacts.

Physical and cyber threats present complex and dynamic challenges that also require active and real-time monitoring. The physical and cyber processes at Duke Energy are integrated at an enterprise level by the Enterprise Protective Services internal team of experts. Enterprise Protective Services has a Threat Intelligence Program and Facility Physical Risk Assessment Standard to assess threats and implement security mitigations. The Duke Energy Threat Intelligence Program collects, analyzes, and delivers information on threats to the physical and cyber assets to provide actionable insight to make threat-informed, risk-based decisions. This centralized function continuously protects the infrastructure and information of all employees, trusted business partners, and customers through alignment of active threat monitoring and analysis activities across the business. The immediate goal of the Threat Intelligence Program is to provide a holistic understanding of potential threats to better determine mitigation controls necessary to protect people, protect assets, and protect the Companies' ability to power the customers and communities served by DEP and DEC.

The Facility Physical Risk Assessment Standard utilizes a two-pronged approach to evaluate physical security at the most critical facilities:

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1. A risk-based approach to determine a facility's *Facility Security Risk Level* classification, and
2. A Design Basis Threat approach, which evaluates the vulnerability of physical protection systems against physical threats with methodologies that use deter, detect, delay, deny, and communicate security principles.

Duke Energy's cybersecurity team leverages the NIST CSF for active monitoring. This framework includes five elements: identify, protect, detect, respond, and recover. Additionally, Duke Energy uses the MITRE Corporation's Adversarial Tactics, Techniques, and Common Knowledge Framework, which is a model for cyber adversary behavior, reflecting the various phases of an adversary's lifecycle and the platforms they are known to target.

Duke Energy's Secure Access Device Management ("SADM") is an example of an internal project designed to mature our NIST CSF Capabilities. The SADM platform allows Duke Energy to perform automated and remote password management, access logging, and device/event information retrieval for field devices, with functions of SADM included below:

- Facilitate accurate asset/inventory management;
- Standardize systems and processes for secure remote access to field devices;
- Manage post-fault and other operational event records; and
- Implement a common solution and support model across all jurisdictions.

Active and real-time monitoring of DEC and DEP fuel supply ensures stable and reliable service to South Carolina customers. Duke Energy leverages a Gas Dashboard to provide visibility to gas burns 24 hours a day. Users include gas traders and schedulers, real-time power traders, unit commitment, Energy Control Center dispatchers, and senior management. Users monitor hourly and daily gas burns at each gas unit on Transco, Piedmont, CGT, and PSNC pipelines. During high and low gas demand days, pipelines may impose operational restrictions limiting daily/hourly flexibility, requiring the gas desk to monitor hourly plant burns over a 24-hour gas day period to stay within the tolerances and avoid pipeline penalties. The Gas Dashboard compares estimated gas burns to forecasts with pipeline tolerances to give an early warning "Alert" if projected burns could result in excess transport fees or a penalty. The Companies evaluate the information from this tool and take appropriate action to balance gas burn volumes within tolerance level to avoid a penalty.

Should the Companies receive notification from Transco of a force majeure event, there would first be reductions to service before gas supply would be completely cut off. Transco can divert

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gas if there are operational difficulties, and the Companies would coordinate with Transco to minimize service interruption. Typically, the Companies' gas deliveries flow from the south on Firm Transportation. Depending on the source of supply interruption, the Gas Desk would actively engage the market to purchase delivered supply from the north as an alternative to help offset any disruption from the south.

During normal operations the coal transportation team meets, at a minimum, weekly with station personnel and the railroads to monitor and review on-going operational matters that can impact delivery schedules and station inventories. During events, the frequency of calls with station personnel and railroads are increased to a minimum of daily and in some cases periodically throughout the day to work through on-going delivery concerns.

During peak demand periods plants can receive new fuel oil shipments in one to two days from initial notice to supplier. However, most plants in the Carolinas require an eight-to-ten-day lead time to replenish to max safe fill levels if deliveries occur during daylight hours only. Based on active monitoring and reports provided by the meteorology group, the fuel originator will begin increasing fuel oil deliveries prior to the forecasted weather event. During a weather event the fuel oil originator actively monitors the on-site inventory at each station daily and receives on-going updates of expected fuel oil consumption for the next seven days. As needed, the originator can activate additional transportation suppliers that have been contracted with for such purposes. During extreme periods of demand, maintaining 24-hour logistics and unloading is critical to maintaining tank replenishment.

A component of the Companies' integrated fuel strategy addresses fuel burn variations by actively monitoring the power market for opportunities to make power purchases to support system load demands when economic and/or needed for reliability. Purchases from the power market can be utilized to displace coal, gas, or fuel oil generation when coal or fuel oil inventory is low, flexibility on the pipelines is constrained, as well as managing fuel price volatility. The power market is very liquid and can be used to supply megawatts on a 24-hour basis utilizing various products over various time horizons.

Extreme weather, fuel supply interruptions, bulk electric system, physical and cyber threats are dynamic and complex risks that require active and real-time monitoring to respond to changes. Without this continuous monitoring, realized threats in these areas could result in service interruptions ranging from localized to broader system outages. The Companies engage in active and real-time monitoring of these threats to mitigate or eliminate service disruptions for South Carolina customers.

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3. Asset Inspection and Maintenance Programs

Ensuring asset conditions are maintained is a critical factor in ensuring reliable service to South Carolina customers. Rigorous asset inspection and maintenance programs are employed to ensure systems and infrastructure are prepared to withstand extreme weather, vegetation challenges, telecommunication system disruptions, supply chain interruptions, bulk electric system threats, and physical and cyber threats. These programs are also employed to confirm the Companies' hydro dam safety requirements.

The DEC and DEP non-nuclear generation fleet has numerous reliability, inspection, and maintenance programs. The goal of these programs is to maintain reliable non-nuclear generation. Standards are utilized to establish the scope and periodicity of maintenance for critical components such as transformers, turbines, and generators. These components are specifically managed by a dedicated team of engineers through an internal software platform. The software algorithm utilizes industry experience, original equipment manufacturer recommendations, performance data, and past inspection results to make informed recommendations. This ensures the right maintenance activities are occurring to support reliability of non-nuclear generation equipment.

Critical non-nuclear generation equipment is outfitted with sensors that capture performance data. This is monitored by operating personnel and engineering resources. Most stations have in-house engineering teams that are devoted to the reliability of the assets. Additionally, a central performance monitoring team utilizes advanced learning software to provide early detection of critical issues and direct maintenance activities. This is accomplished by comparing expected results against actual data. Periodic surveillances of various plant components that could be subject to extreme weather are performed. Outdoor components, such as cooling towers, transformers, and valves are walked down to ensure they are not being affected by extreme weather conditions. Outdoor temperature controls the periodicity at which walkdowns are performed; the colder or hotter the temperature, the more frequent and detailed the walkdowns. By identifying these items early, maintenance teams can address smaller issues that could otherwise grow into large outages.

The peak load of all DEC and DEP nuclear generation units is monitored closely. While reactor operators in the control room monitor the operating conditions of the plant in real-time, engineers, data scientists, and leaders examine these conditions over a longer period. A complex computer program uses signals sent from various plant instrumentation to compare the actual peak net electrical output of the unit to a baseline value. The baseline value considers various environmental conditions and operating parameters to determine if the plant is producing the

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expected peak output. The data is evaluated daily, and a more detailed examination is required weekly. Unexpected conditions are identified and aggressively investigated in order to restore net electrical output back to peak capacity.

The Companies' transmission system manages and assesses operational assets through a diverse approach of inspection and maintenance programs to ensure the integrity of the grid and plan for end-of-life equipment needs. All transmission circuits are inspected twice annually through the aerial patrol program, which consists of trained observers looking for significant threats to transmission conductors and structures from either vegetation, aging, external damage including lightning and wind, or collateral damage including public interference. Transmission substation facilities are inspected numerous times throughout the year, depending on their level of remote monitoring in place. Substation visual inspections include looking for early signs of component degradation, overheating, abnormal operating conditions, and vandalism. Deficiencies are addressed through the corrective maintenance program in a priority commensurate with the risk presented. The preventive maintenance program is in place to proactively test, inspect, and refurbish major transmission components such as circuit breakers, transformers, and protection and control devices before they can mis-operate and introduce vulnerabilities onto the grid.

The Companies' Vegetation Management programs are designed to support grid reliability performance from tree related events such as broken limbs, or trees falling due to wind and ice loading. The Companies leverage an Integrated Vegetation Management program to exercise best management practices. This includes circuit maintenance trimming, hazard tree identification and mitigation, customer identified issues, and herbicide application to maintain right-of-way floor. It is important to note that the program is not designed to prevent damage from healthy trees outside the right of way that under extreme conditions fall into or have limbs break and blow into lines.

Additionally, work is ongoing to transform transmission facilities in each of the Companies' service territories through the South Carolina ("SC") Grid Improvement Plan.[6] The associated transmission programs are outlined below:

1. The Physical Security program includes addition of fences, intrusion detection, and similar technologies at high-risk substation locations.
2. The Cyber Security group of projects involve the elimination of devices vulnerable to external cyber-attack.

[6] Commission Docket No. ND-2020-28-E, Joint Petition of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC to Establish a Consolidated Informational Docket for Review and Consideration of Grid Improvement Plans (NDI Opened Pursuant to Commission Order No. 2020-533).

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3. Transmission Line Hardening & Resiliency work involves rebuilding vulnerable line segments to improved standards to reduce threats from high winds, lightning, and vegetation, thus preventing loss of system redundancy and/or customer outages. It also encompasses continuation of the Danger Tree removal program and strategic improvements to identify high risk trees to promote storm hardening and system resiliency.
4. Substation Hardening & Resiliency ("H&R") projects consistent of replacing vulnerable equipment such as oil filled circuit breakers and Load Tap Changer Transformers with state-of-the-art equipment capable of withstanding severe grid conditions. The Substation H&R program also includes flood mitigation projects; stations susceptible to flooding are either mitigated through installation of flood walls, elevating equipment, or relocating equipment.
5. System Intelligence projects consist of deploying smart field devices and infrastructure to improve grid operator system awareness, locate system faults, and provide means to remotely sectionalize circuits and restore customers following outages.

For the Companies' distribution systems, asset inspection and maintenance programs include inspection and maintenance of poles, various transformers, manholes, vaults, and switchgears. As recent events have reinforced, the Companies must be ready for severe weather before it strikes and reduce the impact of storms that are increasing in frequency and intensity. The SC Grid Improvement Plan seeks to harden the grid against severe weather. The distribution programs included in the SC Grid Improvement Plan are outlined below.

- The Self Optimizing Grid program redesigns key portions of the distribution system and transforms it into a dynamic smart-thinking, self-healing grid. The grid will have the ability to automatically reroute power around trouble areas, like a tree on a power line, to quickly restore power to the maximum number of customers and rapidly dispatch line crews directly to the source of the outage.
- The Targeted Undergrounding program strategically identifies the Companies' most outage prone overhead power line sections and relocates them underground to reduce the number of outages experienced by customers. Equipment on these line segments can experience shortened equipment life and additional equipment-related service interruptions. Targeted Undergrounding addresses areas with outlier outage performance and improves service while lowering maintenance and restoration costs for all customers.
- The Long Duration Outage/High Impact Sites program is designed to improve the reliability in parts of the grid where the duration of potential outages is expected to be much higher than average. Focus areas for this program are radial feeds to entire communities or large groups of customers as well as inaccessible line segments (e.g., off-road, swamps,

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mountain gorges, extreme terrain). Many of the areas served by these long, rural, single-sourced feeders can experience significant impacts to the local economy and to quality of life when the entire town loses power. Further, operational and repair costs are generally higher than average in these areas due to the special equipment required.

- The capabilities offered through the Distribution Automation program can transform what may have been an hours-long power outage for hundreds or even thousands of homes and businesses into a momentary outage – or potentially help avoid an outage altogether.

Asset Inspection and Maintenance Programs also help the Companies mitigate the threat associated with distribution system peak load conditions. Since asset failures tend to happen when the asset is seeing major stress, the Companies' asset inspection, maintenance, and end of life programs represent a key defensive strategy to mitigating failures prior to the extreme weather event or adverse conditions.

Beyond those traditional programs that mitigate peak load threats to the distribution system, the SC Grid Improvement Plan includes an Integrated Volt-Var Control ("IVVC") program that allows the distribution system to optimize voltage and reactive power. Other Grid Improvement Plan programs, such as Self Optimizing Grid, require appropriate capacity planning to enable power re-routing in case of loss of primary source. Distribution engineers calculate the anticipated peak seasonal loading for five years and perform yearly updates to the plan using the average annual load growth percentage, and local knowledge of planned industrial, commercial, and large-scale residential growth.

The Companies have a high reliance on technology and communications for work and asset management, engineering, construction, maintenance, metering, and service restoration processes. Ensuring that the communications infrastructure is reliable, robust, and resilient to threats is a critical concern. Continuous attention to inspecting and maintaining these assets, replacing them at end of life, and upgrading to the latest, secure technologies when needed is paramount for business continuity.

The SC Grid Improvement Plan includes an Enterprise Communications program that addresses technology obsolescence, secures vulnerabilities, and provides new workforce-enabling capabilities. This program includes improvement and expansion of the entire communications network from high-speed, high-capacity backbone fiber optic and microwave networks to wireless connections at the edge of the grid. Key themes across all Enterprise Communications improvement initiatives are to maximize the asset's structural resiliency against extreme weather events or other physical threats, provide equipment redundancy or alternate routing capabilities

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for back up contingencies and/or to ensure vendor support for patching for technology assets for optimum cyber security threat abatement capabilities.

Private wireless technologies are also being considered as a strategy to limit reliance on commercial telecommunications providers. This is especially important following major weather events where restoration priorities for service to critical utility locations do not always align with large population center restoration priorities.

The threat of supply chain interruptions for critical distribution equipment is also managed through asset inspection and maintenance programs. The asset management team holds quarterly reviews with Supply Chain colleagues on equipment needs, conducts monthly reviews on labor pipeline needs, and reviews critical asset spare needs (e.g., submersible transformers, distribution-to-distribution transformers, and power electronics). When contracts for assets types (poles, transformers, etc.) come up for renewal, Distribution and Supply Chain jointly undertake a coordinated strategy for diversification of suppliers and even parts for those suppliers to minimize and mitigate assessed and identified risks.

The Companies are also developing a "ride through" protection and control strategy for distributed energy resources that minimizes impacts from temporary faults while still assuring effective protection and control. This is becoming more important as growth in distributed energy resources continues.

The threat of physical and cyber-attacks on grid infrastructure is more sophisticated and is on the rise. The Companies' asset inspection and maintenance programs address localized issues of vandalism that do not directly cause an outage but weaken the durability of field assets. When asset inspections occur, these issues are identified and either repaired as a maintenance task or the asset is replaced (if it is at end of life from the damage) to restore it to proper durability. Some examples include the Critical Equipment Inspection program for larger oil-filled equipment near waterways and the Surface Mounted Equipment program for other oil-filled equipment at ground level. Another of the Companies' asset programs is the Spill Prevention, Control, & Countermeasures program where containment plans are created in compliance with EPA expectations. These programs help the Companies address environmental risk from physical threats and asset damages.

Dams associated with the Companies' hydroelectric stations receive numerous inspections. Earthen dams are inspected every two weeks and concrete dams are inspected quarterly by trained personnel. Additional inspections are performed after an intense rainfall or an earthquake. All

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dams receive an annual engineering inspection and a separate annual inspection by the FERC. Every five years an inspection is completed by an independent engineering consultant, per FERC requirements.

Reliable utility service to South Carolina customers depends on the critical utility system equipment working as designed. Asset inspection and maintenance programs are employed to ensure this is the case every day. When faced with threats to reliable service, these programs are essential to mitigating or eliminating service disruptions.

4. Emergency Response and Business Continuity Plans

Forecasting and planning, active and real-time monitoring, and asset inspection and maintenance programs are all in place to mitigate or eliminate potential disruptive events that would impact South Carolina customers. However, there are situations where threats are realized. These threats could come in forms such as a severe winter storm, a physical security breach, or a global pandemic. When a disruptive event has occurred, Duke Energy's mission is to restore service to South Carolina customers with a safe, efficient, systematic response. DEC and DEP accomplish this by harnessing the efforts of all Duke Energy employees to align to and execute their formal Emergency Response and Business Continuity Plans.

Duke Energy embraces the Federal Emergency Management Agency ("FEMA") National Incident Management System recommendations to plan for "all-hazards" and not just for a single type of event. Duke Energy utilizes Business Continuity and Emergency Management plans regardless of the type of event at hand.

The purpose of the Business Continuity Program, through its overall planning methodology and associated elements, is to: minimize risk to the enterprise, mitigate potential losses, and ensure continuation of critical business operations in the event of a business disruption or disaster until normal operations can be resumed.

The Companies' Business Continuity Program includes key elements that:

- Evaluate potential risks that could adversely impact critical business processes;
- Analyze potential impacts to the Companies if critical business processes are impaired or cannot operate;
- Develop recovery strategies necessary for the appropriate continuation or resumption of business processes;

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- Encourage scalable and adaptable response framework to support recovery strategies;
- Encourage development of prevention and mitigation strategies leveraging exercises, lessons learned, benchmarking and best practices;
- Identify key dependencies between critical business processes;
- Define a business continuity plan template with the appropriate documentation to guide an effective recovery process; and
- Address annual business continuity plan maintenance requirements to help ensure approved and viable plans.

Duke Energy's Enterprise Emergency Management Program uses the following integrated three-tiered approach to address incidents and crises.

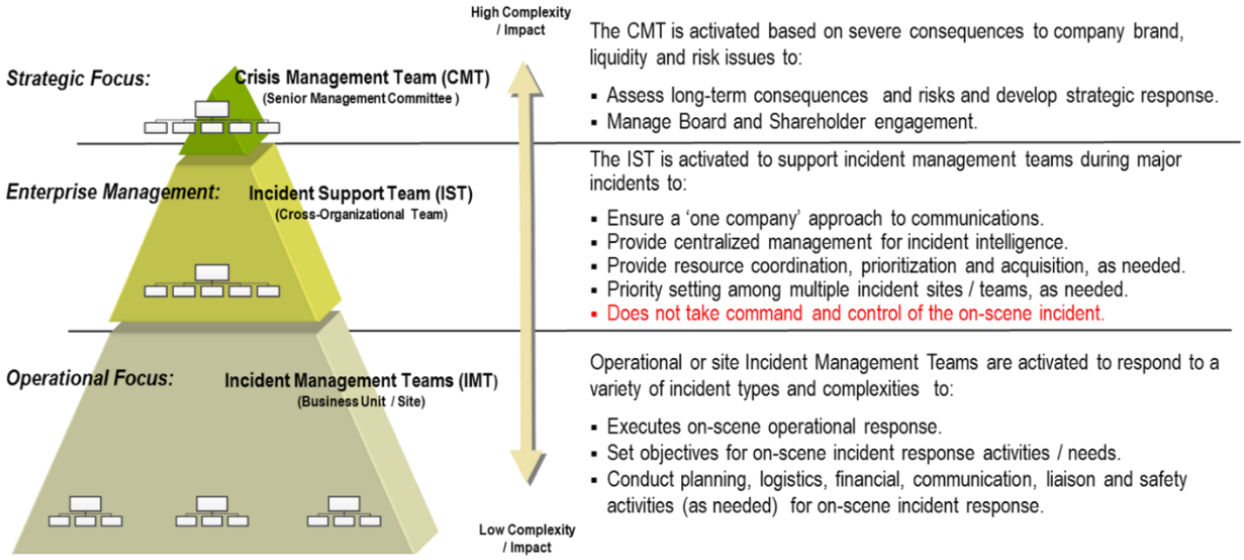
- Strategic Focus: Involvement of the enterprise Crisis Management Team for strategic planning relating to mitigation of crisis consequences and impacts to the enterprise, including severe reputational, financial, legal, or regulatory impacts. Duke Energy's Crisis Management Team is comprised of the Senior Management Committee and is activated based on potential or actual severe consequences to brand, liquidity, and risk issues during incident response and recovery activities.
- Enterprise Management: Management and coordination of enterprise-level incidents to provide oversight, coordination and communication during an incident that has the potential to cause significant operational impacts. Duke Energy's Incident Support Team acts as the central management team for incident intelligence and support for activated Incident Management Teams. As incident severity increases per defined thresholds, the Incident Support Team integrates with and briefs the Crisis Management Team as needed.
- Operational Focus: Incident Management Teams provide management of emergency response actions to an incident by site personnel or emergency responders. Incident management processes will vary from location-to-location based on operations, local regulations, and local capabilities. In most incidents, the local facility will respond to minor incidents without assistance. Larger incidents may require off-site support, possibly from the community, other industry, or other business units. As incident severity increases per defined thresholds, Incident Management Teams integrate with and brief the Incident Support Team as needed.

The Enterprise Emergency Management Structure defines a relationship that ensures integration and coordination of activities as various levels of emergency management and response organizations reach activation status.

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An incident's characteristics and its potential to adversely affect the enterprise will determine which levels may be activated. The following graphic highlights the nature of this integrated crisis management approach:

Figure 4.1 Integrated Response Team Structure



Each of the Duke Energy business units (distribution, transmission, nuclear/non-nuclear generation, fuels, corporate support functions, etc.) apply this structure in an integrated and cohesive manner to ensure seamless response to realized threats in order to mitigate impact to South Carolina customers.

DEC and DEP conduct annual exercises to prepare for major weather events that have the potential to disrupt electric service to customers in South Carolina. The drills are intended to assess the effectiveness of the Transmission and Distribution teams to respond to major weather events. Team members participating in the exercises are expected to respond as if there were an actual event and to apply their knowledge of the emergency response plan to restore power to customers safely and efficiently. Identification of knowledge, tool, and process gaps to be addressed prior to the start of each hurricane season is a key outcome of the exercises.

The Companies have implemented the Incident Command Structure ("ICS") Event Response Organization to rapidly and efficiently support a successful emergency response throughout the

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organization. The Incident Command Structure is the nationally accepted model for responding to incidents in accordance with the National Incident Management System.

The Incident Command Structure establishes an organized way to respond to emergencies using standard job roles, forms, and terminology. This method of organizing an emergency response is used for short- and long-term operations across the government, industry, and private sector. As a common structure, the Incident Command Structure ensures a fast and efficient emergency response. The most important benefit provided by an ICS-based organization is the clear identification of the response leader and the response leader's chain of command. This approach is designed to optimize Duke Energy's operational, planning, and logistics capabilities while providing effective communication to our customers and partners.

The Distribution Command Center will collaborate with Transmission Energy Control Center to determine any mitigation steps that need to be considered based on the grid status alert level for the jurisdiction. If extreme weather is a factor, the Distribution Command Center will focus on getting the system to optimal configuration and determine with the Energy Control Center if any temporary equipment needs to be closely monitored for status. The Distribution Command Center will monitor alarms as normal with focus on high state alarms from telemetered devices which may only need to be observed as they approach the peak or may need intervention via switching or assessment by field resources.

If needed, the Companies could implement their feeder rotation plan—or rolling blackouts—to mitigate the impact of an extreme weather event challenging the ability of the system to serve peak loads. This is never the preferred mitigation. In extreme circumstances, the Companies have the ability through the Energy Control Center to initiate various actions that could reduce the demand for energy. These plans will call upon all available nuclear/non-nuclear generation to be brought online. The Energy Control Center could request that wholesale customers and municipalities reduce their loads through demand side management programs. During the summer, residential customers who have signed up for air conditioning load shed program would be activated. The Energy Control Center would have the ability to implement voltage reduction programs that can reduce the load on the system for a short period of time during the peak. If these measures are not enough, the Companies could shed load through feeder rotation plans to shut off service selectively in a planned manner. Feeder rotation is implemented by operator interactions with the load shed application in the Distribution Management System based on a feeder prioritization list that is updated annually by planning engineers. The amount of load relief needed at the system level will determine whether distribution feeder rotation can be utilized or if transmission will need to reduce load by curtailment. Either of these plans can be activated very quickly and only a short notice is

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required to implement. The rotation plan is the preferred plan thus allowing the Distribution Command Center to be more discriminate among the classification of circuits.

During these times, the Companies also consider demand side management tools such as the EnergyWise Program and voltage regulation via load voltage management to reduce load on the system. All of these tools are available to be used at the discretion of the Energy Control Center System Operator.

Emergency systems will be activated to the appropriate level to respond to identified threats. If the threat level of the event exceeds the capability of the resources allocated, an escalation process will occur to put the necessary resources in place to respond. Plans to respond to physical threats or intentional damage to distribution equipment can include but are not limited to:

- Establishment of secure perimeters (road closures, traffic exclusion zones, vehicle checkpoints, etc.)
- Sealed assets (manholes, vaults, meters)
- Physical barriers (fencing, cattle guards, other hard barriers as appropriate)
- Active monitoring (cameras, federal and local law enforcement, command center staffing, field personnel, etc.)
- Airspace security plans (No Drop Zone, temporary flight restrictions)
- Federal and local law enforcement support or Duke Energy security personnel to escort field personnel to damage locations to perform essential work activities

Distribution has mitigation plans in place to ensure outage restoration activities can be performed safely and effectively in the event of a loss of key restoration systems due to a cyber-attack or system failure. The most significant impacts to restoration are total or partial loss of key restoration systems such as the Outage Management System, Distribution Management System, Supervisory Control and Data Acquisition, or any communications systems. Loss of computer access including loss of internet or intranet will prevent key personnel from accessing these systems. The Companies maintain electronic and hard copies of certain distribution system information at operations centers for use as contingency tools. Distribution has established standards to ensure identification, prioritization, and restoration of outages can be executed in the event of a total or partial loss of key restoration systems such as those described above, or any communications systems.

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The Distribution Business Continuity Plan makes provisions for events that impact the availability of a highly skilled workforce. First, the Companies prioritize work to ensure that available staffing is applied to the most essential tasks, such as imminent hazards presenting risk to the public, outage restoration, and requests for new service. Available employees will be shifted internally across the Companies' locations to ensure the most essential tasks are given priority. In the Carolinas, Duke Energy also has access to a large base of qualified contract technicians and the ability to seek support from its Midwest and Florida service areas for short-term employee assistance or equipment requests if native resource availability is compromised.

The Companies' Transmission functions have been reviewed through a risk assessment by the corporation and those viewed as critical have developed business continuity plans to allow for operations to continue without interruption. These plans address loss of facility and loss of employees. Transmission's System Operators are Certified and Task Verified by NERC. These plans make provisions for when the workforce is impacted by events. Each Energy Control Center has a fully functioning backup control center to operate the Transmission Bulk Electric System if the primary facility becomes inoperable. The system that monitors the Bulk Electric System is fully redundant and on loss of the current active system, control will automatically fail to the secondary system.

For pandemic responses recently in place to address concerns stemming from COVID-19, the Companies' plans incorporate additional robust measures to mitigate impacts to essential personnel. Measures included remote reporting of non-essential personnel, robust monitoring of first and second person contacts with contact tracing and strict adherence to quarantine requirements, staggered schedules for essential employees, effective personal protective equipment and social distancing practices, implementation of a no visitor policy at the Companies' facilities, elevated cleaning practices at the Companies' facilities and aggressive sanitization of facilities after a documented exposure has occurred, and the development of a medical testing program for employees and contractors with potential exposure prior to return to the workplace. For essential control centers, the Companies also implemented proactive testing and temperature screening.

Strategic suppliers are required to hold manufactured safety/emergency product inventory specifically for the Companies' needs. This supports inclement weather conditions as well as other emergent needs. This material is made available at the Companies' request. Duke Energy's supply chain strategy includes multi-supplier strategies for like products to ensure product continuity. Supply Chain monitors vendor performance and lead times and adjusts sourcing appropriately as needed. On hand material inventories are maintained for the Companies' distribution systems,

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including two supply centers (Fairfax and Garner Distribution Centers) to support the distribution system; additionally, there are five supply centers outside the Companies' footprint that can be used to transfer material as necessary for emergent distribution needs. All seven supply centers hold many like items that can be utilized amongst multiple regions depending on system requirements from state to state.

The Transmission organization has emergency plans that address capacity constraints, blackout restoration and storm preparedness and restoration. These plans provide details on the various actions that should be done prior to the event and after the event. The plans address the potential for large disruptions to the system and how to possibly mitigate those events. On hand material inventories are maintained for the Companies' transmission system at a key supply center.

The generation Emergency Response Program emphasizes FEMA's Incident Command System. Incident Management Team members at each facility conduct annual training to maintain knowledge and proficiency in executing emergency plans. An important feature of the Companies' program is its alignment to FEMA standards. This allows the Companies' personnel to integrate seamlessly with South Carolina's external responding agencies in unified command to ensure the most efficient response and use of resources.

Each generating facility has an Emergency Action Plan containing a general process that has been standardized across the fleet while applying specific details to address the unique hazards and emergency actions at each location. Each generating facility Emergency Action Plan is supplemented with emergency response plans that provide specific response actions for all emergencies identified from the facility hazard analysis. Each nuclear generation site has abnormal and emergency operating procedures to address response to extreme weather conditions. Based on a specific set of environmental conditions (rain accumulation, projected ice buildup, exterior temperature, wind speed, etc.), various actions are taken to harden the plant against the projected weather. Actions vary from increased monitoring to reconfiguration of plant systems based on the projected weather. These abnormal and emergency procedures can also be used flexibly to respond to extreme weather situations.

Maintaining proficiency of employees to regularly execute emergency protocols requires practice and necessitates both training and conducting emergency response exercises. Incident Management Team members participate in annual tabletop exercises with realistic scenarios allowing the use of emergency plans in a learning environment. Performance is evaluated and lessons learned applied to ensure continuous improvement. Additionally, full field exercises are

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conducted annually integrating external response agencies to improve the use of integrated command, improve communications, and build partnership with vital response agencies.

Emergency action plans are in place for each of the Companies' hydroelectric stations. These plans include notification charts for state and county emergency management agencies for natural flooding events as well as dam failure events.

The Companies' nuclear fleet is reliant on a highly skilled workforce for day-to-day work activities and for managing emergencies. The workforce is susceptible to several potential threats, including a pandemic, civil unrest, or labor unrest.

Like other business units within the Companies, the nuclear/non-nuclear generating stations have been concerned about COVID-19. Nuclear/non-nuclear generating stations in South Carolina and North Carolina which serve customers in South Carolina use Pandemic Business Continuity Plans that include details for maintaining operations, critical supply deliveries, and sequestering operations personnel. The most valuable asset at any of the DEC and DEP generating facilities is the Companies' operations staff. Ensuring the safety and well-being of essential employees is vital. The Pandemic Business Continuity Plans proscribe escalating steps to ensure continued availability of operations staff and the resources needed for continued nuclear/non-nuclear generation. At the extreme end is a sequestration plan that details how a facility would house essential staff during critical situations.

Civil unrest is a local external threat to the Companies' infrastructure that could impact multiple locations simultaneously. The Companies have processes in place to monitor external activities in the vicinity of assets and to take actions to protect employees and the facilities. Corporate office facilities are pre-emptively closed if a near-by protest or other disruptive activity is expected. The Companies' nuclear plants are protected by a robust security plan that ensures there are not any impacts to plant safety due to external physical security threats.

A labor dispute at one or more locations could challenge energy production. Processes are in place to manage and sustain the nuclear workforce like maintaining a reserve (above minimum requirements) of licensed operators. As a result, historically there has not been an impact on Duke Energy nuclear fleet safety or production due to labor disputes.

Nuclear/non-nuclear generation stations are required to establish a primary means of communication with the Balancing Authority and Transmission Operator which is normally a phone line dedicated to each location. A secondary means is required in case of loss of primary

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means and contact numbers are provided in training documents. Secondary means of communication include radio, cell phone, or satellite phone depending upon location.

Distributed Control System networks have on-site plant servers which collect information locally and the on-site non-nuclear generating station can view and leverage this information. In the event of a data issue or an alarm on the Distribution Control System, Operations will increase physical verification of operational performance through increased rounds or site walk-downs.

Telecommunications Business Continuity Plans and Service Level Agreements are in place through contractual obligations and are owned by the IT organization.

The Companies' nuclear fleet utilizes diverse communication systems. These include office phone systems, mobile communications, satellite phone systems, in-plant communication systems, and in-plant public address systems. Physical systems undergo periodic maintenance and testing to ensure proper operations.

In addition, software applications are utilized to provide work management tools and processes for both day-to-day activities and, while extremely rare, plant emergencies. Software applications are developed and maintained per established nuclear fleet procedures and processes that ensure reliability.

The fuels system has a completely redundant backup location established at an alternate location should the main trading floor location become inoperable for any reason. A Business Continuity Plan is in place to ensure timely transfer of controls and operations to the alternate location. Additionally, the Fuel Procurement Business Continuity plan allows for employees to perform their activities from home by utilizing a Virtual Private Network or remote log in to on-site machines. Exercises are held periodically to practice staffing and operating the system from the alternate site.

In addition to preparing for weather disruptions or peak load situations, Duke Energy business units participate in the North American Electric Reliability Corporation's Grid Security Exercise every two years. The exercise includes other utilities and electric power organizations from across North America as well as federal and state government organizations. The exercise is an opportunity for Duke Energy to demonstrate a coordinated response effort to recover from simulated coordinated cyber and physical security threats and incidents, strengthen crisis communications relationships, and to gain/apply lessons learned. The intended key outcomes for the exercise are to:

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- Exercise incident response plans;
- Expand and enhance local and regional response;
- Improve engagement with interdependent sectors;
- Identify opportunities to improve potential weaknesses within the supply chain; and
- Improve communication.

Use of diverse communication systems and applications ensures impacts due to disruptions are minimized. In addition, a response infrastructure is in place to ensure reliable communication systems and processes are available when needed for required work activities. This ensures vulnerabilities due to system outages are minimized. For example, plants in refueling or maintenance outages receive priority for addressing communication or information technology-related emergent issues.

Threats that may destroy, damage, or disrupt utility service are complex and dynamic. The impacts to South Carolina customers from these threats can range from local service disruptions to broad based system outages. Duke Energy is committed to providing safe and reliable electricity to South Carolina customers. In order to accomplish this mission, the Companies employ threat mitigation strategies, planning and forecasting, active and real-time monitoring, asset inspection and maintenance programs, and emergency response and business continuity plans. These strategies seek to mitigate or eliminate disruptions to service.

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CHAPTER 3: ASSESSMENT OF VULNERABILITIES

Order Item 3: To what degree will the utility systems and infrastructure be impacted. Vulnerabilities are weaknesses within utility systems, processes, or infrastructure.

Overview

An assessment of vulnerabilities and the impact identified threats can have on utility systems and infrastructure can be evaluated by reviewing the past performance of the Companies' utility systems when faced with realized threats. The Companies assess for vulnerabilities by reviewing past performance. Historical damage and outages caused by named storms and extreme weather events is one example. The performance of the Companies' defense from in-depth physical and cyber systems against an ever-increasing rate of attacks is another example.

Historically, the Companies have been diligent in preparing for these threats and executing their strategies to mitigate or eliminate realized impacts to reliable service for South Carolina. The Companies are proud that their system and departments have worked together seamlessly, harnessing the power of a vertically integrated utility to avoid brownouts or blackouts in DEC or DEP territories in the face of extreme weather and other threats.

The Companies also recognize that the threat landscape is dynamic. Threats are evolving and growing exponentially. We face increasing levels of complexity in the challenges to providing safe, reliable service to South Carolina customers. The Companies are committed to implementing innovative, comprehensive and efficient mitigation strategies to continue to provide reliable utility service to customers.

In this Chapter, the Companies have provided an assessment of vulnerabilities and the impact identified threats can have on utility systems and infrastructure. The Companies evaluate these impacts through the lens of actual historical events. Additionally, the Companies provide context for the complex and evolving nature of the threat landscape.

Vulnerabilities and impacts to reliable utility service are reviewed through the following types of events:

1. Extreme weather events;
2. Physical and cyber-attacks;
3. Fuel supply disruptions;

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4. Workforce disruptions;
5. Telecommunication system disruptions;
6. Bulk electric system threats; and
7. Dam safety and integrity issues.

Detailed Narrative

1. Extreme weather events

The 2020 Atlantic tropical storm season was extremely active with 30 named storms, the most in history, beating the prior 2005 record of 28 named storms. The season also had a near-record number of hurricanes (13) and major hurricanes (6). The season also featured a record-setting 12 landfalling named storms on to the US Mainland, including a record-tying six landfalling hurricanes. In addition to warm weather tropical storms, South Carolina customers are also impacted by ice storms, tornadoes, and flooding. Below is a table showing significant storms impacting the Companies' South Carolina customers since 2014.

Storm	Company	System Outages [1]	SC Outages [1]	% Customers Restored in X Days	System Incremental O&M Cost ($M) [4]	SC Retail Incremental O&M Cost ($M) [4]
2014 Ice Storms	DEP	102,500	102,500	3 Days	32	15
Hurriance Matthew	DEP	1,400,000	300,000	99% - 6 Days 100% - 7 Days	105	54
Hurricane Florence	DEC	1,800,000	200,000	86% - 3 Days	90	12
[2]	DEP			100% - 9 Days	462	49
Hurricane Michael	DEC	1,200,000	100,000	95% - 3 Days	80	8
[3]	DEP			100% - 5 Days	31	1
Winter Storm Diego	DEC	768,000	255,000	95% - 1 Day	56	12
	DEP			100% - 3 Days	32	1
Hurricane Dorian	DEP	295,000	27,000	94% - 2 Days 100% - 4 Days	170	18
Tropical Storm Zeta	DEC	943,000	226,000	70% - 1 Day 100% - 4 Days	53	21

[1] Outage numbers are approximate
[2] South Carolina Retail capital investment costs as a result of Hurricane Matthew include $20 million
[2] South Carolina Retail capital investment costs as a result of Hurricane Florence include $20 million
[4] Approximate amount of costs per storm in which deferral accounting was requested

While the table above shows numbers of outages, restoration times and incremental costs, the one below describes the extensive damage to the grid infrastructure caused by these storms.

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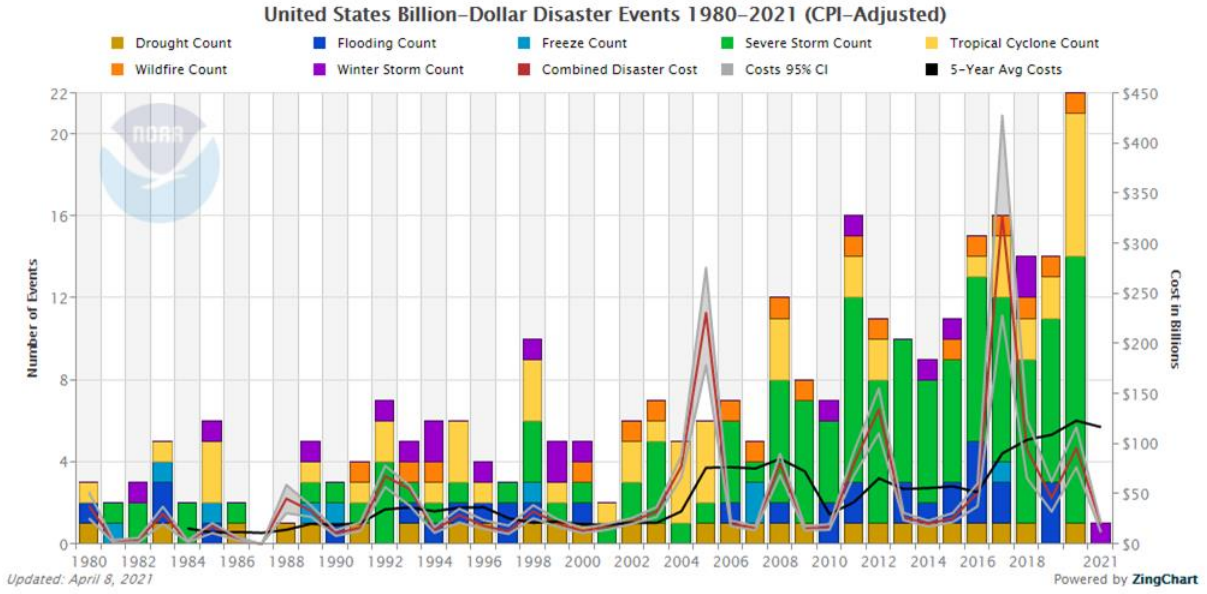
Storm	Damage
2014 Ice Storms	More than 2,100 spans of primary conductor and 880 spans of secondary conductor were down. More than 6,900 trees had to be cleared from lines. More than 67,000 feet of primary and secondary conductor was replaced, while 430 poles were dispatched to South Carolina operation centers.
Hurriance Matthew	115 substations and 58 transmission lines out of service, almost 300 miles of downed wire, approximately 2,000 downed poles, and 800 damaged transformers across Duke Energy Progress's system.
Hurricane Florence	142 substations and 53 transmission lines out of service, more than 220 miles of downed wire, approximately 5,700 downed poles, and 2,200 damaged transformers across the Carolinas' system. Nine transmission substations and two wholesale points of delivery (PODs) were flooded as a result of the storm. In addition, 45 transmission lines, 90 substations and 48 wholesale PODs were out of service.
Hurricane Michael	This fast-moving storm brought heavy winds and rain to the already saturated our service territory, resulting in widespread damage and outages. Transmission impacts from the storm included 16 transmission lines, 31 substations and 4 wholesale PODs were out of service.
Winter Storm Diego	Winter Storm Diego caused widespread damage and outages and was the most significant early December storm since 2002's ice storm. Transmission impacts from the storm included 21 transmission lines, 26 substations and 5 wholesale PODs were out of service.
Hurricane Dorian	Hurricane Dorian brought high winds and producing tornadoes and heavy rain, resulting in widespread damage and outages.Transmission impacts from the storm included 6 transmission lines, 8 substations and 10 wholesale PODs were out of service.
Tropical Storm Zeta	The remnants of Hurricane Zeta reached the Carolinas as a tropical storm bringing powerful winds and heavy rain, resulting in widespread damage and outages. Transmission impacts from the storm included 29 transmission lines, 64 substations and 12 wholesale PODs were out of service.

Recent trends in major weather events – including Tropical Storm Zeta, Hurricane Michael, and Hurricane Florence – illustrate the magnitude of the challenge the grid faces today from weather. In addition, the number of customers impacted by weather events is increasing due to population growth in regions most affected by weather. The National Oceanic and Atmospheric Administration's published article "U.S. Billion-Dollar Weather and Climate Disasters" shows trends in counts of billion-dollar weather and climate disaster events.[7]

[7] NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, *BILLION DOLLAR WEATHER AND CLIMATE DISASTERS: OVERVIEW* (2021), https://www.ncdc.noaa.gov/billions/

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↓ View Data Table Download:

During 2020, there were **22 separate billion-dollar weather and climate disaster events** across the United States, **breaking the previous annual record of 16 events** that occurred in 2017 and 2011. The **2020 costs were $95.0 billion**, with Hurricane Laura, the August derecho and the historic Western wildfires as the most costly events. The billion-dollar disaster events during 2020 caused the fourth-highest annual U.S. cost total since 1980.

The frequency and severity of extreme weather events have created unique challenges to the nuclear/non-nuclear generation systems with managing generation unit reliability, sufficient reserves, and lake levels to maintain dam safety. These instances arise with back-to-back storms or atypical extreme weather patterns.

Extreme cold and extreme heat events cause high demand on the Companies' power generation system, which presents challenges to serve peak loads. Plans and procedures are in place to mitigate these challenges. The Companies maintain planning reserve margins and daily reserve margins to ensure peak load is met during extreme events. In the Carolinas, the Companies have demonstrated the ability to meet the challenges encountered during extreme weather events. During the Polar Vortices of 2014 and 2015, as well as the extreme sustained cold weather the area encountered in January 2018, which included seven consecutive days of significant high demand, the Companies demonstrated the ability to meet the challenges that extreme weather events present.

Being a vertically integrated utility allows the Companies to coordinate planning and operations within distribution, transmission, nuclear/non-nuclear generation, and fuels to ensure DEC and

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DEP are prepared and able to meet the challenges of extreme weather events. In addition, the Companies maintain load reduction plans that can be implemented if non-nuclear generation resources are not sufficient to meet gross customer demand.

Specific to the nuclear generation fleet, extreme hot or cold weather has had minor impact on operations. Due to the robustness of the weather protection program, the impacts of these events did not result in a significant change to peak load. The main impacts were limited to instrumentation issues or minor reductions in power to accommodate established plant limits. Extreme hot weather reduces the efficiency of the plant, which can reduce a facility's overall electrical generation. Extreme cold weather can cause personnel safety issues due to ice buildup and has the potential to freeze outdoor instrument lines.

The Carolina heat wave in the summer of 2012 is one instance where the nuclear fleet utilized its extreme weather processes to manage the impact from the event. Temporary cooling was established at several plants in advance of the heat wave and levels in various oil reservoirs were adjusted in anticipation of the sustained hot weather. Fuel tanks associated with plant equipment were topped off and site walkdowns performed for vulnerabilities. Work schedules across the nuclear fleet were re-evaluated and work that had potential to impact nuclear generation output was rescheduled. Peak power levels at some plants were slightly reduced due to the loss of efficiency. Thunderstorms during this time were particularly challenging and lightning strikes resulted in the loss of some outdoor non-essential instruments.

The Polar Vortex early in the winter season in 2014 was another instance where the nuclear fleet utilized its extreme weather processes. Temporary heating was established in specified locations and oil levels were regularly checked. Fuel tanks associated with plant equipment were topped off and temporary enclosures were built around vulnerable equipment. Heat trace systems were rechecked for functionality and outdoor insulation was checked for adequacy. By procedure, the frequency of operator monitoring of susceptible plant equipment was increased to allow immediate corrective action of deficiencies. During the event, ice buildup on outdoor locations created personnel safety conditions. Special winter traction-enhanced footwear and ice melt were staged in advance to protect plant workers. The extreme cold weather did affect some outdoor non-essential instruments, causing them not to function correctly with limited impact to plant operation. While a solar eclipse may be rarer than hurricanes and thunderstorms, this type of event still requires careful coordination and planning of multiple business units at the Companies to ensure customer electricity demand is met. In conjunction with systems operations in 2017 for the solar eclipse that year, the Distribution Control Center coordinated closely with solar-based distributed energy resources.

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Extreme weather events have created challenges for the Companies' transmission systems. Even though severe weather can result in tens of thousands of customer outages, the Companies' Transmission group works to harden and prevent large scale outages through both annual inspection and maintenance programs as well as the Grid Improvement Plan. The Grid Improvement Plan programs and other grid improvements enable Transmission to facilitate prompt recovery of transmission circuits, stations and ultimately customers following large scale weather events thereby creating resiliency in the grid.

Hurricanes Matthew (2016) and Florence (2018) resulted in approximately 10 substations in the DEP service territory to experience severe flooding. In some cases, these resulted in customers being without power for over four days and required months to complete repairs and equipment replacements to reestablish normal grid configurations and redundancy.

Severe weather events have resulted in the loss of large numbers of transmission circuits and substations. In the Companies' service territories, hurricanes have resulted in upwards of 50 circuit lockouts, ranging from 44kV up to 230kV. These events impact normal grid configurations, reduce redundancy, and can result in lengthy customer outages which can, at times, affect hundreds of thousands of customers. In recent years, Transmission has been able to restore all customer impacts in South Carolina in a matter of days, even when facilities have physical damage

2. Physical and cyber-attacks

Physical and cyber-attacks on the Companies' systems are increasingly complex and can impact reliable utility service. Duke Energy utilizes both physical and cyber security operations centers to monitor threats 24/7. Consistent communications to personnel are used to ensure employees know what to report and how to report.

Cyber threats to reliable utility service were most publicly demonstrated in attacks on the Ukrainian power grid in 2015 and 2016. Such attacks could impact controls, software, or telecommunications infrastructure needed to operate an increasingly digital distribution grid. The proliferation of distributed energy resources expands the potential cyber-attack surface to penetrate the Companies' distribution systems. As explained earlier, the top threats to reliable utility service from a cyber security perspective include remote connections used by vendors, negligent and/or malicious use of removable media, and supply chain compromise.

The importance of the Companies' intelligence and risk assessment programs is imperative to being able to identify, detect, deter, mitigate, and eradicate vulnerabilities to their systems. Threat

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Intelligence Analysts and Risk Assessment Security Specialists work together to determine the best physical and cyber defense strategies based on the criticality of a facility and its associated threat risk.

The Duke Energy cyber security team utilizes the Common Vulnerability Standardized System scoring and exploit activity structure to identify and prioritize vulnerabilities on a weekly basis with affected business areas. Depending on scoring, the necessary response process would be utilized. For example, for a zero-day exploit (a "zero-day" is a vulnerability for which a patch is not currently available, and there is evidence of active exploits), the cybersecurity team would reach out across the potentially impacted business areas for immediate resolution. Zero-day exploits are rare in the operational environment, and by the Companies' implementing multiple redundant systems, a long-term and wide-ranging compromise would have had to occur. Additionally, without physical access to a system, the adversary's actions could be contained and eradicated allowing recovery to take place.

Physical threats to critical distribution or transmission equipment take the form of vandalism or coordinated attacks on infrastructure. A well-publicized sniper attack on a California substation in 2013 damaged 17 substation transformers, caused $15 million in damages, and led to $100 million in physical security investments. While less dramatic than those other physical threats, NERC data showed that theft was the top physical threat to the grid in 2017, in some cases involving perpetrators removing copper ground wire from utility poles.[8]

From a physical security perspective, if physical access is used to launch a physical attack the identification, containment and recovery could be more complicated and the extent of impact increased. To indicate the security risk level certain facilities possess, the following tier levels are assigned to critical infrastructure based on this logic:

- Tier 1 = High: Majority of consequences in either the Catastrophic or High Impact categories;
- Tier 2 = Medium: Majority of consequences in the Medium Impact category, with some potentially in other categories; and
- Tier 3 = Low: Majority of consequences in the Medium or Low Impact categories, with none in the Catastrophic category.

[8] INFRASTRUCTURE SECURITY AND ENERGY RESTORATION OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY U.S. DEPARTMENT OF ENERGY, *AN ASSESSMENT OF COPPER WIRE THEFTS FROM ELECTRIC UTILITIES* (APRIL 2007), https://www.oe.netl.doe.gov//docs/copper042707.pdf

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One example from a physical-security perspective is threat aggressors that are most likely to carry out such an attack are intent on causing damage to the grid. Aggressors could include insiders (e.g., employees or contractors), a lone terrorist or a coordinated team of terrorists. Insiders would commit crimes mostly for personal benefit such as revenge or monetary gain. Terrorists would commit attacks for ideological reasons, and their commitment to success, at any cost, would likely be greater than other threats.

Some of the Companies' non-nuclear generation sites have experienced breaches in the physical security perimeter in recent history. None of these incidents resulted in a loss of power generation. Events are discovered either by personnel observation or by the control room through security equipment and an array of security cameras around the generation station's property. In these cases, the Security emergency response plan at the station is followed. All non-suspicious trespassers are removed from a site immediately. Law enforcement is dispatched for suspicious or cases involving criminal activity.

3. Fuel supply disruptions

A loss of gas supply could ultimately lead to a generator not being able to count towards system capacity. The degree of impact depends on the length and extent of the loss of gas supply. The Companies have programs and practices in place to provide for fuel supply assurance, including the use of inventory management and alternate fuel sources. For example, during the extreme sustained cold weather event the area encountered in January 2018, which included 7 consecutive days of significant high demand, available fuel oil (49M gallons of inventory plus deliveries of 7.7M gallons) was less than required by the economic non-nuclear generation plan (~60M gallons). Meeting the plan would require over 1,000 additional truck deliveries and would deplete fuel oil inventory that would disable 2,400MW oil CT capacity with an additional cold front being forecast another week out. Duke Energy engaged the power and gas market to displace the planned oil burn with incremental gas and power purchases totaling 138,700 MWhs. These options were cost effective for customers and had the added benefit to preserved fuel inventory for the next week of cold weather. Additionally, Distribution System Demand Response used to reduce peak demand was activated 14 times for a total duration of approximately 50 hours over the period.

Although solar provided minimal capacity benefit during the extreme sustained cold weather event encountered in January 2018, solar energy did help reduce natural gas and oil consumption between the morning and evening peaks. The Companies ended the period with a remaining oil inventory level of 23.6 million gallons to help support future weather events and system contingencies. The Companies consumed approximately another 5.9M gallons of oil during the

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week of January 14-19, 2018, as another burst of wintery weather in the Carolinas increased demand. The Companies' fuel oil consumption for the month of January 2018 totaled 42.8 million gallons. In contrast, for the Texas Blackout, during the week of February 11-20, 2021, the Companies burned a total of 2.2 million gallons of fuel oil in place of higher spot price natural gas and withdrew 400,000 MMBtu of natural gas from its storage facilities. The different approaches to manage fuel and purchased power based on market availability demonstrates the flexibility that has been developed to effectively manage reliability and cost during weather events.

4. Workforce disruptions

Workforce disruptions can cause impacts to the utility systems and service as well. Duke Energy is reliant on a highly skilled workforce for day-to-day operations and for managing emergencies. The recent global pandemic is one example of workforce impacts to utility service and highlights how Duke Energy managed through this crisis to prevent service disruptions.

Duke Energy's detailed pandemic response plan ensured sufficient personnel coverage for prioritized work. Through early deployment of the corporate-wide Incident Support Team, a structure was established quickly to manage the rapidly changing environment of the 2020 COVID-19 outbreak. The structure allowed for quick dissemination of information throughout the organization and a uniform, coordinated response to the known and not-yet-anticipated needs of each of Duke Energy's business units. The rapid alignment to CDC guidelines helped to minimize the impact on employees and contractors. The Companies kept front-line workers safe while successfully generating steady and reliable energy throughout the pandemic. Putting special COVID-19 safety protocols in place, the Companies completed the needed activities throughout their system to ensure SC customers had reliable energy.

As explained earlier in this response, civil unrest is an additional example of workforce disruptions that can impact utility systems and service. This is a local, external threat to Duke Energy infrastructure that could impact multiple locations simultaneously. Duke Energy has processes in place to monitor external activities in the vicinity of assets and to take actions to protect employees and the facilities. Corporate office facilities are pre-emptively closed if near-by protests or other disruptive activity is expected, as was seen during periods of 2020 and 2021.

5. Telecommunication system disruptions

The Companies rely on telecommunications and technology for much of their day-to-day operations. Industry examples of telecommunications disruptions include:

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- The Nashville bombing on Christmas Day 2020 rendered all communications services unavailable in and out of the AT&T central office including the AT&T FirstNet First Responder's network. All Piedmont Natural Gas ("PNG") connectivity was lost during this interruption, along with any internet or leased services provided by AT&T for operations centers. For a period of several days, control and management of the PNG system resorted to a manual process. This interruption occurred during a cold spell where gas pressures require much tighter management and control. This event and its impacts are still under review for any mitigation actions. Privatization of network control for critical sites will have increased interest.
- In 2018, the recovery from impacts to commercial carrier communications networks following landfall of Hurricane Michael took several days. This was a result of continued impacts from debris clearing efforts on fiber required to connect commercial cellular towers to their core networks that controlled call traffic. Commercial cellular carrier restoration priorities do not always align with utility restoration needs. With limited cell connectivity in a region, there is impact on all traffic as the general public and the utilities contend for bandwidth for internet/data access and voice/text ability. With no prioritization, any grid control traffic is also simultaneously contending with the general public for access and is forced to wait on the commercial carrier restoration for relief. In comparison, Duke Energy communications networks and infrastructure are designed to better survive such events.

Duke Energy non-nuclear generation has experienced disruption due to telecommunication events. Typically, these events have resulted from a severed fiberoptic line during construction activities at a single non-nuclear generation facility. During the ensuing telecommunication outages, the power plants remained on the grid, communications with the transmission operator occurred either via radio or via cellular telephone, and applications were managed locally in a manual method. Cellular communications calls are made to inform station personnel of any known restoration times. With personal mobile device capabilities, those communications also occur via email since an impact to the Duke Energy telecommunications network may not impact a worker's mobile carrier.

The Companies' nuclear fleet utilizes diverse communication systems. This minimizes production vulnerabilities due to service disruptions. Physical systems, including emergency response systems, undergo periodic maintenance and testing to ensure proper operations.

Software applications are utilized to provide work management tools and processes for both day-day activities and to manage plant refueling or maintenance outages. Software applications are

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developed and maintained per established nuclear fleet procedures and processes that ensure reliability.

In addition, a response infrastructure is in place to ensure reliable communication systems and processes are available when needed for required work activities. This ensures vulnerabilities due to system outages are minimized. For example, plants in refueling or maintenance outages receive priority for addressing communication or information technology-related emergent issues.

The Distribution organization relies on technology for significant work management processes, mobile data terminals to deliver work information to field employees as well as grid management, metering, and billing systems' communications infrastructure. In other jurisdictions outside the Carolinas, Duke Energy has experienced loss of primary and redundant inter-regional leased data transport circuits impacting availability and access to systems and applications hosted at the core data centers. Control centers in the affected regions were unable to access cellular-connected devices because connection to the cellular networks routed through the Duke Energy data centers. The Transmission control centers have redundant data and communication networks as required by NERC Policy (COM-003) and are able to operate in the event the corporate network is compromised. As a result, a redesign is underway to include cloud connectivity, regionalized application and data availability, along with privatization of connectivity to edge devices to mitigate future isolation events.

6. Bulk electric system threats

Bulk Electric System events have the potential to impact reliable utility service. It is important for distributed energy resources to have the ability to sustain operations when momentary power fluctuations occur. In April 2019, a 230KV transmission fault at a DEP substation in Raleigh, NC triggered a loss of approximately 322MW of distributed energy resources. A subsequent analysis revealed 458MW of added load during this event. Had this event occurred during peak solar output, the lost production could have been as much as 765MW. This immediate loss of distributed energy requires system operators to add flexible generation to cover for the lost output.

Other utilities outside of the Carolinas have experienced additional types of Bulk Electric System events. Two examples are outlined below.

- In Great Britain, a blackout in August 2019 was triggered by lightning fault. The grid lost 500MW of DER, 738 MW of offshore wind, and 641 MW of gas-fired turbines resulting in 1.1 million customers out of power.

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- In California, several widely publicized events were caused by transmission faults triggered by wildfires. The Blue Cut Fire in 2016 resulted in the loss of 1200 MW and the Canyon 2 fire in 2017 resulted in the loss of 900 MW.

These types of Bulk Electric System events underscore the importance of Duke Energy's SC Grid Improvement Plan to modernize the delivery of reliable, efficient, and sustainable power through upgrades to transmission and distribution systems, distributed generation, and technology infrastructure. The Grid Improvement Plan involves using sensors, computers and applications that require substantial deployment of telecommunications technology with flexibility, security, reliability, and manageability that together add resiliency. With a marked increase in the numbers of devices deployed outside the fence of the substation, there is a subsequent increased risk and vulnerability to the operations if commercial communications network providers are the sole source of communications connectivity. Private wireless technologies are under consideration as a strategy to limit reliance on commercial telecommunications providers. This is especially important following major weather events where restoration priorities for commercial telecommunications services critical to utility locations do not align with large population center restoration priorities. A prioritized balance of private versus commercial connectivity is necessary to ensure the best customer experience and value to the overall Grid Improvement Plan. Given the dependency today's customers have on electronic devices across all customer classes for automation, monitoring and control as well as internet connectivity, any interruption in service must be mitigated.

As seen in the historical performance in the face of complex threats, the Companies have performed well and embraced the lessons learned to continuously improve. DEC and DEP are proud of the reliable service they have provided to South Carolina over the years yet recognize the responsibility to remain vigilant and the need for regulatory and legislative support to maintain the ability to withstand such threats for the benefit of customers. Threats to reliable service are dynamic and can evolve at an increasing pace. The Companies remain committed to continue to harness the collective agility and innovation of employees and engage with stakeholders and customers to meet the challenges of the future for South Carolina customers.

7. Dam safety and integrity issues

The structural integrity of hydro dams is critical, not only to reliable service, but also the safety of the surrounding communities. The main threats to dams are flooding (associated with hurricanes/tropical storms) and earthquakes. A dam failure would disrupt the hydroelectric generation associated with the dam. It could also disrupt thermal generation if a nuclear station or fossil station uses the reservoir for operations.

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The Companies are proactive in ensuring dam stability. Over the past 25 years, capital upgrades have been made to increase the flood capacity of 14 dams and two more dam upgrade projects are currently under construction. Over the past 20 years, Duke Energy has made capital upgrades to increase the seismic stability of four earth embankment dams; a fifth one is under construction, and a sixth one is being planned/designed.

Major flooding events associated with named storm systems were safely passed without dam safety incidents or concerns. Five examples of hurricanes in which the Companies successfully managed dam systems are Florence (2018), Francis and Ivan (2004), Beryl (1994), and Hugo (1989). The key factors in being able to safely pass large floods are ensuring each dam has an adequate spillway capacity, ensuring spillways are fully functional, and having a well-developed flood operations protocol. The Companies flood operations protocol/process includes working with internal meteorologists for forecasting major rain events, frequent coordination calls (with management, operations staff, corporate communications staff, government, and community relations staff) prior to and during the event, and frequent communications with the public and local emergency management agencies during the event.

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CHAPTER 4: ASSESSMENT OF RISKS TO UTILITY SERVICE

Order Item 4: An evaluation of the potential for loss, damage or destruction of key assets and resources and factors that could limit the supply of nuclear/non-nuclear generation over an extended period of extreme weather conditions for each of the state's generation sources.

Overview

The Companies provide service to South Carolina customers from a diverse mix of generation sources. While periods of extreme weather conditions can impact generation supply, diversity in the generation mix as well as weather hardening efforts have allowed the Companies to successfully supply reliable power to South Carolina through the 2014 and 2015 Polar Vortices. Lessons learned from these weather events, as well as from the Texas Blackout, have been acted on to mitigate future weather event impacts to generation supply.

In this Chapter, the Companies have provided an evaluation of the potential for loss, damage or destruction of key assets and resources as well as factors that could limit the supply of generation over an extended period of extreme weather conditions. Additionally, the Companies have provided weather hardening tactics used to ensure each of the diverse generation sources serving South Carolina customers can withstand future weather events and provide reliable service.

Evaluation of potential for loss, damage or destruction of key assets and resources and factors that could limit the supply of generation included:

1. Extreme weather events that can disrupt electric service for South Carolina customers;
2. Extreme weather events that can challenge ability of generation to serve peak loads;
3. Extended drought periods impacting water requirements; and
4. Generation impacts from transmission.

Detailed Narrative

1. Extreme weather events that can disrupt electric service for South Carolina customers

The Companies have weathered two recent extreme polar vortices (2014 & 2015) and a severe sustained cold weather event in January 2018. These are just two examples of extreme weather events that can disrupt electric service for South Carolina customers. Other examples include ice

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storms, hurricanes, tropical storms, tornadoes, flooding, and severe thunderstorms. The Companies are prepared for extreme weather and are always seeking to improve.

Generation employs fleet-wide guidance that identifies actions and responsibilities to prepare nuclear/non-nuclear generation stations for both summer and winter seasons. Winter preparation activities include checking insulation and heat trace systems. Summer preparation activities include checking insulation and cooling systems. Individual generating stations have also created site-specific procedures to document necessary actions unique to their plant locations and typical weather events. Nuclear/non-nuclear generation sites have standard Preventive Maintenance associated with cold weather preparation entered into their formal work management systems to ensure visibility and timing of completion of these activities. For mission critical generating units, the Companies ensure that planned outages occur in the shoulder months (spring and fall) to be prepared for heavy generation run periods to support the peak summer and winter loads. Formal maintenance and reliability programs further institute the required actions to ensure equipment performance, recommended condition assessments and inspections for extreme weather readiness.

Nuclear generation sites leverage abnormal and emergency operating procedures to address response to extreme weather conditions. Usually based on a specific set of environmental conditions (rain accumulation, projected ice buildup, exterior temperature, forecasted and actual wind speeds, etc.), various actions are taken to harden the plant against the weather. Actions vary from increased monitoring to reconfiguration of plant systems based on the forecasted and then actual weather conditions.

Periodic surveillances of various plant components that could be affected by extreme weather are part of power generation extreme weather mitigation strategies. Outdoor components such as cooling towers, transformers, and valves are visually inspected to ensure they are not being affected by extreme weather conditions. Outdoor temperature controls the periodicity at which walkdowns are performed; the colder or hotter the temperature, the more frequent and detailed the walkdown. At certain thresholds, maintenance supplemental actions are needed such as building temporary enclosures or adjusting plant equipment.

Prior to each peak weather season, the nuclear fleet weather readiness procedure requires implementation of a site-specific weather readiness checklist. The checklist ensures a methodical checkout of various components such as heat trace systems, construction of temporary enclosures, cooling systems, and other weather-related items. The site updates these checklists dependent on lessons learned from season to season and to capture any industry-related operating experience.

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As each site develops its weekly schedule, one of the major considerations is the management of risk. The risk profile has entries for grid stability, as well as for weather conditions. As environmental conditions change or the available electricity reserve changes, the risk profile changes. Should the risk profile fall below a certain established threshold, Operations evaluates the remaining work activities and makes decisions about which activities remain on the schedule and which are removed. Specifically, for environmental and grid condition changes, diesel generator and switchyard activities are a primary focus.

One of the lessons learned from the Texas Blackout was that the deregulated energy providers had issues getting operators to plants. In times of system critical needs, the Companies ensure adequate staffing of operating shifts and if needed, even have operators remain close to plants. With predicted bad weather (e.g., flooding, hurricanes, heavy snow/ice), we may have station personnel stay at or near plant and carpool as needed via company vehicles to ensure proper staffing to run the plant.

Extreme weather events have also significantly impacted transmission infrastructure and power availability to customers across all classes (retail, commercial, industrial). Major hurricanes along the coastal Carolinas region as well as inland tornadoes have the largest history of impact on the system, with past hurricanes resulting in upwards of 50 transmission lines being taken out of service, ranging from 44kV up to 230kV. These events significantly impact normal grid configurations, reduce redundancy, and result in lengthy customer outages, sometimes up to tens of thousands of customers during a single event.

Most commonly, vegetation falling into a transmission line is the initiating event, although straight line winds and flooding have also resulted in loss of power to customers. With trees or tree debris impacting lines, secondary damage may also occur such as broken conductors, insulators, ground wire, or structures; these secondary impacts complicate recovery and lead to longer outage durations. Severe weather events have also resulted in substation flooding, requiring transmission equipment to be de-energized. During Hurricanes Matthew (2016) and Florence (2018) approximately 10 substations in the DEP service territory were impacted by severe flooding. In some cases, these resulted in customers being without power for over four days and required months to complete repairs and equipment replacements to reestablish normal grid configurations and redundancy. The Nichols 115kV substation near Nichols, SC is one example; this station was flooded with over 5 feet of water from the nearby Lumber River during Hurricane Matthew. This station suppled power to over 2,000 customers, and without it in service the grid needed to be reconfigured to route temporarily route power to these residents. A significant rebuild effort was required to replace all flood damaged equipment including circuit breaker, protective relays, and

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control equipment. A permanent flood barrier wall has since been erected to prevent future flooding impacts to this substation.

2. Extreme weather events that can challenge ability of generation to serve peak loads

Extreme cold and extreme heat events can also cause high demand on the Companies' systems, which presents challenges to serve peak loads. The Companies' nuclear/non-nuclear generation fleets have plans and procedures in place to mitigate these challenges. The Companies maintain planning reserve margins and daily reserve margins to ensure DEC and DEP can meet peak load during extreme events. In the Carolinas, the Companies have demonstrated during the Polar Vortices of 2014 and 2015, as well as the extreme sustained cold weather encountered in January 2018 (which included seven consecutive days of significant high demand), that the Companies can meet the challenges extreme weather events present. After each of these events, the Companies utilize lessons learned to continuously improve on preparation and response to extreme weather events. The Companies also utilize lessons learned from other utilities in the industry that have been challenged by extreme weather events to adopt additional industry best practices. It is also important to note that being a vertically integrated utility allows the Companies to coordinate their planning and operations within distribution, transmission, nuclear/non-nuclear generation, and fuels to ensure the Companies are prepared and able to meet the challenges of extreme weather events. Without this essential coordination that a vertically integrated utility can provide, functions would work independently, likely creating gaps in reliability. In addition, the Companies maintain load reduction plans that can be implemented if generation resources are not sufficient to meet gross customer demand.

3. Extended drought periods impacting water requirements

Extended dry periods can cause drought issues which can derate units or force them off-line due to water requirements. Certainly, the Companies' hydro units would be subject to lower generation in droughts.

To conserve water storage capacity for power production and municipal water supplies during drought conditions, Low Inflow Protocol provisions are included in Duke Energy's FERC hydropower licenses. The goal of the Low Inflow Protocol is to delay the point at which usable water storage is fully depleted during severe droughts.

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4. Generation impacts from transmission.

The Companies' transmission system in the Carolinas is highly networked with nuclear/non-nuclear generation diversely located across the system. While this does not eliminate the vulnerability, it does reduce the Companies' exposure to single transmission line or equipment failures impacting nuclear/non-nuclear generation facilities. The Companies rely primarily on nuclear/non-nuclear generation connected directly to the transmission system within their collective footprints. This limits exposure to loss of nuclear/non-nuclear generation capacity due to loss of transmission facilities outside of the Companies' control.

From a transmission perspective, extreme cold weather events (without ice/snow) that can cause peak loading higher than anticipated have typically caused only localized issues and have not resulted in significant widespread loss of transmission infrastructure that would result in nuclear/non-nuclear generation impacts. Severe weather such as hurricanes or major ice storms, however, are a more serious threat due to the physical damage that can result to transmission lines or station equipment connected to generating plants. Often this damage is caused by trees falling on lines causing damage to equipment. Historically, the biggest risk has been from hurricanes coming on shore in the Carolinas and causing damage to the Companies' transmission infrastructure. These events are generally accompanied by significant damage to the Companies' lower voltage distribution infrastructure which results in reduced customer load so that any loss of power generation has not resulted in system capacity concerns. Historically, restoration of transmission infrastructure and nuclear/non-nuclear generation has kept pace with restoration of load.

There is a small number of nuclear/non-nuclear generating facilities on the bulk power system that are subject to being unavailable or having output reduced by failure of a single transmission line or associated equipment. As an example, Duke Energy's Bad Creek Pump Storage facility is served from a single 525kV transmission line and Brunswick Nuclear Plant is required to reduce output due to the loss of a single 230kV transmission line. Most of Duke Energy's nuclear/non-nuclear generating facilities, however, can withstand multiple outages to lines or equipment before the generator output is impacted. A major ice storm or hurricane can cause physical damage to transmission infrastructure resulting in the possibility of multiple generating facilities having reduced output or being removed from service. Again, during these type events the Companies' low voltage distribution infrastructure also has been impacted and customer load is reduced.

Regarding loss of substations and switchyards associated with generators, the primary issue the Companies have experienced is loss of substation(s) associated with flooding that often

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accompanies hurricanes. As an example, the Wallace 230kV substation approximately 30 miles north of Wilmington, NC has flooded in the past reducing the generator output at the Brunswick Nuclear Plant. Duke Energy has completed flood mitigation at the Wallace substation and has either implemented or planned or implemented flood mitigation at other vulnerable substations across the system. These efforts also reduce the impact of flooding on the ability to serve load.

The Companies rely primarily on nuclear/non-nuclear generation connected directly to the transmission system within their collective footprints. This limits exposure to loss of nuclear/non-nuclear generation capacity due to loss of transmission facilities outside Duke Energy's control. In addition, the Companies plan for the loss of power generation capacity and have on system operating reserves available as well as reserves that are available from their neighboring utilities as members of a reserve sharing group.

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CHAPTER 5: IDENTIFICATION OF RESILIENCY SOLUTIONS

Order Item 5: The plans of the utility to anticipate, prepare for, adapt to, withstand, respond to, and recover quickly from service disruptions. Cost impacts to the utility and customers should be identified. Specifically, the impacts to customer bills due to increases in fuel and other costs should be identified.

Overview

Duke Energy places significant focus on preventing service disruptions to South Carolina customers. The Companies focus on forecasting, planning, monitoring, and inspection programs to prevent or mitigate service disruptions. However, there are times when service disruptions occur based on the identified threats to utility service. When these disruptions occur, the Companies' top priority is to safely restore service to South Carolina customers in an efficient, systematic way. The Companies accomplish this by leveraging their integrated plans and resources across the entire DEC and DEP system.

In this section, the Companies have provided the plans to anticipate, prepare for, adapt to, withstand, respond to, and recover safely and quickly from service disruptions impacting South Carolina customers and how these efforts impact customer billing. The Companies have described the kinds of costs associated with these efforts, which ultimately appear in customers' bills in rates set in base rate cases to recover test year and deferred costs (which are amortized to smooth and put downward pressure on bills) or in fuel cases, where increased costs of fuel or purchased power would materialize from the prior year.

The following plans to anticipate, prepare for, adapt to, withstand, respond to and recover safely and quickly from services disruptions are included:

1. Emergency response and business continuity plans;
2. Black Start system plans;
3. Supply chain interruption plans;
4. Vegetation management program;
5. Bulk electric system plans; and
6. Fuel supply interruption and cost management plans.

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Detailed Narrative

1. Emergency response and business continuity plans

Duke Energy leverages emergency response and business continuity plans to minimize risk to the enterprise systems, assets and resources, mitigate potential losses, and ensure continuation of critical operations in the event of disruptions. Duke Energy embraces the FEMA National Incident Management System recommendations to plan for "all-hazards" and not just for a single type of event. Duke Energy utilizes Business Continuity and Emergency Management plans regardless of the type of event at hand.

The Emergency Response Organization is designed to support the critical activities and functions necessary for Duke Energy's distribution organization to rapidly respond to any type of natural or manmade event. The Region Incident Commander and Incident Management Team have overall accountability of ensuring Duke Energy is prepared and ready to execute the Emergency Response Plan for major events while also leading a staff covering the following responsibilities: operations, planning, logistics, finance, human resources, public information, liaison, safety, and the Distribution Control Center. The Emergency Response Plan provides governance for major event response and is a key component of each region's Business Continuity Plan.

Distribution utilizes modeling to predict outage events, customer outages, estimated time of restoration and resources needed to meet that estimated time. The models are used as decision support tools to prepare for subsequent outages that result from major weather events. Having the ability to gauge the magnitude of the power outages that are likely to occur as well as knowing the location of the outages are vital pieces of information. These insights allow the Companies to pre-position resources and produce power restoration plans to minimize the amount of time our customers are without power.

Distribution has an escalation process to allow scalability of response based on the event level. When outage events occur that exceed the capability of local resources, then the Incident Commander at the appropriate level determines the additional resources required to respond and restore to normal operations. Having well-defined escalation guidelines enable the Companies to respond to events more efficiently and completely.

The below table illustrates the complex nature of these escalation guidelines and decisions:

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Escalation Table	Level 0	Level 1	Level 2	Level 3
Impact Area	Normal Planned Work or Isolated Outages	Limited to Ops Centers	Limited to Zone	Forecasted or actual damage across multiple zones
Estimated Time of Restoration	< 6 hours	6-12 hours	12 – 24 hours	> 24 hours
Logistics	Ops Center logistics needs coordinated by existing leaders and Work Management staff	Site Incident Command Logistics Staff	Zone Incident Command Logistics Staff	Regional support for resource movements, base camps sites, or mutual aid group support
Crew Needs	On-duty resources	Ops Center assets (On-Duty and Call Out)	Zone Assets	Multiple assets from outside zone or region
Financial	Normal charging	Charge Codes may be enacted for minor assets	Special Charge Codes; Storm Purchasing; MED	Charge Codes required; Storm Purchasing; MED
DCC Support	DCC to Field tech on-site	DCC to Area/Site Incident Command	DCC to Zone & Site Incident Command	DCC to Region, Zone, & Site Incident Commands
In Charge (Incident Commander)	Field Tech	Area/Site Incident Commander	Zone Incident Commander	Region Incident Commander

The Companies' liaisons from the Incident Management Team serve as points of contact for key external stakeholder groups before, during and after a major storm event. These groups include but are not limited to public officials, Governor's office, State and County emergency management, State Emergency Operations Centers, Department of Transportation, law enforcement, National Guard/military support, hospitals and hospital administrators, and nursing

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home administrators. Liaisons communicate information such as estimated time of restoration, resource availability during restoration, impacts to local and state communities including approximate number of customers impacted, and flood protocol and restoration information as applicable. Liaisons also gather information from external stakeholders to share with internal teams, especially any shifts in restoration prioritizations regarding critical facilities impacted during the storm.

Outside of those emergency response activities, the Companies are improving the grid to enhance resilience. The Companies' SC Grid Improvement Plan was developed through a comprehensive analysis of the trends affecting our business in the state and the tools to best address those trends in a cost-effective and timely manner. The Targeted Undergrounding program and Fuse Replacement project within the Distribution Automation program of the Grid Improvement Plan provide resilience against weather and other natural events. The Self-Optimizing Grid program helps customers save money in avoided outage costs; allows more distributed energy resources (such as solar) to be on the grid; and provides containment and mitigation of outages by reducing thousands of impacted customers in an outage down to hundreds or less. Through December 31, 2020, the Companies avoided 30.7 million customer minutes of interruption due to self-healing network operations in South Carolina. In 2020, during Tropical Storm Zeta alone, 1,927,300 customer minutes of interruption were avoided due Self Optimizing Grid network operations. That provides a clear-cut example of resilience benefits that helps the Companies during emergencies.

On the generation side, the Business Continuity Plan developed for each non-nuclear generating facility provides guidance in a staged manner as impacts from a disruption increase. The onsite staff and work focus at the plant shifts in several stages from normal operations including all supporting work to only sequestered operations staff operating the facility and responding to emergent issues. The plans identify the required supplies and materials to maintain non-nuclear generation and how they will be delivered. For extreme cases, the plans contain how essential operations staff will be sequestered, what supplies will be needed, and how they will be acquired.

Also, all hydroelectric stations and regulated solar sites are monitored and controlled from the Regulated Renewables Operations Center ("RROC") in Charlotte, NC. A completely redundant backup location for the RROC is setup at an alternate location should the main location become inoperable for any reason. An RROC Business Continuity Plan is in place to ensure timely transfer of controls and operations to the alternate location. Exercises are held periodically to practice staffing and operating the system from the alternate site.

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Emergency response plans have also been prepared for every station. These plans have been standardized to mimic Incident Command System standards allowing the Companies to work efficiently with outside agencies. The Companies' Non-Nuclear Generation organization typically has at least one full scale exercise a year at SC/NC generating station including external agency participation. Local, county, and sometimes state agencies are involved in planning, executing, and evaluating these drills. External agencies benefit from understanding our hazards and potential needs better and Duke benefits from the relationships developed. Recent joint field exercises conducted in the Carolinas include simulated anhydrous ammonia releases at Rogers Energy Complex (Rutherford and Cleveland Counties, North Carolina) in 2017. Participants included Rutherford EMS. Simulated anhydrous ammonia release at Belews Creek Station (Stokes County, North Carolina) in 2018. Participants included Belews Creek Fire, Stokes-Rockingham Fire and Rescue, Greensboro Fire, Greensboro Regional Hazmat, Pioneer Community Hospital of Stokes, and Stokes County Emergency Management. A flood event was simulated at WS Lee Station (Anderson County, South Carolina) in 2019. Participants and observers included South Carolina Department of Health and Environmental Control, South Carolina Highway Patrol, and Greenville County Emergency Management. These events successfully exercise the station Emergency Response Plans and joint response capabilities with public response agencies in realistic scenarios.

In order to quickly respond and provide external communications during natural flooding events or flooding associated with a dam failure, emergency action plans are in place for each of the Companies' hydroelectric stations. These plans include notification charts for state and county emergency management agencies for natural flooding events as well as dam failure events. Training sessions and tabletop exercises are performed annually in February. State and county emergency management agencies, National Weather Service, and other agencies attend these sessions. In addition to tabletop exercises for dam failure scenarios, exercises are also performed for flooding (high water) events.

The Companies' dam safety experts are requested occasionally to present during South Carolina Emergency Management Division's staff training sessions. The most recent presentation occurred March 16, 2021. Megan Wood, SCEMD Dam Safety and Flood Response Program Manager, is the main contact.

For the nuclear generation fleet, weather-induced service disruptions are uncommon and of small magnitude due to the robust design of the nuclear plants. There are procedural restrictions on the operation of the nuclear facilities should extreme weather be projected to directly impact the site. If a tornado or hurricane takes a track which will put it near or inside the plant boundary, conditions

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may dictate a controlled shutdown of the plant prior to the extreme weather arriving. After the weather has left the area, the plant restarts and provides power back to the grid.

In the event of a major storm impacting transmission service, Transmission has organized its major storm response organization by adopting the general Incident Command System used nationally for federal emergency response to national events, creating a simple and stable line of communication and event direction. In addition, this Incident Command System form and function allows Duke Energy to clearly communicate to other utilities and emergency response agencies at the time of an event per the storm plan. The objective of the storm plan is to establish a consistent approach and level of responsibility for each emergency response event. The storm plan provides the authority and coordination needed to restore electric service and maintain business continuity from emergency storm events. It consolidates authority to a System Level "top down" organizational structure for major storm responses and organizational structure for minor storm events.

Additionally, the storm plan relies on previously established agreements and relationships with industry peers and organizations that provide support during extreme weather and other events. Mutual Assistance groups are a consortium of investor-owned electric companies pulled together to effectively and collaboratively share electric restoration resources as needed to respond to significant outage events. Agreements are in place throughout the industry and provide for equipment, peer company and contract resource sharing and other forms of assistance to help with restoration from the impacts of extreme weather events. Duke Energy's mutual aid agreements are for storm or event outage restoration only. The length of stay by responding DEC and DEP personnel will be mutually agreed to by both companies. Generally, this period should not exceed 14 consecutive days, including travel time to the work area and return to the point of origin.

The Companies' Transmission group has developed emergency plans to maintain system stability and continuity of service during periods of severe capacity shortages caused by unscheduled outages of generating units, fuel shortages, equipment failures, unit startup delays, or Transmission system limitations. While it is generally recognized that capacity shortages are most probable during the heavily loaded summer and winter seasons, capacity shortages may occur at any time during the year. The ability of the system to remain intact and stable during these shortages may depend on quick and coordinated actions to reduce system demand.

2. Black Start system plans

Black Start plans are system restoration plans designated units to rebuild the system following a system-wide disturbance that results in parts or all experiencing a complete loss of power. The

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Companies will activate their respective black-start system restoration plans in these situations. In the instance where the disturbance causes portions or the entire system to be in a blacked-out state, there are several actions that will take place to restore the integrity of the power grid. The first priority will be starting our black start units or utilizing power from our neighbors and creating a transmission path for these resources to provide offsite power to our Nuclear Fleet to ensure they can remain safely shutdown. The next priority is getting power to other non-nuclear generation resources and to the Energy Control Centers. Finally, additional load and non-nuclear generation is added as the restoration effort continues to rebuild the transmission system and restore connectivity to the Interconnection.

3. Supply chain interruption plans

Duke Energy's Supply Chain organization relies upon a multifaceted approach and strategy when preparing for and responding to anticipated (and unanticipated) service disruptions. Strategic partnerships have been developed with critical suppliers to help ensure the availability of materials during storms and other service disruptions, while alternative supplier strategies are in place to obtain materials and reduce the reliance on any specific supplier (or region). The Companies also actively monitor and assess risks associated with their critical suppliers in efforts to reduce and mitigate risk exposure to the Companies and their customers.

Alliance contracts with strategic suppliers provide requirements for suppliers to stock manufactured at-risk storm related materials at their facilities which are available to ship to desired locations once notified and arrive within 24 to 48 hours of notification. Utility distributors also provide emergency material support as required. Multiple supplier strategies are in place for like materials to provide alternative supply options and contingencies if any one supplier (or supplier location) is incapacitated by a storm path. Additionally, Duke Energy has alliance contracts with strategic labor providers for line construction, vegetation management, engineering, storm assessments, outage support, etc. that provide prompt labor and materials support to the Companies.

Duke Energy's Supply Chain organization has developed and maintains a list of critical suppliers and vendors who support each respective business unit. Critical suppliers can be identified as a supplier who, if unable to execute, affects business continuity significantly, performs mission critical work, or has limited suppliers available as replacements. The critical supplier list is reviewed and updated annually, and each supplier is assessed based on default, financial, performance, and reputational risk exposure.

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Duke Energy is a part of several mutual assistance groups in which resources, equipment and information are shared across other utilities.

Along with the above mutual assistance programs, Duke Energy's Supply Chain teams work closely with local municipalities and electric cooperatives helping each other with materials and supplies needed for recovery after storm events.

The Companies utilize a sizeable list of local and diverse suppliers in South Carolina. These local and diverse supplier relationships are established through Duke Energy's Corporate Responsibility programs facilitated by the Supply Chain department. Local suppliers provide great flexibility during storm events and are valued partnerships that provide economic development opportunities for South Carolina.

Duke Energy has a largescale Integrated Supply Program with a national and worldwide distributor for the electric industry. By utilizing this Integrated Supply Program, Duke Energy has access to the distributor's inventories across the country, and Integrated Supply Program buyers can search and procure materials for Duke Energy. During the initial stages of the COVID-19 pandemic, Duke Energy utilized this relationship to acquire out of stock Personal Protective Equipment ("PPE") items for our employees so that service could be maintained for our customers.

During emergency recovery events, the Companies' Supply Chain teams work closely with the Duke Energy Government Affairs Office to obtain transportation waivers for Duke Energy's transportation trucks and shipments from our suppliers. This collaboration between Duke and local State Department of Transportation departments helps to ensure that shipments of materials are not delayed due to permitting issues.

4. Vegetation management program

The Vegetation Management program proactively maintains rights-of-way via tree trimming and removal and includes removing off right-of-way danger trees that present threats to transmission circuits. All transmission circuits are inspected via aerial flight patrols twice per year to look for threats to the system, and critical issues are promptly addressed. The ongoing work to protect the transmission system from weather events helps to limit the impact to customers. When storms or significant weather events are forecast, system work is halted. Lines and substations where work is being performed are restored as available to reduce potential for customer impact. Transmission conducts pre-storm aerial patrols to identify line conditions and potential threats.

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Vegetation management is integrated into the Companies' Incident Command Structure response as well as the Logistics Support Structure. The damage forecasting tools include models for vegetation management resources required and the Logistics team within the ICS structure fills resource gaps while also preparing for contingency scenarios leveraging mutual aid and contractor relationships to secure resources. At conclusion of abnormal weather events, the Companies conduct targeted sweeps to identify and address vegetation related opportunities (hanging limbs, leaning or damaged trees) that weren't essential to initial restoration, but are critical to preparing the grid for the next potential event. Additionally, the Companies' Vegetation Management team monitors the industry's vegetation-related hardening programs and leverages organizational benchmarking to stay abreast of threats that are impacting the grid such as disease and insect infestations. Setting internal targets to accomplish a high percentage of the annual vegetation management work plan before the onset of the Carolinas' storm season prepares the Companies to recover more quickly from service disruptions.

5. Bulk electric system plans

Duke Energy has plans in place for mitigating the risks as well as responding to events related to Bulk Electric System events. These include loss of imported purchased power, the underperformance of purchased on system generation and managing the limits to operational control of facilities.

The Eastern Interconnection (a major connected power grid comprised of multiple utilities and operating areas covering the eastern half of North America) allows utilities to import power from other utilities. The ability to import power can be impacted due to transmission constraints or nuclear/non-nuclear generation outages. These constraints and outages change the physics of the system and can cause the potential for overloading. Utilities preemptively analyze these conditions and may reduce the ability of the system to export or import power to keep from the possibility of the overloads occurring, thus preventing more detrimental impacts to the system. The limiting of imports/exports can pose a risk to the system when capacity is needed by a utility.

Periodic risk assessments of transmission stations and substations are performed to identify any of those stations or substations that if rendered inoperable or damaged could result in instability, uncontrolled separation, or cascading within an interconnection. An unaffiliated third party verifies the risk assessment. For a station or substation identified in the risk assessment an evaluation of potential threats and vulnerabilities to physical attack is performed and a physical security plan is developed and implemented.

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If long-term purchases of on-system generation (e.g., Anson Plant, Broad River Plant, etc.) fail to perform during extreme events (e.g., forced outages), the Companies will seek replacement capacity and/or energy through near-term purchases. If near-term purchases are not available, then the Companies will utilize pre-determined load reduction plans to balance resources and demand and ensure NERC Reliability Standard compliance. Additionally, the Eastern Interconnection allows the ability for utilities to import power from other utilities. While system protection is critical and can limit the amount of import capacity, Duke Energy has agreements in place for emergency imports and participates in reserve sharing agreements when system constraints can accommodate the need for additional off-system imports.

6. Fuel supply interruption and cost management plans

With increasing amounts of solar and battery storage planned for the Companies' systems, it will be vital for maintaining reliability, that the Companies have sufficient firm, dispatchable resources with capability for sustained high capacity factors needed to ensure the Companies are able to charge battery storage should customer demand be sustained at a high level for a multi-day period. Battery storage under fixed price PPAs may not be operated in manner that is most beneficial to ensuring reliability with meeting peak customer demands. If the battery storage is under system operator control, the system operator will optimize the charging and discharging cycles of battery storage to ensure reliable system operations. The Companies attempt to manage variability of non-firm resources by providing adequate dispatchable non-nuclear generation reserves that can operate on short notice as variable resource output declines.

An extreme cold weather scenario could be like that of a gas supply service disruption. Typically, fuel oil is a backup source of fuel for short-term peaking needs during normal system and load conditions. With respect to the question of how the Companies can (or do) hedge against utilizing higher cost fuel oil during peak periods, the Companies primarily burn fuel oil when it is more economic than burning gas, e.g., for the Texas Blackout, during the week of February 11-20, 2021 the Companies burned 2.2 million gallons of fuel oil in place of higher spot price natural gas. Given the geographic locations of its non-nuclear generating stations, DEP maintains off-site oil inventories from which inventories are pulled from as needed, providing a hedge against increasing fuel oil prices. The Companies also contract for natural gas inventory storage allowing the Companies to withdraw natural gas during periods of high demand which minimizes customer exposure to higher natural gas costs during an extreme cold weather event or supply disruption.

The Companies also use the purchases from the power market to support system load demands when economic or if needed for reliability. The power market can be utilized to displace coal or gas dispatches for economics, when inventory is low or flexibility on the pipelines is constrained,

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as well as managing fuel price volatility. The power market is very liquid and can be used to supply megawatts on a 24-hour basis utilizing various products over various time horizons.

Two examples where the power purchases were used to reduce customer costs and off-set fuel supply disruption caused by weather are outlined below.

- As an example of coordination between the power desk and fuels on a cold day was on February 18th, 2015 when delivered Transco Zone 5 (Z5) gas traded $38.65 per MMBtu. The gas desk coordinated with the power desk to avoid purchasing higher priced natural gas as the power desk was able to purchase power from the market at lower prices than self-generation. On this day, approximately 29,800 Megawatt hours (MWH) were purchased. For gas day February 20th, natural gas traded for $19.10 per MMBtu for delivered Transco Z5. As part of the active integrated management of the fuel and power portfolios, the gas and power desk coordinated, and the gas desk again avoided buying higher price gas for self-generation and the power desk purchased over 16,700 MWH realizing substantial savings for the customer.
- An example of collaboration between the power desk and the coal origination group occurred during the summer of 2017. Inventory levels became a concern at Cliffside Station as a result of higher than anticipated burns driven by warmer than projected temperatures. This situation was compounded by a coal unloading stacker failure in late August. Through coordination with the coal origination group the power desk facilitated keeping Cliffside 5 and 6 at minimum load until coal inventories could be replenished to target levels in mid-September.

While the power purchase examples cited above demonstrate situations where purchased power reduced costs to customers, there are also times when purchases are leveraged for reliability or to reduce future customer risk.

When service disruptions occur from fuel supply threats to utility service, the Companies leverage their diverse resources include enterprise resources as available and structured plans to support reliable, affordable service to South Carolina customers in an efficient, systematic manner. Balancing cost and reliability for customers during normal times and in extreme weather conditions requires effective use of power market. When cold winter weather causes gas prices to escalate, additional purchased power often presents a more cost effective and equally reliable alternative to power generation at elevated fuel prices. For example, during the extreme sustained cold weather the area encountered in January 2018, power purchases totaling 138,700 MWhs were cost effective for customers at $194/MWh as additional gas CT generation would have caused an

approximate average cost of $450/MWh. This purchase also aided fuel oil inventory management by avoiding depleting the oil inventory which would have disabled 2,400MW oil CT capacity with an additional cold front forecast another week out.

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CHAPTER 6: IDENTIFICATION OF OTHER FEDERAL AND STATE RELIABILITY REQUIREMENTS

Order Item 6: Other federal, state and/or local reliability and resilience requirements including, but not limited to, joint reliability plans or assessments, coordinating agreements, and wholesale purchase agreements.

Overview

The Companies comply with a number of federal, state and local regulatory reliability and resilience requirements. These requirements impact operations in DEC and DEP nuclear/non-nuclear generation, transmission, and security organizations. Compliance with these requirements further support reliable utility service for South Carolina customers.

In this section the Companies have provided a brief summary of the additional federal, state and/or local reliability and resilience requirements that govern operations across the Companies.

Additional federal, state and/or local reliability and resilience requirements are listed for the following segments of Duke Energy:

1. Nuclear/Non-Nuclear Generation;
2. Transmission; and
3. Security.

Detailed Narrative

1. Nuclear/Non-Nuclear Generation

The Companies' nuclear/non-nuclear generation stations comply with a multitude of standards enacted by state and federal regulators and/or legislatures as well as federal and state agencies. Nuclear/non-nuclear generating stations comply with dozens of U.S. Nuclear Regulatory Commission, FERC and NERC standards. Operating permits are normally issued by the state the generating facility is located in and are categorized into air permits (Title V) and water permits under the National Pollutant Discharge Elimination System. The Companies also prepare and submit compliance plans for regulatory requirements. Of course, the Companies' work is reviewed or otherwise conducted based upon rules and regulations issued by or approved by the Public Service Commission of South Carolina and the North Carolina Utility Commission, and cost recovery established by same.

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The nuclear industry has a unique infrastructure that provides oversight of safety and reliability requirements at the federal level through the Nuclear Regulatory Commission and other government agencies. The Nuclear Regulatory Commission specifically focusses on key plant components, systems, and programs that have the potential to impact plant reliability and resilience through activities such as inspections and interactions with the Nuclear Regulatory Commission Senior Resident Inspector that is assigned to each nuclear site.

In addition to federally mandated requirements, the industry also participates in the Institute of Nuclear Power Operations, whose mission is to promote the highest levels of safety and reliability in support of operational excellence at all nuclear generating facilities. The Institute of Nuclear Power Operations has a defined strategy using formal industry performance objectives and criteria. This includes formal plant evaluations on a two-year frequency and accreditation of formal training programs. DEC and DEP sites have a history of exemplary ratings from these evaluations. The sum force of this oversight structure provides a high level of accountability toward operational excellence for the Companies in sustaining the highest levels of safety and optimized reliability.

DEC and DEP nuclear/non-nuclear generation complies with all NERC Reliability Standards pertaining to the generator owner and/or generator operator registrations. These requirements ensure that the Companies are properly maintaining and protecting their critical assets for reliable operations.

The North Carolina Utility Commission requires all black start units be started annually to verify unit operability. Non-nuclear generation has implemented a more robust verification to cold start test unit ability during cold temperatures (<35deg F) annually. This initiative ensures better reliability for grid restoration efforts.

All dams associated with the Companies' hydroelectric stations are regulated by the FERC's Division of Dam Safety and Inspections. The Companies have a robust dam safety program to monitor and maintain dams and to ensure they are safe. The dam safety program is structured to meet or exceed all federal requirements. All elements of the Companies' dam safety program are reviewed by the FERC.

The National Pollutant Discharge Elimination System permits are issued by the States on behalf of United States' Environmental Protection Agency and provide limits on what a non-nuclear generating facility can discharge, provide monitoring and reporting requirements, and other provisions to ensure that the discharge does not impact water quality or the public's health. Steam generating stations (coal, combined cycle, and oil-fired steam generation) require a source of

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cooling water for condenser operation. Many sites are permitted to withdraw water from the local waterbody for the purpose of condensation cooling and then return the water back to its source. Each of these stations have a National Pollutant Discharge Elimination System permit that regulates the maximum average temperature that can be discharged by the facility.

During periods of extreme heat, these water bodies increase in temperature which decreases the amount of heat that can be absorbed during the condensation process without exceeding the permitted discharge temperature limit. This requires the coal or natural gas generating station to reduce the thermal load of the condenser which also reduces net unit production.

When sustained hot weather is coupled with drought, the effects are compounded as less cool water is flowing through the waterbody, reducing the rate that the warmer water is replaced by cooler inflow. Further, these conditions often result in decreased lake levels. If sustained droughts were to occur, lake levels could fall below the intake of facilities forcing them into an outage as result of insufficient makeup water for steam production and/or makeup to cooling towers.

2. Transmission

The Transmission organization complies with over 150 applicable Operations & Planning and Critical Infrastructure Protection standards issued and enforced by NERC as well as integrated resource planning standards for South Carolina. Transmission is responsible under NERC Reliability Standards to act as the Balancing Authority. The Balancing Authority has responsibility to maintain nuclear/non-nuclear generation and load within specific boundaries. It also controls interconnection frequency within defined limits. And is responsible for ensuring that it has sufficient capability to respond to frequency deviations to maintain interconnection frequency within those predefined bounds.

The Companies' transmission systems are planned to meet NERC Reliability Standards such as Transmission Planning ("TPL"). NERC Standard TPL-001-4 requires an annual assessment of the Transmission systems against established performance requirements for the planning horizon which is typically 10 years. The TPL standard also requires that Duke Energy coordinate contingency information to identify any potential issues that might be caused by a contingency from outside of the system and to share assessment results with neighboring utilities. The annual assessment results in a corrective action plan that identifies projects to upgrade existing equipment, construct new projects and/or develop operational procedures to resolve identified transmission issues. These performance requirements are intended to ensure the BES will operate reliably over a broad range of system conditions and a range of probable contingencies. A reliable transmission

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network must be capable of moving power throughout the system without exceeding voltage, thermal and stability limits, during both normal and contingency conditions.

The Companies perform an annual assessment of the transmission system at various load conditions; Summer Peak, Winter Peak and Spring Valley for both near term (1-5 years) and long term (5-10 years) periods. These studies are based on a 50/50 load forecast. Models are updated to accurately to reflect the transmission system configuration and network for that period. Long-term firm transactions are modeled between balancing authority areas and reserve sharing requirements are considered in the appropriate power flow simulations. Modeling of these transactions is consistent with contractual obligations.

Annual studies are then performed for normal and contingency conditions in accordance with the NERC Reliability Standard TPL-001-4. Thermal, voltage and stability limits should not be violated or exceeded for normal operation or under contingent conditions such as: single transmission circuit, single transformer, single generating unit, single reactive power source, or sink. In addition, higher level contingencies such as combinations of generating units, transmission circuits, transformers, and capacitor banks, as well as bus or breaker faults and faults with protection system failures, are evaluated.

Transmission under NERC Reliability Standards, acting as a Transmission Operator and/or Balancing Authority, has developed Operating Plan(s) to mitigate operating Emergencies, and that those plans are coordinated within a Reliability Coordinator Area. These plans must address power generation capacity shortages, ability to perform load shed, potential fuel shortages, underfrequency load shedding plans, and black start restoration plans. These plans are reviewed annually by Transmission.

NERC Protection & Control ("PRC") standards also support transmission reliability and resiliency. NERC Standard PRC-004 (Protection System Misoperation Identification and Correction) requires protection system mis-operations be identified and corrected, including review of extent of condition for related relay scheme vulnerabilities where it is prudent to implement corrective actions. NERC Standard PRC-005 (Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance) requires maintenance and testing plans be in place for BES protection systems in order to proactively validate the ability of composite protections systems to promptly isolate system faults and carry out their design functions. PRC-023, PRC-024, and PRC-027 all establish design criteria for BES relays to ensure the transmission grid and transmission to nuclear/non-nuclear generation interface all operate reliably and consistently under diverse operation conditions. The Companies have robust processes in place

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to ensure compliance to all PRC standards, including detailed procedures, personnel training, and periodic auditing.

The Companies also have mature IRP processes that include planning reserve margin analysis (Resource Adequacy Study) that considers reliability risks and economics associated with ensuring planning for adequate resources for meeting a one day in 10-year Loss of Load Expectation metric based on load forecasts and weather sensitivities including climate change sensitives. The one day in 10 years threshold is set by state planning guidance. Effective Load Carrying Capabilities for evolving resources (e.g., wind, and solar plus storage) are utilized in the IRP process in order to ensure resource adequacy from these evolving resource types. Transmission Planning includes generators in their study models that have executed Interconnection Agreements. The reliability of those generator interconnections is studied and planned for in separate Interconnection Studies. In addition, any long-term firm purchase commitments are studied and planned through the Transmission Service Request process.

3. Security

The electric, nuclear power, hydro power and natural gas sectors adhere to mandatory regulations as well as enforceable security standards and voluntary guidelines. These regulations, standards, and guidelines cover a range of physical and cyber security.

One of the key requirements that impacts many of the business units are the NERC Critical Infrastructure Protection ("CIP") requirements. Duke Energy has a formal program, CIP Program Management, an enterprise level team that owns, creates and maintains policy that sets expectations for sustainable security management controls and establishes responsibility and accountability to protect the Bulk Electric System. CIP Program Management ensures alignment and consistent implementation of enterprise processes and procedures to comply with NERC CIP standards across Duke Energy.

Additionally, with the Companies' having a range of energy infrastructure, there are a number of regulations, standards, and guidelines spanning the business. One example for the nuclear business unit is 10CFR73.54, *Protection of Digital Computer and Communication Systems and Networks*, regulated by the Nuclear Regulatory Commission. 10CFR73.54 directs those licensees subject to the requirements to "provide high assurance that digital computer and communication systems and networks are adequately protected against cyber-attacks, up to and including the design basis threat (DBT)."

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The DBT concept as defined by the NRC is "a profile of the type, composition, and capabilities of an adversary." Both the cyber and physical nuclear security teams use DBT as a basis to safeguard systems and protect against radiological sabotage. The physical protection plan must be designed to prevent significant core damage and spent fuel sabotage; therefore, ensure that the capabilities to detect, assess, interdict and neutralize threats up to and including the design basis threat of radiological sabotage at all times.

Additionally, the FERC has a requirement for the Companies to complete the Annual Security Compliance Certification. This certification must be completed by December 31 of each year and includes a Physical Security Checklist as well as a Cyber Asset Designation Worksheet.

Lastly, relative to Duke Energy's natural gas business, adherence to the Chemical Facility Anti-Terrorism Standards is required for certain high-risk chemical facilities that possess chemicals called Chemicals of Interest at concentrations. This program is regulated by the Department of Homeland Security ("DHS"), Cybersecurity and Infrastructure Security Agency ("CISA"). The natural gas business, through voluntary public-private partnership, consistently engages with DHS' Transportation Security Administration ("TSA") and has leveraged the opportunity for both the Corporate Security Reviews ("CSR") as well as the Validated Architecture Design Review ("VADR"). The CSR process allows for consistent engagement with partners from TSA, and the VADR, a newer review available to industry, continues the partnership with TSA as well as with partners from DHS and CISA.

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CHAPTER 7: ASSESSMENT OF CURRENT UTILITY PROCESSES AND SYSTEMS TO WITHSTAND POTENTIAL ICE STORMS AND OTHER WINTER WEATHER CONDITIONS

Order Item 7: Identification and exercises of utility plans, processes, and infrastructure to determine if current utility preparedness plans to ensure utility service meet peak customer demand under extreme scenarios. Identify areas for improvement and steps taken to address the areas of improvement.

Overview

Winter storms pose a particular threat to the Companies' operations and can challenge the ability to provide reliable power to South Carolina customers. To mitigate this threat to service, DEC and DEP engage in winter storm preparation and readiness activities and leverages formal processes to ensure reliable service to South Carolina customers during winter weather conditions.

In this section the Companies have provided an overview of winter preparation and readiness activities and the formal processes leveraged to provide reliable service to South Carolina. Because of the regulated structure in South Carolina, the Companies are well positioned to effectively meet their obligations to provide service to customers in their service territories and to leverage the integrated nature of operations to coordinate activities across multiple functions to effectively meet such obligations. The current regulatory paradigm has multiple touchpoints and processes that are crucial in the Companies' reliability and resiliency in facing the types of threats discussed in this response. This structure established by South Carolina statutes and regulations provides for single point accountability and ongoing regulatory oversight to ensure both customer affordability and service reliability and helps to guard against the distributed performance concerns exacerbated in the Texas Blackout.

Duke Energy's plans, processes and infrastructures to ensure utility service meets peak customer demands under extreme winter weather includes:

1. Winter weather preparations;
2. Storm response plans; and
3. Formal winter weather management processes.

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Detailed Narrative

1. Winter weather preparations

Integrated seasonal utility planning

To meet their obligation to customers and the Commissions in North and South Carolina, the Companies perform bi-annual preparedness reviews for operational functions prior to the summer and winter seasons. This review includes coordination between meteorology, operational departments, customer services, and communications and is used to evaluate and assess the necessary actions which should be completed before the summer and winter seasons. These reviews provide coordination with operational functions to ensure departments are prepared for severe weather conditions. The review includes a seasonal weather forecast, load expectations, allows for identification of operational concerns such as assessment of generation availability and weatherization plans, communication protocols between organization and the public, transmission and distribution maintenance, and other operational concerns prior to entering the summer and winter weather seasons. Further facilitating a culture of readiness, the Companies have included "super-peak" case studies of extreme load conditions as part of the integrated seasonal preparedness reviews.

Generation

The Companies' non-nuclear generating stations are designed to operate based on historical ambient temperatures for the location in which they are constructed/installed. The technologies and equipment installed by the Companies are capable of operating in freezing conditions and any systems or equipment located outdoors are generally supplied with insulation and/or heat tracing. The key is proper design and maintenance of the equipment.

New plants have been designed with ambient temperatures representing the lowest recorded temperatures in the area. As an example, DEP developed the design criteria document that was used to bid the work at Asheville generation plan. The low design temperature (-16F) is consistent with the lowest recorded temperature in the Asheville area in recent history (e.g., last 20-40 years).

Newer stations have specific temperature ranges identified in their originating bid specifications and design criteria. In issuing request for proposals for new generation, the Companies also specifically call out freeze protection requirements, as shown below:

- Mechanical Design Criteria: "Freeze protection shall include insulation with, or without, heat tracing. Design conditions for freeze protection are tabulated in the Site Data" and

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- Electrical Design Criteria: "Heat Trace system shall comply with NERC Polar Vortex requirements."

The biggest winter storm risk to nuclear/non-nuclear generation is with ancillary equipment (e.g., instrumentation and compressed air systems) which have a higher propensity to freeze during severe cold weather. The Companies' fleet guidance and site-specific procedures call these systems out as areas to inspect prior to the winter season. Plant personnel typically conduct pre-winter season checks of heat tracing, insulation, and critical equipment to ensure they are functional for the cold weather. Similar checks are performed in advance of summer and hurricane seasons to ensure that insulation, rain protection, and air conditioning systems are in good working order.

The Companies' nuclear fleet implemented a fleet-level procedure titled Seasonal Readiness to be used in conjunction with site-specific seasonal readiness procedures to prepare the nuclear fleet for reliable operation during the summer and winter periods. Site-specific procedures include details particular to each site for ensuring appropriate actions are taken in preparation for winter and summer periods. These documents are updated regularly to account for Operating Experience that can be used to improve future performance. Any equipment deficiencies (e.g., missing insulation or heat trace that doesn't work) are quickly addressed when identified.

The DEC and DEP nuclear fleet has a procedure in place to establish readiness for hot and cold weather preparation at each site. This fleet procedure establishes a consistently high standard for operational readiness prior to each weather season. Each site has a series of actions for its operators and technicians to perform with the goal of ensuring the site is ready to handle the upcoming weather conditions. Reports are available which contain the inventory of weather-related items and to effectively manage the workload. Completed preventive maintenance checks on heat trace and ventilation systems help develop repair plans, as needed. The leadership team tracks these items, prioritizes them, and documents them on the extended leadership update call held every Friday.

If a plant experiences specific issues during cold weather operations, the lessons learned are captured in a tracking program and adjustments made to the procedures to prepare for the next season of cold weather. In addition, other nuclear facilities share their lessons learned across the industry when they experience weather-related events requiring a reduction from peak power or have significant consequences.

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The nuclear fleet weather readiness process discussed above ensures a methodical checkout of various components such as heat trace systems, construction of temporary enclosures, cooling systems, outdoor insulation, and other weather-related items. The site updates these checklists dependent on lessons learned from season to season and to capture any industry-related operating experience.

Each site also has abnormal and emergency operating procedures to address response to extreme weather conditions. Usually based on a specific set of environmental conditions (e.g., rain accumulation, projected ice buildup, exterior temperature, wind speed, etc.), various actions are taken to harden the plant against the projected weather. Actions vary from increased monitoring to reconfiguration of plant systems based on the projected weather. Use of these abnormal and emergency procedures is flexible and applied to respond to extreme weather situations.

Transmission

Transmission performs annual training with System Operators, Incident Commanders and support staff to simulate various events on the BES. The BES is Transmission elements or devices that are operated at 100 kV or higher on the electrical grid. System Operators in the Control Centers receive dedicated training on Load Shed processes and Black Start simulations. Black Start is the process of restoring the electric grid to operation without relying on the external electric power transmission network to recover from a total or partial shutdown. These operators have available restoration plans that utilize black start designated units to rebuild the system in the unusual event a partial or complete power system blackout occurred. Working with Generation, Transmission identifies the units that will be tested and used to perform Black Start restoration if needed. For storm preparedness, Incident Commanders and support staff perform yearly tabletop drills prior to the active storm season. If there is an active winter storm season, the summer storm drills may be canceled.

For transmission substations cold weather mitigation is provided for in design specifications for transformers and apparatus, therefore specific weatherization is not required. Protective relays are installed in environmentally controlled houses, and control house and substation equipment problems generate alarms so the operators monitoring the system can dispatch crews for immediate attention and response. Transmission's overall maintenance plan performs visual inspections and operational functions on a defined schedule set forth in the Transmission Maintenance Program Portfolio and Maintenance Interval Schedule. These items are a form of assessment and information gathering.

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Transmission manages and assesses operational assets through a diverse approach of inspection and maintenance programs to ensure the integrity of the grid and plan for end-of-life equipment needs. Transmission substation facilities are inspected numerous times throughout the year, depending on their level of remote monitoring in place. Substation visual inspections include looking for early signs of component degradation, overheating, abnormal operating conditions, and vandalism. Weather considerations for these inspections would include verifying cabinet heaters are operational for circuit breakers, transformers, and related equipment with sensitive instrumentation, as well as verifying HVAC systems for buildings/enclosures containing protective relays and battery systems, where installed and applicable. Deficiencies are addressed through the corrective maintenance program in a priority commensurate with the risk presented. The preventive maintenance program is also in place to proactively test, inspect, and refurbish major transmission components such as circuit breakers, transformers, and protection and control devices before they can mis-operate and introduce vulnerabilities onto the grid, and to ensure their operational readiness.

All transmission class circuits are inspected twice annually through the aerial patrol program, which consists of trained observers looking for significant threats to transmission conductors and structures from either vegetation, aging, external damage including lightning and wind, or collateral damage including public interference. Wood pole transmission circuits are inspected from ground walking patrols every four to six years depending on the geographical conditions. Inspections are to identify groundline rot and other structural deficiencies, but also provide an opportunity to inspect insulators and hardware. Transmission towers are also inspected on a periodic basis to identify structural deficiencies and other defects requiring repair/replacement.

2. Storm response plans

When it comes to preparing for ice storms and other winter weather events, the Companies' utilize an emergency response plan detailed in Chapters 2 and 5. The emergency response plan involves drills for winter weather events and activation of the Incident Command System during real events to ensure that the Companies have a scalable event response structure, well-defined roles and responsibilities, and appropriate resource acquisition and staging to manage the event. The Incident Management Team has liaisons who partner with key external stakeholder groups before, during and after a major storm event. These groups include but are not limited to public officials, Governor's office, State and County emergency management, State Emergency Operations Centers, Department of Transportation, law enforcement, National Guard/military support, hospitals and hospital administrators, and nursing home administrators.

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3. Formal winter weather management processes

Load and demand-side management

The Companies maintain an annually updated load reduction plan for use during a system emergency when reduction of load is required to stabilize the electric grid. In the context of winter weather, that would be due to extreme cold that causes customer load to increase to heat their premises. If needed, feeder rotation (rolling blackouts) would be implemented based on a feeder prioritization list that is updated annually by planning engineers. The amount of load relief needed at the system level will determine whether distribution feeder rotation can be utilized or if transmission will need to reduce load by curtailment. Either of these plans can be activated very quickly and only a short notice is required to implement. The rotation plan would be the preferred plan since it allows system operators to be more discriminating among the classification of circuits.

During times of extreme winter weather, the Companies also consider demand side management tools such as the EnergyWise® program and voltage regulation via load voltage management to reduce load on the system. All of these tools are at the discretion of the Transmission Energy Control Center system operator. The plan considers that many of the circuits will need to be restored in sections due to extreme cold conditions and long outage times. After load has reduced on the circuit, then the next major sectionalized device on the circuit backbone can be restored.

Grid Improvement Plan components

It is important to note in considering reliability and resiliency in extreme winter weather that several SC Grid Improvement Plan programs prepare the Companies for ice storms and peak load during such an event. These programs include IVVC, Self-Optimizing Grid and Targeted Undergrounding as discussed in multiple sections of this response.

- IVVC capabilities enable a grid operator to lower voltage as a way of reducing peak demand (peak shaving), thereby reducing the need to generate or purchase additional power at peak prices or protecting the system from exceeding its load limitations. The current DEP Distribution System Demand Response program uses the peak shaving mode of IVVC to support emergency load reduction. DEC's IVVC program will offer peak shaving capabilities for emergency load conditions as well.
- Should an ice storm cause outages in South Carolina, the self-healing grid implemented in the Self-Optimizing Grid program would automatically reroute power around the trouble area to quickly restore power to the maximum number of customers and rapidly dispatch crews directly to the source of the outage as soon as the weather allows.

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- The Targeted Undergrounding program's conversion of overhead lines to underground in key areas will also decrease the number of lines available for ice accumulation to cause outages.

While winter storms pose a threat to utility service, the Companies leverage the formal preparedness and response plans, processes and infrastructures in place to limit utility service interruptions for South Carolina customers while constantly looking for opportunities to improve protections for customers.

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CHAPTER 8: IDENTIFICATION OF BEST PRACTICES, LESSONS LEARNED AND CHALLENGES TO UTILITY SERVICE

Order Item 8: Information related to reliability, lessons learned from similar experiences, and challenges of the provision of safe and reliable utility service under extreme weather conditions and other threats.

Overview

The Companies actively engage in the identification of best practices, lessons learned and learning from all challenges to utility service. Continuous improvement is a foundational element of Duke Energy's enterprise operational excellence culture and is critical to the Companies' success. Employees at the Companies excel at both internal learning across the diverse operations portfolio and external learning through industry engagement and leadership.

In this section, the Companies have provided an overview of the best practices, lessons learned and challenges to utility service. This overview is presented by operational group within Duke Energy.

Best practices, lessons learned and challenges to utility service are presented for the following operational areas:

1. Distribution;
2. Generation;
3. Transmission;
4. Fuels;
5. Supply Chain; and
6. Security.

Detailed Narrative

1. Distribution

The distribution business unit actively pursues lessons learned to not only improve the Companies' processes and procedures but also to ensure customers are receiving reliable service. Examples of internal processes serving this purpose are emergency response plans, analysis of industry events, weather modeling and the Long Duration Outage review process. Distribution also engages in benchmarking events with other utilities to share best practices.

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As previously mentioned, Distribution has implemented the Incident Command Structure Event Response Organization to rapidly and efficiently support a successful emergency response. The Incident Command Structure is the nationally accepted model for responding to incidents in accordance with the National Incident Management System and carries out the emergency response plan. The scalability of Distribution's emergency response plan provides response blueprints for all levels of events. As required in the emergency response plan, after action reviews are conducted after exercises/drills, major events such as hurricanes and ice storms, and as deemed appropriate to gain lessons learned to improve future response efforts. After action reviews are expected to be completed within 14 days of the event and items identified as opportunities are put into action plans with assigned owners and due dates. Any items identified applicable to other jurisdictions are shared across the enterprise as appropriate.

The Companies' customers in South Carolina benefit from the size and geographic diversity that is derived from having multiple geographic service areas. Having a significant utility presence in the Carolinas, Florida and the Midwest has allowed the Companies to respond quickly when South Carolina is threatened by severe weather, as the Companies can call upon employees and resources from the unimpacted regions. Both the Midwest and Florida regions have sent hundreds of resources multiple times in the last several years in response to significant weather events in the Carolinas. This internal ability to support restoration efforts augments resource requests made through the mutual assistance groups to which Duke Energy belongs. Having geographic diversity also allows for critical information and best practice sharing across a wide geographic area and multiple types of weather threats.

Distribution participates in multiple energy industry groups and associations including Edison Electric Institute ("EEI"), Electric Power Research Institute ("EPRI"), Southeastern Electric Exchange, and All Hazards Consortium. These forums allow the Companies to proactively address challenges that can impact emergency response as well as engage in discussions which shape policies and agreements that provide the governance framework for sharing of resources and equipment. The discussions involve development and application of new technologies and digital platforms to increase productivity and lower costs.

The partnerships created through industry group and association participation allow the Companies to establish benchmarking opportunities to share best practices and lessons learned. The engagements allow Distribution to target specific areas for improvement and learn how other electric utilities manage those areas. They also provide an opportunity for other electric utilities to learn from us. Benchmarking activities are conducted at least annually and have addressed a

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range of topics including Pandemic Response, Emergency Response Organization Structure, and Base Camps & Alternative Housing for storm response.

As an example of the Companies' continuous improvement and industry monitoring, the Companies have identified five lessons learned from the Texas Blackout that apply to the distribution organization. These are:

1. Review Critical Customer lists to ensure sites that meet the approved definition are listed, including a review of gas compressor, liquefied natural gas, and critical telecom facilities;
2. Review current procedures and drills for circuit rotation;
3. Review current procedures and drills for cold load pick up;
4. Review current design specifications for certain operating equipment on the Distribution system for cold weather parameters; and
5. Ensure critical distribution facilities with back-up generators use anti-gel additive for diesel fuel oil in preparation for extreme cold weather.

For the Companies' weather modeling process, incorporating best practices and lessons learned is crucial to pre-positioning resources and producing power restoration plans to minimize the amount of time customers are without power from major weather events. The prediction models are trained using data from previous weather events. Distribution uses an implementation of the Random Forest algorithm to build regression models which predict impacts by a given major weather event. The predictions are interpreted, formatted and sometimes edited by Duke Energy's Meteorology Department before being distributed for planning purposes.

The Companies' outage management system's outage and restoration data is uploaded into data analytics software to isolate the longest outages. Engineers review each outage for correct timestamp data, compare to advanced metering infrastructure records that indicate when customers' meters were re-energized, and validate off-on statistics. Additionally, the Companies review where protective devices operated to limit interruptions to ensure they are located in the right spots on the grid and understand how they are used to restore service incrementally during repairs. These learnings are shared with crews and patrol leaders that sometimes lead off-system crews that are here to support major events.

Finally, the Companies seek to continuously improve by learning from events, whether under normal "blue sky" or extreme weather conditions, through the targeted Outage Follow-Up process. The Outage Follow-Up examines root causes through forensic analysis and supports improvements in several ways:

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- It can act as means to identify underlying material or manufacturer defects, construction standards gaps, maintenance actions and/or new improvement programs;
- Development and improvement programs such as Declared Protection Zone, Transformer Retrofit, Long Duration/High Impact Outage Mitigation, Flood Mitigation, Fuse Replacement, and Targeted Undergrounding have arisen from Outage Follow-Up learnings; and
- Documented storm intensity escalation, down bursts and micro-bursts within a storm front, or increased damage due to climate intensity according to the National Oceanic and Atmospheric Administration could drive accelerated implementation of hardening programs like Targeted Undergrounding and design standard adjustments to account for storm and event intensity.

2. Generation

Non-nuclear generation

The Companies' non-nuclear generation fleet utilizes multiple sources for identifying Best Practices, Lessons Learned and Challenges. The North American Generation Forum ("NAGF") is one resource to access operational experience across the industry as it relates to generation reliability and NERC compliance. Operational Excellence is categorized by risk and actual impacts where the more significant items require corrective actions. In addition, other external resources include peer benchmarks, the Fossil Networking Group, and the EPRI. All these organizations and working groups promote continuous learning and performance improvement. All of Duke Energy's five generating jurisdictions share best practices. Finally, internal organizational structures like Review Boards and Working Teams ensure that performance gaps are identified and resolved.

The electric generation industry has numerous collaborative groups that share Operational Excellence to learn from past events in order to prevent future issues. Duke Energy routinely participates in and leads networking groups to share the Companies' experiences and learn from peer utilities. Examples include the Fossil Networking Group (which includes Dominion, Southern Company, Duke Energy and AEP), and other well-respected industry groups like NAGF and EPRI. NAGF is an industry resource to access Operational Excellence with a specific focus on NERC reliability standards compliance. The Companies regularly participate in many benchmarking activities. As leaders in the industry, representatives across Duke Energy's

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generating jurisdictions chair many programs. To name a few, Duke Energy currently chair EPRI's Unit Flexibility Program as well as Electric Utility Cost Group's Solar User's Group.

For every major generation-impacting event, man-made or natural disaster, these groups share root cause information and lessons learned. The Texas Blackout was no different and information was shared among peer utilities. In fact, Duke Energy conducted an enterprise-wide review of internal policies and protocols to ensure the vulnerabilities from the Texas Blackout had been addressed. Included in this review was a robust look across generation's roughly 100 stations with regards to severe weather-related NERC lessons learned, including:

- LL20110902 Adequate Maintenance and Inspection of Generator Freeze Protection;
- LL20110903 Generating Unit Temperature Design Parameters and Extreme Winter Conditions;
- LL20111001 Plant Instrument & Sensing Equipment Freezing Due to Heat Trace & Insulation Failures;
- LL20120101 Plant Onsite Material and Personnel Needed for a Winter Weather Event;
- LL20120102 Plant Operator Training to Prepare for a Winter Weather Event; and
- LL20120903 Winter Storm Inlet Air Duct Icing.

Generation Cybersecurity works directly with EPRI and the Fossil Networking Group in benchmarking exercises across the generation sector of the utility industry. In these sessions with industry peers the teams identify opportunities and lessons learned for the generation cyber security program. The team also participates in pilot activities to progress generation cybersecurity technologies and identify future opportunities to reduce the risks of cyber threats.

Operational Excellence sharing is done internally through a corrective action program whereby issues identified at one site are entered into the program and then evaluated for impact on other units. In addition, generation shares information with industry peers to compare performance differences and identify improvement opportunities.

Nuclear generation

Nuclear generation technology is a very unique way of generating electricity. This technology requires a detailed understanding with the end goal to generate safe, clean, life-sustaining electrical power. While the U.S. nuclear industry operates a variety of different reactor types and vintages, all utilities are part of a larger community joined together through INPO. INPO is the key resource for the nuclear industry and among other oversight programs, compiles lessons learned and

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Operating Experience for use by the entire industry. Categorization of Operating Experience by risk, significance, component, affected power, and many other criteria occurs to allow utilities to search for relevant operating experience. This open information sharing is different as compared to almost any other industry and makes the Duke Energy nuclear team and the entire nuclear industry stronger by the willingness to share experiences to prevent events.

Sharing nuclear Operating Experience is also done internally across the Companies' nuclear fleet, through the corrective action program. Issues identified at one site are entered into the program and selected for nuclear fleet Operating Experience depending on the potential applicability.

Innate to the culture of nuclear generation is the strong desire to learn and improve. Looking internally across the nuclear fleet can provide some comparative measure of performance differences and identify improvement opportunities. However, the real learnings occur when comparing to industry peers. There is a very healthy engagement between utilities who support each other for various benchmarking activities and assessments. Certain benchmarks and assessments require an industry peer to participate in order to satisfy the requirements of the assessment. In addition, leaders from the utilities also participate as an INPO member for a period of time to gain exposure to the industry. They will then return to their home plants and bring that experience back to share and continuously improve.

Weather-related examples

In the Carolinas, the Companies have demonstrated during the Polar Vortices of 2014 and 2015, as well as the extreme sustained cold weather the area encountered in January 2018, which included 7 consecutive days of significant high demand, that the Companies can meet the challenges that extreme weather events present. After each of these events, the Companies utilized lessons learned to continuously improve on preparation and response to extreme weather events. The Companies also utilized lessons learned from other utilities in the industry that have been challenged by extreme weather events, which provides additional best practices that the Companies adopt. For example, the Companies evaluated the NERC Lessons Learned from prior cold weather events.

The Companies have consistently been prepared for extreme weather and are always seeking to improve. Outlined below are examples of measures the Companies have instituted over decades of resilient operations.

- Cold weather guidance document: Non-Nuclear generation has a formal fleet-wide guidance document "Seasonal Preparation Guideline" (FHG-OPR-NA-GDLN-OP-0005)

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that identifies actions and responsibilities to prepare generation stations for both summer and winter seasons. Winter preparation activities include checking insulation and heat trace systems. Stations have also created site-specific procedures to document necessary actions unique to their plant.

- Stations have cold weather preparedness procedure/checklists to be used in the Fall: Generation has created a formal guidance document "Seasonal Preparation Guideline" (FHG-OPR-NA-GDLN-OP-0005) that identifies actions and responsibilities to prepare generation stations for both summer and winter seasons. Winter preparation activities include checking insulation and heat trace systems. Stations have also created site-specific procedures to document necessary actions unique to their plant.
- Stations have standard Preventive Maintenance associated with cold weather preparation entered into their Work Order system.
- For the Companies' mission critical nuclear/non-nuclear generating units, the Companies ensure that planned outages occur in the shoulder months (spring and fall) to be prepared for heavy runs to support the peak summer and winter loads.

In addition to all of the cold-weather preparation activities the Companies already have in place, as a constantly learning organization, the Companies' nuclear/non-nuclear generation fleet is instituting three additional cold-weather prep actions as a result of Texas Blackout lessons learned outlined below.

- Action 1: Ensure a Lessons Learned session is held at end of each peak season, winter/summer.
- Action 2: Ensure fuel oil operation is reliable on units with fuel oil as back-up fuel and pre-winter testing frequency is adequate to ensure reliability.
- Action 3: Identify vital off-site power supplies related to power generation and coordinate with Distribution to ensure they are on the critical load list. Consider support systems required for continued station operation, such as: municipal water supplies, gas compressor stations, etc.

The Companies are gaining learnings and Operational Experience from the unique operational challenges greater amounts of variable generation introduces. Solar and other variable generation that rely on the natural fuel sources of the sun and wind cannot be dispatched like traditional units. This requires redundant generation to be online and available to support variations in generation and load, particularly in extreme weather events. During extreme winter events, heating load remains high while solar generation may be reduced for a prolonged period of time due to cloud

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cover, snows and icing. In heat waves, solar drops significantly in the evening as the sun sets but demand for cooling remains high. The variability of solar and wind resources can necessitate dispatchable units to cycle on/off multiple times within a short period. The additional cycling increases required maintenance and decreases unit reliability of the dispatchable generation. The Companies have a robust Unit Flexibility program (which is a model in the industry) designed to assist Combined Cycle gas units enhance their operations that allow further CO2-free solar generation to the Companies' systems. The Companies, along with the broader industry, are closely reviewing both the Texas Blackout and California Blackout events in light of variable generation integration to learn as much possible about specific operational challenges of integrating increasing amounts of solar and wind in extreme weather situations as the Companies transition their generation portfolios.

Being vertically integrated utilities allows the Companies to coordinate planning and operations within distribution, transmission, generation, and fuels to ensure the Companies are prepared and able to meet the challenges of extreme weather events. In addition, the Companies maintain load reduction plans that can be implemented if generation resources are not sufficient to meet gross customer demand.

Other examples

The Companies' Generation organization works with Information Technology ("IT") Telecommunications on lessons learned from events impacting generation or where lessons learned in one jurisdiction can aid in lessons learned and mitigation in other jurisdictions. IT evaluates the strategic nature of the Duke Energy telecommunications network to enhance its capabilities systemwide across all jurisdictions. IT evaluates those lessons learned in a multi-layered approach - at the plant level, state level, and/or system level that increase reliability and reduce downtime. If a station is operating solely with remote control, the loss of telecommunications networks could mean no visibility into that particular plant side and on-site personnel would have to shift from remote operation to on-site operation.

Flooding issues have been realized on occasions at the Companies' hydro sites as well as some gas-fired sites located near substantial rivers with large upstream watersheds. Two examples are:

- HF Lee experienced substantial flooding over the years from the Neuse River in Goldsboro, NC; and
- Sutton station's administration building was subject to several feet of water and the unit experienced a bowed rotor on the turbine during Hurricane Matthew in 2017.

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Nuclear/non-nuclear generation integrate flooding considerations at generation sites as part of seasonal, hurricane, and storm preparation and planning processes.

The COVID-19 pandemic certainly provided many challenges. In order to have an orderly and safe working experience generating and delivering reliable energy to customers, the Companies quickly activated Emergency Management processes detailed in Chapters 2 and 5. Through early deployment of emergency Incident Management Teams and the corporate-wide Incident Support Team, Duke Energy established a structure to manage the rapidly changing environment of the 2020 COVID-19 Virus outbreak. This structure allowed for quick dissemination of information throughout the organization and a uniform, coordinated response to the known and future anticipated needs of nuclear/non-nuclear generating facilities. The rapid alignment to CDC guidelines helped to minimize the impact on the Companies' employees and contractors. The Companies kept front-line workers safe while successfully generating steady and reliable energy throughout the pandemic. Putting special COVID-19 safety protocols in place, the Companies completed the needed unit maintenance activities throughout the system to ensure South Carolina customers had reliable energy during the entirety of the pandemic period.

In addition to the Emergency Management processes activated during the pandemic, the Companies' non-nuclear generating stations deployed Pandemic Business Continuity Plans. The plan includes details for maintaining operations, critical supply deliveries, and sequestering operations personnel. The most valuable asset at the Companies' nuclear/non-nuclear generating facilities is operations staff. Ensuring the safety and well-being of essential employees is vital. The Plan prescribes escalating steps to ensure continued availability operations staff and the resources needed for continued non-nuclear generation. At the extreme end is a sequestration plan that details how a facility would house essential staff during critical situations.

3. Transmission

Duke Energy Transmission is actively engaged in internal and external lessons learned as well as utilizing strong internal Operating Experience processes. These activities allow Transmission consistent within Duke Energy to have a continuing learning and check and adjust culture.

With each region in Transmission using the Incident Command Structure, the Companies have been able to leverage processes that have been developed in one region and applied to others. A prime example is the effort that Duke Energy Florida has dedicated to their storm planning. Transmission has been taking these efforts and applied them to the other regions including South Carolina. For instance, South Carolina has updated their damage assessment process, deployment of crews through the system and their ability to share crews between other Duke Energy regions.

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The Companies have also been able to leverage Logistics Sections and been able to develop processes that will track employees as they move between regions during large storms to help in restoration. Transmission works closely with Distribution on securing and sharing base camps and staging sites as the Companies respond to storm events. Using the Distribution resource demand and potential outages based on the Meteorology models, Transmission can prepare for impact to the Companies' systems and deploy crews where impact may be greatest, especially during ice storms.

Duke Energy service areas cover a wide geographic range from Midwest areas (OH, KY, IN) to the Southeast (NC, SC) and the middle of Florida. As such, each region might be subjected to weather conditions that other regions are not challenged with (e.g., tornadoes, severe continuous hot or cold days, hurricanes, etc.). Due to strong internal Operating Experience programs and practices, however, severe and significant events occurring in one region are shared with other regions and even other Duke Energy business units to ensure best practices, lessons learned. Some Operating Experience programs are: Duke Energy Continuous Improvement Work Groups where events reports are shared across business units; Safety Alerts from Environmental Health and Safety; peer teams consisting of similar functional leaders across different regions, and Corrective Action Programs that emphasize preventing major events by learning from lower impacting events.

In addition to the internal method, the Companies rely upon uses external agencies such as North American Transmission Forum ("NATF") and EPRI to gain operating experiences and best practices. Duke personnel are active members different practices groups in the North American Transmission Forum (e.g., System Operations, Training, Engineering, etc.) which share operational standards and practices, reliability processes and programs, maintenance practices and programs, design standards and event analysis. The Companies participate in NATF assisted visits to other utilities which allow us to benchmark and see how others are operating and performing their work. The NATF performs analysis of major events that have occurred in the industry and shares lessons learned and best practices from these events with their members. The Transmission organization has worked with the NATF on evaluating criteria and developing a tool that will allow the Companies to evaluate their resiliency model maturity. Transmission individuals also participate on various EPRI projects to help build Duke's response to events that can impact the Companies' operations.

As a result of extreme weather internal lessons learned and those from industry trade groups, like the NATF, in the Duke Energy service territory or across the United States, the Companies work with these organizations and others to attempt to influence changes in various federal and state policies to ensure continued and future reliability and operability of the grid for these types of

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events. As discussed throughout these questions, the types of policy conversations at the federal and state levels as renewable resources continue to be added around operational challenges, loss of operational control with higher levels of purchased power and regulatory recovery of Transmission investments for support of renewables and reliability. Due to the interconnected nature of the North American grid, it will be essential to have clear, consistent and coordinated policy approaches to Transmission grid reliability at both the federal and state level to maintain reliability during extreme weather events as the grid transforms to support greater variable and intermittent resources.

4. Fuels

After the Polar Vortex of 2014, the Fuels organization launched winter and summer preparedness meetings held each December and May to review preparations for the upcoming season and review the last season's performance. This preparedness meeting is an integrated meeting, including all major utility functions (Fuels, Generation, Transmission, Distribution, Customer Services, Communications), sharing detailed weather information from the internal Meteorology Department, specific operational preparedness plans and lessons learned, and potential peak customer demand winter or summer scenarios. Additionally, Fuels seasonally reviews its response to the extreme weather event and makes changes based on the identified lessons learned. Following subsequent extreme weather and price events, including the extreme sustained cold weather the area encountered in January 2018, Fuels reviewed its response to the events and found the changes made to be reasonable.

The Fuels organization is actively monitoring the broader industry and fuel supply chains as the changing generation mix impacts fuel dynamics. Across the industry, coal stations have experienced significant reduction in capacity factor (run time) which directly correlates to lower coal consumption and reduced revenue for mines. Coupled with environmental pressures, the mining industry has consolidated, decreasing accessibility of certain fuels. Given the tightening supply market, the Companies continue to evaluate their fuel flexibility capability to burn nontraditional coals including Illinois Basin, and Northern Appalachian coal at various facilities. Fuel flexibility, the blending of these coal products with traditional coal products (e.g., Central Appalachian), reduces fuel costs, provides reliable fuel supply and supports a coal procurement strategy that minimizes market and delivery risks of open positions in a volatile fuel environment. The commercialization of dual fuel units (coal or gas) increases the ability to expand on the fuel flexibility initiative and will continue to be evaluated for opportunities to reduce fuel costs and improve reliability of supply. As additional coal units retire and capacity is reduced, the associated financial pressures will likely result in a further reduction in coal access.

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5. Supply Chain

Duke Energy's Supply Chain organization has been highly successful in supporting storm response, pandemic support, worldwide material shortages, shipping constraints and other supply chain disruptions that can impact the Companies' utility service by having strategic relationships with key suppliers.

To help minimize any disruption in service, the Companies have internal labor resources available within the state of South Carolina that can quickly restore power following a storm or respond to emergent situations. To augment these local resources, Duke Energy also has internal labor resources in other service territories, including North Carolina, Florida, Ohio, Kentucky, and Indiana that can be quickly deployed to South Carolina as needed. The internal geographical resource mix helps offset any anomaly in one area by drawing on internal resource needs from other locations per federal and state requirements.

Duke Energy's Supply Chain organization has also negotiated agreements with contractor resources to help support ongoing maintenance and capital work in their assigned geographic service area. These contractor resources are also known as native resources; and can also be redeployed quickly to meet the customer needs in other geographical areas, especially to restore power following a storm or other emergency.

In addition, Duke Energy's Supply Chain organization has also negotiated agreements with non-native contractors to provide storm restoration services. These are contractors who do not normally operate on Duke Energy's system but are available during times of need.

Duke Energy has its own pre-staged storm boxes with critical materials for storm recovery in all regional supply centers across all utility operational jurisdictions. This allows the Companies to pull storm boxes from other states to meet material needs and speed any recovery of largescale storm damage in South Carolina.

Further, Duke Energy has mutual aid agreements in place with other utilities to aid in the restoration of power following a storm or other emergencies, which include the ability to access additional labor and materials. These agreements are referred to earlier in this response as Mutual Assistance agreements.

Duke Energy's non-nuclear Generation organization has engineering, maintenance, and machine shop capabilities to fabricate and machine spare parts, as well as perform significant repairs on

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critical pieces of non-nuclear generation equipment. Duke Energy's vast inventory combined with significant enterprise buying power, and ability to locate materials and parts via the RAPID system, enhances the Companies' ability to make or repair materials or equipment in-house versus buying from a supplier resulting in greater flexibility in the supply chain.

During the recent COVID-19 pandemic, Duke Energy was in short supply of PPE items. Duke Energy's Supply Chain made calls around the world to obtain appropriate amounts of PPE and utilized local pharmacies to obtain compounded hand sanitizer. Additionally, Duke Energy's Supply Chain partnered with an internal environmental lab to secure supply ingredients to produce hand sanitizer to supply the Companies' plants and operations facilities that enabled employees to safely continue working to provide service to customers.

Duke Energy's Supply Chain organization has negotiated agreements with third-party vendors to furnish temporary housing, food, sanitation, and other critical needs to native and non-native contractor resources as well as mutual aid partners during storm restoration efforts to ensure that work is completed as quickly as possible in a safe and efficient manner. These agreements allow Duke Energy's Supply Chain to pre-stage warehouse and housing for labor and materials in response to largescale storm events.

Duke Energy's Supply Chain members participate in internal and external industry groups (e.g., EEI, NATF, etc.) for lessons learned activities post major storm or supply shortage events. These learning events are facilitated by industry support groups and have participation from other utilities' supply chain representatives to review future improvement activities for continuous improvement.

6. Security

Duke Energy's security teams routinely collaborate and coordinate with peer utilities, industry partners, government agencies and security organizations to share intelligence, lessons learned and best practices. One valuable avenue to do so is through benchmarking. Benchmarking is conducted with utility companies in the United States, Fortune 500 companies in the financial and technology industries, as well as through relationships, such as the Electricity Subsector Coordinating Council, Information Sharing and Analysis Centers, and the NATF.

In addition to the enterprise dedication in being a key leader and partner both within the industry as well as with other key critical infrastructure sectors to identify best practices, employees are the first line of defense and imperative to the culture of security within Duke Energy. Not only does Duke Energy ensure and implement lessons learned and corrective action program post-event, but

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Duke Energy also consistently drills and exercises processes, plans, and procedures. As a result of those opportunities, lessons learned are captured, reviewed, corrective actions are identified, and then followed through to implementation.

One of the many strengths of the Enterprise Security Team is to take lessons learned and translate them into awareness products. The Security Awareness program is focused on creating a stronger security culture throughout the enterprise. Duke Energy conducts regular training related to NERC CIP, physical and cyber security threats. The Security Awareness Program also leverages national awareness campaigns such as Preparedness Awareness Month (September) and Cybersecurity Awareness month (October) to focus communications in specific areas of security. Additionally, weekly awareness communications are shared enterprise-wide through multiple mediums to remind Duke Energy personnel of their role in protecting the Companies from security threats such as phishing e-mails, insider threats and suspicious activity reporting. As the utility industry is well-known and regarded for embodying a culture of safety, Duke Energy is dedicated to educating employees to embrace and implement a culture of security as well.

Summary

Duke Energy's Operational Excellence enterprise framework states: "*Continuous improvement empowers employees to continually learn and improve performance. We accelerate to excellence through ongoing improvements and a culture that systematically reviews, adjusts and innovates operational performance*."; the Companies embraces and seeks out every opportunity to identify best practices, lessons learned and challenges as this is how we provide excellent utility service to South Carolina customers.

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APPENDIX

Definitions:

Alliance contract	Also known as a strategic agreement or contract is a multi-year supplier relationship to provide services or materials at a total cost beneficial to Duke Energy that includes the supplier and Duke Energy working closely together in a cooperative fashion to improve efficiencies, and identify and implement additional value add opportunities, while maintaining or improving quality. Strategic or Alliance agreements are competitively bid prior to award and are generally three years to five years in length.
Advanced Persistent Threat (APT)	Classification of cyber security threats defined as highly trained cyber criminals or nation state-sponsored cyber teams.
"Companies"	Used within this document to indicate DEC and DEP
DEC	Duke Energy Carolinas, the utility subsidiary of Duke Energy that owns and operations nuclear, coal, natural gas, renewables and hydroelectric generation to generation approximately 23,200 megawatts of owned electricity capacity to 2.7 million customers in 24,000 square-mile service area of North Carolina and South Carolina.
DEP	Duke Energy Progress, a public utility subsidiary of Duke Energy, owns nuclear, coal, natural gas, renewables and hydroelectric generation. That diverse fuel mix provides about 13,700 megawatts of owned electricity capacity to 1.6 million customers in a 29,000 square-mile service area of North Carolina and South Carolina.
Distribution	Duke Energy business unit that manages electricity distribution to customers in Duke Energy's 6 state service area.
Enterprise Security	Duke Energy business unit that manages the physical and cyber security programs for the enterprise's regulated and commercial operations.
Fuels	Duke Energy business unit that manages the fuel supply strategy and policy to support Duke Energy coal and natural generation fleet.
Generation	Duke Energy business units that generate a combined 51,000 megawatts of electricity for customers in 6 states. Includes nuclear, coal, natural gas, solar and hydroelectric generation technologies.

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Mutual Assistance groups	These comprise of the following interfaces. Edison Electric Institute Mutual Assistance utility partners for craft labor resources are available to support identified needs. The Utility Supply Management Alliance provides utility peer group support for emergent needs with a major communication distribution list for identified needs. The North American Transmission Forum Regional Equipment Sharing for Transmission Outage Restoration Program is an agreement designed to enhance the resiliency and reliability of the energy grid by identifying the replacement of emergent equipment needs following disastrous events. The Spare Transformer Equipment Program electric industry program is an agreement that provides the ability to support the restoration of the nations' transmission system with increased inventory of power spare transformers and transferring those transformers to affected companies in the event of a transmission outage caused by a terrorist attack or other 'triggering event'.
NERC	The North American Electric Reliability Corporation, a non-profit agency that is the designated Reliability Organization for North America, subject to oversight by the Federal Energy Regulatory Commission and governmental authorities in Canada. Their mission is to assure reliability and security of the electric grid mainly through the development and enforcement of Reliability Standards.
Peak Load	The highest or maximum consumer demand for electricity that occurs over a specified period of time (e.g., hour, day, week, month, season, year).
Supply Chain	Duke Energy business unit that manages the sourcing and supply chain functions for the enterprise's regulated and commercial operations.
Transmission	Duke Energy business unit that manages Duke Energy's electric transmission system, which includes over 32,000 miles of high-voltage power lines and more than 3,000 substations in six states.