STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-100, SUB 190

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c)	))))))	**DIRECT TESTIMONY OF SAMUEL HOLEMAN III AND PATRICK O'CONNOR ON BEHALF OF DUKE ENERGY CAROLINAS, LLC AND DUKE ENERGY PROGRESS, LLC**

I. INTRODUCTION AND OVERVIEW

Q. MR. HOLEMAN, PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND POSITION WITH DUKE ENERGY CORPORATION.

A. My name is John Samuel Holeman III (Sam), and my business address is 526 S. Church Street, Charlotte, North Carolina, 28202. I am the Vice President of Transmission System Planning and Operations for Duke Energy Corporation.

Q. BEFORE INTRODUCING YOURSELF FURTHER, WOULD YOU PLEASE INTRODUCE THE PANEL.

A. Yes. I am appearing on behalf of Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC ("DEP" and together with DEC, the "Companies" or "Duke Energy") together with Patrick O'Connor on the "Reliability and Operational Resilience Panel." Witness O'Connor will introduce himself.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I graduated from Clemson University in 1983 with a B.S. Degree in Electrical Engineering and in 1985 with a M.S. Degree in Electrical Engineering. I also obtained a Master of Business Administration Degree from Queens University in 2014. I am a registered Professional Engineer in North Carolina and South Carolina. I am also a member of the Institute of Electrical and Electronics Engineers. I am a former NERC Certified System Operator.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I joined Duke Energy in 1985 and have held various engineering and management positions in System Planning and Operations of increasing responsibility throughout my career. These positions include: Energy Management System Application Engineer; System Operating Center Engineer; System Operator; Manager, System Operating Center; Director, System Operating Center; and Director, Engineering and Training.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. In my current position, I am responsible for compliance with the North American Electric Reliability Corporation ("NERC") and Federal Energy Regulatory Commission ("FERC") Bulk Electric System safety and reliability regulations applicable to Balancing Authority, Transmission Operator, and Transmission Service Provider functions, as well as planning and operations for Duke Energy's regulated electric jurisdictions serving in the states of North Carolina, South Carolina, Florida, Indiana, Ohio, and Kentucky. I have also been extensively involved with and now manage the ongoing NERC, SERC Reliability Corporation ("SERC"), and ReliabilityFirst ("RF") Bulk Electric System reliability compliance obligations for Duke Energy's regulated electric utilities. I served as Chair of the SERC Operating Committee from 2007 through 2009 and was also Chair of the NERC Operating Committee from 2009 through 2011. I also served as the NERC Event Analysis Subcommittee Chair from 2012 to 2014 and served on the NERC Essential Reliability Services Task Force from 2014 to 2015.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE NORTH CAROLINA UTILITIES COMMISSION ("COMMISSION")?

A. Yes. I have testified before the Commission several times, including in the 2022 Carbon Plan proceeding in Docket No. E-100, Sub 179 ("2022 Carbon Plan Proceeding").

Q. MR. O'CONNOR, PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND POSITION WITH DUKE ENERGY CORPORATION.

A. My name is Patrick O'Connor, and my business address is 525 South Tryon Street, Charlotte, North Carolina. I am a Lead Quantitative Analyst for DEC.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I hold a B.A. in Mathematics and Political Science from the University of North Carolina at Chapel Hill and received a Master of Environmental Management Degree with a focus on Energy and Environment from Duke University.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I began my career in 2010 at BCS, Inc. supporting the U.S. Department of Energy's Wind and Water Power Technologies Office and state government clients on technology R&D and energy policy topics. In 2013, I moved to Oak Ridge National Laboratory where I was a member of the research staff, managing projects related to techno-economic, capacity expansion, and production cost modeling of renewable energy technologies and energy storage.

In 2018, I joined Duke Energy as a Lead Quantitative Analyst in the Fuels and System Optimization ("FSO") organization.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. As a Lead Quantitative Analyst in FSO, I am responsible for developing, running, and maintaining models and analytical processes that support the economic and reliable operation of the DEP and DEC systems. My work primarily focuses on the Companies' mid-term forecasting and planning (months to years), and near-term unit commitment (day- to week-ahead) functions including optimization strategies to ensure fuel security, quantification of load and renewable forecast uncertainties to set operating reserve levels, and other quantitative modeling activities which inform production cost and resource commitment decisions. I additionally support the Companies' resource planning efforts, including both capacity expansion and reliability verification modeling.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. No.

Q. IS THE PANEL SPONSORING ANY EXHIBITS?

A. No.

Q. MR. HOLEMAN, ON BEHALF OF THE PANEL, PLEASE BRIEFLY DESCRIBE THE PURPOSE OF THE PANEL'S TESTIMONY.

A. The purpose of the Panel's testimony is to sponsor and highlight several key themes addressed in Appendix M (Reliability and Operational Resiliency) and the reliability validation discussion in Appendix C (Quantitative Analysis) of the Companies' Carolinas Resource Plan ("Resource Plan"), which constitutes the 2023-2024 Carbon Plan and Integrated Resource Plan ("CPIRP" or the "Plan"), as filed with the Commission on August 17, 2023.

As discussed in those documents, N.C. Gen. Stat. § 62-110.9 tasks the Companies and the Commission with the obligation to "*maintain or improve upon* the adequacy and reliability of the existing grid"[1] as they plan, adopt, and adjust the CPIRP. The Companies' efforts to advance the energy transition and exit coal generation will be transformative to their generation fleets and underlying grid, connecting unprecedented amounts of new supply-side resources and leveraging demand-side tools necessary to retire significant amounts of coal-fired generation and achieve the carbon emission reduction targets important to the Companies, their customers in the Carolinas, and established by N.C.G.S. § 62-110.9. To that end, President and Chief Executive Officer ("CEO") of NERC, James Robb, noted in his recent testimony before the United States Senate that the country's bulk power system is at an "inflection point" with risk to customers steadily increasing as a result of the rapid energy transformation that is currently underway throughout the country.[2]

[1] N.C.G.S. § 62-110.9(1) (emphasis added).

[2] The Reliability and Resiliency of Electric Service in the United States in Light of Recent Reliability Assessments and Alerts. Testimony of James B. Robb, President and CEO of NERC, before the United States Senate Committee on Energy and Natural Resources (June 1, 2023), *available at* energy.senate.gov/services/files/D47C2B83-A0A7-4E0B-ABF2-9574D9990C11.

As Appendix M explains, the Companies are meeting this challenge by building solutions around three governing principles raised by Mr. Robb that must be addressed to preserve grid reliability: (1) adopting an orderly pace for the energy transition; (2) replacing retiring generation with resources that provide both sufficient energy and essential characteristics for stable grid operation (including flexibility, voltage support, frequency response, and dispatchability); and (3) shifting planning focus to address the impact of inverter based resources and distributed energy resources.[3] In order to effectuate an orderly energy transition, appropriate planning through modeling and analysis is essential, including validating the fundamental reliability of the Plan Portfolios against the Companies' operating experience.

More specifically, the Panel's testimony reaffirms that system reliability remains a core planning and operating requirement in the development of the CPIRP and provides an update on recent operational reliability challenges that continue to reinforce the Companies' approach to planning for a secure, adequate, and reliable grid. The Panel's testimony then describes how the Companies incorporated reliability verification into development of the Plan Portfolios discussed in Chapter 3 and finally outlines the Companies' efforts to address the reliability directives laid out in the Commission's December 31, 2022, Order Adopting Initial Carbon Plan and Providing Direction for Future Planning ("Carbon Plan Order") in Docket No. E-100, Sub 179.

[3] *Id.*

Q. PLEASE EXPLAIN HOW THE REMAINDER OF THIS PANEL'S TESTIMONY IS ORGANIZED.

A. Section II of the Panel's testimony identifies the portions of the CPIRP and the Companies' requests presented to the Commission for approval in support of the Plan that this Panel sponsors.

Section III of the Panel's testimony explains that reliable, dispatchable generation is needed to meet the reliability mandate of N.C.G.S. § 62-110.9 and ensure that the Companies are able to meet customer demand 24 hours a day, 7 days a week, 365 days a year.

Section IV of the Panel's testimony describes how the Companies incorporated reliability verification into development of the Plan Portfolios discussed in Chapter 3.

Section V of the Panel's testimony addresses how the Companies are meeting specific directives from the Commission's Carbon Plan Order.

II. SPONSORSHIP OF THE CPIRP

Q. MR. HOLEMAN, PLEASE IDENTIFY WHICH SECTIONS OF THE CPIRP THE PANEL IS SPONSORING WITH ITS DIRECT TESTIMONY.

A. The Reliability and Operational Resilience Panel adopts and sponsors those parts of the CPIRP describing the Companies' analysis, studies, and plans to ensure that the Plan Portfolios proposed by the Companies as part of the CPIRP maintain or improve upon the reliability of the Companies' systems. In particular, the Panel is sponsoring the following portions of the CPIRP:

- Chapter 2, Methodology and Key Assumptions, Modeling Software and Development of Modeling Assumptions - Reliability Requirements (p. 17). This section describes the key reliability inputs used to ensure the Companies are maintaining or improving upon the adequacy and reliability of the existing grid.
- Appendix C, Quantitative Analysis – Reliability Verification (p. 67). This section describes the reliability verification process undertaken to provide reasonable assurance that the final portfolios perform at levels of reliability equivalent to or better than the current system configuration.
- Appendix M, Reliability and Operational Resilience. This Appendix describes the reliability challenges the Companies face and the efforts the Companies are taking to ensure the adequacy and reliability of their systems is maintained or improved upon.

Q. PLEASE IDENTIFY ANY REQUESTS FOR RELIEF PRESENTED IN THE COMPANIES' CPIRP PETITION AND BOWMAN EXHIBIT 1 THAT THE PANEL IS SUPPORTING THROUGH ITS TESTIMONY.

A. While this Panel is not sponsoring any single specific request for relief presented in the Petition, the Panel's testimony supports the Commission's continued recognition and promotion of reliability as a core planning requirement in the development of the CPIRP. The Panel further supports a

Commission finding that the Companies' proposed CPIRP maintains or improves upon the reliability of the grid as required by N.C.G.S. § 62-110.9.

III. NEED FOR RELIABLE, DISPATCHABLE GENERATION NOW AND INTO THE FUTURE

Q. MR. HOLEMAN, PLEASE BRIEFLY EXPLAIN THE COMPANIES' RESPONSIBILITY TO ENSURE ADEQUATE POWER SUPPLY AND RELIABILITY OF THE GRID AS DISCUSSED IN APPENDIX M.

A. The Companies fulfill a federally mandated and essential role to provide for reliable Bulk Electric System operations on behalf of communities, businesses, and residential customers in North Carolina and South Carolina (collectively referred to as "the Carolinas") 24 hours a day, 7 days a week, 365 days of the year. Moreover, the Carolinas electric system, as part of the SERC electric regional reliability entity, is interconnected to other reliability regions in North America, and the Companies are obligated to meet NERC requirements to collectively ensure the reliability and security of the Eastern Interconnect grid—which ranges from eastern Canada to the Gulf of Mexico, from the Atlantic Ocean to the Rocky Mountains and Texas.

In addition to the reliability imperatives established by NERC and SERC, N.C.G.S. § 62-110.9(1) directs that in developing the CPIRP, "any generation and resource changes [must] *maintain or improve upon* the adequacy and reliability of the existing grid."[4] Further underscoring this fundamental

[4] N.C.G.S. § 62-110.9(3) (emphasis added).

planning requirement, the Commission's Carbon Plan Order recognized "that ensuring system reliability and compliance with mandatory reliability standards as part of the energy transition is a requirement of state law, an obligation uniquely held by Duke and overseen by the Commission, and is nonnegotiable for the continued health and well-being of all North Carolinians."[5]

Q. HAVE THE COMPANIES CONSIDERED SYSTEM RELIABILITY A CORE COMPONENT WHEN DEVELOPING THE CPIRP?

A. Yes. The Companies have continued to promote system reliability as a core planning and operating requirement in developing the CPIRP to ensure that they continue to reliably serve customers, meet their obligations under NERC and SERC, and achieve the legislative mandate to maintain or improve upon the reliability of their systems.

Q. SINCE THE LAST CARBON PLAN FILING HAS NERC ISSUED ANY UPDATES OR CHANGES TO ITS RELIABILITY STANDARDS THAT IMPACT THE COMPANIES' RESOURCE PLANNING EFFORTS TO ENSURE THAT THE CPIRP MAINTAINS OR IMPROVES UPON THE RELIABILITY OF THE SYSTEM?

A. The purpose of NERC Reliability Standards is to address reliability risks and provide a fundamental level of assurance of the continued reliability of the interconnected Bulk Electric System. Since the Companies filed their initial proposed Carbon Plan on May 16, 2022, reliability events across the country

[5] Carbon Plan Order at 36, 56 (Finding of Fact No. 11).

have further underscored the reliability risks and tight system conditions expressed in Appendix M and continue to reinforce the Companies' approach to planning a reliable system, incorporating real-world operating experiences and concerns as the energy transition continues.

On February 16, 2023, FERC issued an Order approving Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1. These new and enhanced Reliability Standards were developed in response to extreme cold weather events in the south-central U.S. on February 8-20, 2021, related to Winter Storm Uri. These revisions target Generator Owner/Operators, Balancing Authorities and Transmission Operators and create a more comprehensive framework of requirements addressing generator preparedness for cold weather operations.[6]

On March 14, 2023, NERC issued an Alert related to the performance of Inverter-Based Resources (IBRs),[7] as recent years have seen multiple events with large-scale, wide-area losses of solar and wind generation due to systemic performance issues. This includes a particularly severe loss of solar event that occurred June 4th, 2022, known as the "2022 Odessa Disturbance." The 2022 Odessa Disturbance loss of solar event that occurred June 4th, 2022, highlighted

[6] Statement on FERC February Open Meeting, NERC Newsroom (Feb. 16, 2023), *available at* https://www.nerc.com/news/Pages/Statement-on-FERC-February-Open-Meeting.aspx.

[7] NERC Alert, Industry Recommendation, Inverter-Based Resource Performance Issues (Mar. 14, 2023), *available at* https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC%20Alert%20R-2023-03-14-01%20Level%202%20-%20Inverter-Based%20Resource%20Performance%20Issues.pdf.

the extant risks of inverter control system misconfigurations in current and future inverter-based resource interconnections, prompting a NERC alert to generation owners. The event was very large in magnitude, with the combined loss of synchronous and IBR generation during the event exceeding the capacity held by ERCOT to respond to significant frequency deviations (known in ERCOT as responsive reserves). Many of the IBR projects which unexpectedly shed generation during the event also did so during a similar event in 2021 despite some having addressed identified control deficiencies.

On May 15, 2023, NERC issued an Essential Action Alert related to Cold Weather Preparedness[8] in advance of the upcoming 2023-2024 winter. This alert comes in response to December 2022's Winter Storm Elliot which provided a significant reliability challenge as high winds and rapidly declining temperatures on December 23rd and December 24th ultimately led to the loss of over 70,000 MW of generation capability in the Eastern Interconnection.[9] This wide-area event placed multiple Balancing Authorities under periods of coincident stress with high loads and high rates of unexpected outages, rendering interconnected utilities unable to supply each other with emergency power when needed. Notably, the PJM BA, historically a reliable source of excess power during periods of need, was also unable to supply the Companies

[8] NERC Releases Essential Action Alert Focused on Cold Weather Preparations, NERC Newsroom (May 15, 2023), *available at* https://www.nerc.com/news/Pages/NERC-Releases-Essential-Action-Alert-Focused-on-Cold-Weather-Preparations.aspx.

[9] December 2022 Winter Storm Elliott Inquiry into Bulk-Power System Operations: FERC, NERC, and Regional Entity Joint Team Status Update (Jun. 15, 2023), *available at* https://www.ferc.gov/ news-events/news/presentation-december-2022-winter-storm-elliott-inquiry-bulk-power-system.

during morning peak loads on December 24th (and in fact curtailed firm purchases into the DEP and DEC BAs). This led to load curtailments by multiple utilities including the Companies to maintain grid reliability.

Finally, NERC issued its Winter 2022-2023 Assessment[10] and Summer 2023 Assessment[11] which discuss regional risks related to extreme cold and gas supply infrastructure in winter, as well as potential reserve shortfalls during above normal conditions during the summer.

NERC's ongoing reliability guidance has informed and validated the risks of these cold weather events and IBR-related concerns described in Appendix M and addressed in the development of the CPIRP. The Companies will continue to monitor NERC's updates and address them within the resource planning and operating system as appropriate.

Q. IS NERC ADDRESSING THE ENERGY ADEQUACY CONCERNS HIGHLIGHTED IN APPENDIX M?

A. Yes. As explained in Appendix M,[12] NERC's Energy Reliability Assessment Task Force has initiated the formal standards development process for two new requirements to evaluate and address risks related to energy availability and the adequate treatment of energy assurance (discussed as "energy adequacy" within

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[10] NERC 2022-2023 Winter Reliability Assessment (Nov. 2022), *available at* https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_WRA_2022.pdf.

[11] NERC 2023 Summer Reliability Assessment (May 2023), *available at* https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2023.pdf.

[12] CPIPRP Appendix M at 10-11.

the CPIRP) in operational and reliability planning. The sources of these risks can vary from system to system but generally include time-varying and correlated uncertainties in supply and demand due to weather, customer demands, renewables output, fuel availability, unit outages and other factors.

The first proposed standard, "Energy Assessments with Energy–Constrained Resources in the Planning Process[,]"[13] seeks to codify the identification and mitigation of supply and demand uncertainties in the planning time horizon (greater than one year). The second proposed standard, "Energy Assessments with Energy–Constrained Resources in the Operations and Operations Planning Time Horizons"[14] would do so at time horizons of less than one year.

The energy transition is changing the nature of risks to power system reliability, and overall grid reliability is ultimately determined by the underlying reliability of individual Balancing Authorities. Subsequently, both of the new proposed standards seek to ensure industry-wide rigor and consistency in the process of assessing reliable and adequate supply of energy at all applicable timescales.

[13] NERC Standard Authorization Request: Energy Assessments with Energy-Constrained Resources in the Planning Time Horizon (June 2022), *available at* https://www.nerc.com/pa/Stand/Project202203EnergyAssurancewithEnergyConstrainedR/2022-03%20Constrained%20Resources%20in%20the%20Planning%20Time%20Horizon%20Standard%20Authorization%20Request.pdf.

[14] SAR: Energy Assessments with Energy–Constrained Resources in the Operations and Operations Planning Time Horizons (June 2022), *available at* https://www.nerc.com/pa/Stand/Project202203EnergyAssurancewithEnergyConstrainedR/2022-03%20Constrained%20Resources%20in%20the%20Operations%20and%20Operations%20Planning%20Time%20Horizons%20Standard%20Authorization%20Request.pdf.

Q. HAS THE UTILITY INDUSTRY EXPERIENCED ANY EVENTS THIS SUMMER WHICH HIGHLIGHT RELIABILITY RISKS DURING THE ENERGY TRANSITION?

A. Yes. The summer of 2023 has experienced tight system operating conditions, with multiple Reliability Coordinators[15] across the U.S. declaring Energy Emergency Alert 1 (EEA1) status indicating that all available generation resources are in use. On July 20, 2023, the California Independent System Operator ("CAISO") declared EEA1 status and deployed emergency generation and demand response resources in response to a faster-than-expected intra-hour ramping.[16] While PJM issued a Maximum Generation Emergency/Load Management Alert and declared EEA1 status late on July 26 for July 27 and again on July 28[17] due to a wide-spread heat wave across the eastern U.S.. During this wide-spread heat wave, the Companies also recorded near-record peak loads.

EEA1 declarations are only the first stage in the notification of potential reliability issues (with load curtailment only occurring during or subsequent to an EEA3 declaration), and both PJM and CAISO were ultimately able to

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[15] The term "Reliability Coordinator" is defined in NERC's Glossary of Terms Used in NERC Reliability Standards, *available at* https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

[16] California ISO, Grid Emergencies History Report (Aug. 16, 2023), *available at* www.caiso.com/documents/grid-emergencies-history-report-1998-present.pdf.

[17] PJM, Maximum Generation Emergency/Load Management Alert (Jul. 28, 2023), *available at* https://emergencyprocedures.pjm.com/ep/pages/viewposting.jsf?id=103964.

maintain BA reliability without further measures. However, their respective experiences continue to underscore the risks associated with the accelerated retirement of existing generators and the changes in net-load associated with a higher penetration of renewables that are discussed in the CPIRP.

Q. PLEASE EXPLAIN HOW THE COMPANIES' OPERATIONAL EXPERIENCES SINCE THE FILING OF THE LAST CARBON PLAN HAVE DEMONSTRATED THE NEED FOR A BALANCED MIX OF RESOURCES TO MAINTAIN OR IMPROVE RELIABILITY DURING THE ENERGY TRANSITION.

A. The Companies believe that the reliability challenges created by the energy transition remain consistent with those described in the initial proposed Carbon Plan, including the need for a balanced portfolio of resources where dispatchable generators complement weather-dependent renewables and energy storage.

The Companies' continued operational experience with a growing quantity of interconnected solar resources has reinforced their understanding of the needs for integrating renewables, in particular the increased operating margins needed to respond to output uncertainties in day-ahead planning and real-time operations as explained in Appendix M. These needs are not new, but they are increasing in magnitude as more solar is added to the DEP and DEC systems, validating the change in operational uncertainty and complexity projected in the CPIRP.

The events of December 24th additionally highlight the need for a reliable and diverse mix of resources—including dispatchable generators, energy storage, and renewables—to meet high loads brought on by severe cold. This event demonstrated that renewables can be a benefit to system reliability, as the day-time ramp of solar generation in DEP and DEC helped provide energy to pumped storage reservoirs in advance of the subsequent Christmas Eve evening and Christmas morning peaks.

Q. PLEASE EXPLAIN HOW THE COMPANIES' EFFORTS TO SET AN ORDERLY PACE FOR THE ENERGY TRANSITION PROMOTES RESILIENCY AND RELIABILITY OF THE SYSTEM.

A. Operational experience over the last year has reinforced the Companies' characterization and understanding of reliability challenges, and the pace of grid transformation directly drives the magnitude of certain risks. As NERC President Jim Robb recently noted in his June 1, 2023, address to the Senate Committee on Energy and Natural Resources, "the central challenge [to the ongoing energy transition] is calibrating that pace of change with the reliability needs of a transforming system that must remain reliable and resilient at all times and under all conditions."[18] Mr. Robb cautions that utilities must manage the pace of the energy transition in an orderly fashion to address the "rapid

[18] The Reliability and Resiliency of Electric Service in the United States in Light of Recent Reliability Assessments and Alerts at 10, Testimony of James B. Robb, President and CEO of NERC, Before the Committee on Energy and Natural Resources, United States Senate (June 1, 2023), *available at* https://www.energy.senate.gov/services/files/D47C2B83-A0A7-4E0B-ABF2-9574D9990C11.

evolution of the generation mix [that] is altering the operational characteristics of the grid."[19]

Consistent with Mr. Robb's testimony, Appendix M acknowledges that operating experience across the United States underscores the need to purposefully manage the pace of the energy transition to identify and address new challenges before they materialize into broad-based risks to the power system.[20] For example, a key challenge to maintaining grid reliability is ensuring that new resources added to the grid have predictable performance characteristics so as to ensure grid stability. As evidenced by continued major grid disturbances,[21] new IBR-based technologies have the potential to respond to grid events unreliably. Until improved national standards are available to dictate, model, and validate performance capabilities, accelerated reliance on these technologies presents System Operators with increasing, unknown risks. As discussed later in this testimony and detailed in Appendix M, the Companies have developed their own new processes for IBR interconnection to reduce uncertainty and risk. Without new mandatory standards applicable to all new and existing projects which influence the bulk power system, the Companies' best defense is to ensure IBRs are added to the system at an orderly pace.

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[19] *Id.* at 1.

[20] CPIRP Appendix M at 19.

[21] NERC Industry Recommendation, Inverter-Based Resource Performance Issues (Mar. 14, 2023), *available at* https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC%20Alert%20R-2023-03-14-01%20Level%202%20-%20Inverter-Based%20Resource%20Performance%20Issues.pdf.

The Companies have also considered the appropriate pace of coal retirements to ensure that the evolving mix of resources added to the DEC and DEP systems are capable in aggregate of adequately replacing the fuel-security and dispatchability of retiring generators. The more rapid the transition, the more compressed the available window becomes for validating that the fundamentally new mix of resources—components of which have limited operational history in the Carolinas—is equally reliable prior to serving as a replacement for coal resources.

The Companies believe that the two-year update cycle for the CPIRP directed by N.C.G.S. § 62-110.9 promotes an orderly pace by requiring that the trajectory of the energy transition be reviewed and adjusted as needed at regular intervals. Reliability remains a non-negotiable foundation of the energy transition, and the Companies will continue to integrate operational learnings into the resource planning process.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS LEVERAGED ACTUAL OPERATIONAL EXPERIENCE TO CONTINUE TO PLAN FOR THE FUTURE, MITIGATE FORESEEABLE RISK, AND PREPARE FOR THE CHALLENGES AHEAD AS REQUIRED BY THE CARBON PLAN ORDER.[22]

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[22] Carbon Plan Order at 132 (Ordering Paragraph No. 8) (directing Duke Energy to "proactively address risks to system reliability in its upcoming first proposed biennial CPIRP, including but not limited to engaging with the Public Staff in leveraging actual operational experience to continue to plan for the future, mitigate foreseeable risk, and prepare for the challenges ahead.").

A. The Companies continually seek to improve capabilities and processes to address potential risks to reliability. This includes regular review and improvement of operational practice, short-term operational planning strategies, fuel and outage planning, among many other topics. In addition, the Companies have undertaken two major proactive efforts taken since 2022.

First, driven by the learnings from Winter Storm Elliot, Duke Energy has further formalized "Grid Risk Assessment" and "Grid Threat" processes in which structured coordination is triggered by thresholds of projected reserve availability. These processes ensure that the Companies proactively assess near-term operational risks and activate cross-functional teams in support of organizational awareness and internal and external communications. By formally and agilely identifying and reviewing risk factors, time-based preventative actions and communications can be triggered to minimize performance risk, maximize opportunity for increasing available resources, and activate internal/external stakeholder communications for coordinated response.

In addition to risk management procedures, Duke Energy has sought to address the potential stability risks posed by the increasing levels of IBRs on the DEC and DEP grids. To that end, the Companies issued their first-ever IBR-specific interconnection requirements in March 2023[23] requiring the use of a new process for interconnecting, solar, battery, wind, and other IBRs to model,

[23] *See* http://www.oasis.oati.com/duk/ (DEC); http://www.oasis.oati.com/cpl/ (DEP).

test, and validate the operational capabilities and performance predictability of these resources during normal and unexpected grid circumstances. As discussed in Appendix M, the purpose of these new interconnection requirements is to provide up-front mitigation of the stability risks brought to light by multiple grid disturbances over the past several years, including the 2022 Odessa event discussed previously in this testimony. The Transmission and Interconnection Panel sponsors Appendix L (Transmission System Planning and Grid Transformation).

IV. INCORPORATION OF RELIABILITY VERIFICATION MODELING CONSIDERATIONS INTO THE PLAN PORTFOLIOS

Q. MR. O'CONNOR, PLEASE GENERALLY DESCRIBE HOW RELIABILITY VERIFICATION WAS UNDERTAKEN IN THE MODELING OF THE COMPANIES' PLAN PORTFOLIOS.

A. As the Commission noted in its Carbon Plan Order, "not all system operational factors can be captured within a model."[24] Accordingly, the Companies mitigate reliability risk in the Plan Portfolios through a combination of direct incorporation of reliability criteria into the portfolio modeling process and the use of quantitative and qualitative considerations to help shape the type and timing of resources available in the future. Consistent with the analysis performed in development of the 2022 Carbon Plan, the Companies again implemented a Reliability Verification process to provide reasonable assurance

[24] Carbon Plan Order at 56.

that the final portfolios maintain or improve upon the reliability of the system.

Specifically, and as detailed in Chapter 2 and Appendix C, the modeling of the Plan Portfolios relies on a two-step process that uses the "EnCompass" capacity expansion model to project future resource additions and subjects the resulting portfolios to a follow-on Reliability Verification modeling step using the Strategic Energy Risk Valuation Model. The capacity expansion step produces a resource mix which is designed to serve a weather normal load profile while maintaining a specified Planning Reserve Margin ("PRM"). The Reliability Verification modeling simulates the dispatch of these future resource mixes under thousands of annual scenarios of unit availability and load and renewable energy uncertainty at hourly resolution, supplementing the capacity expansion outputs as needed to meet minimum reliability criteria. This latter step helps ensure that the modeled portfolios remain reliable and energy assured under realistic approximations of potential future system conditions.

Beyond the internal reliability criteria and constraints included in the modeling process, the Companies have taken additional steps to ensure they evaluate and mitigate reliability risks in the Plan Portfolios, including by controlling the pace and quantity of resource mix changes based on real-world infrastructure and logistics considerations to help ensure that modeled resources should be available when needed in reality. These considerations include firm interstate gas transportation, transmission system reliability, coal unit retirements, new resource execution timelines, and new technology availability.

Q. PLEASE DESCRIBE THE COMPANIES' EFFORTS TO ENGAGE WITH THE PUBLIC STAFF TO ADDRESS RELIABILITY RISKS IN THE CPIRP DEVELOPMENT PROCESS.

A. The Companies met with the Public Staff on March 2, 2023, to discuss development of the 2023 Resource Adequacy Study conducted by Astrapé Consulting, the Companies' proposed methodology for the 2023 Reliability Verification process, as well as the Companies' ongoing assessment of the six reliability risks identified in the initial 2022 Carbon Plan. In addressing the Reliability Verification process, the Companies described planned improvements to the process for 2023 and gave the Public Staff an opportunity to provide feedback thereon.

V. EVALUATION OF RELIABILITY RISKS OUTLINED IN THE CARBON PLAN ORDER

Q. MR. O'CONNOR, PLEASE DESCRIBE THE SIX RELIABILITY RISKS IDENTIFIED BY THE COMPANIES AND RECOGNIZED BY THE COMMISSION IN ITS CARBON PLAN ORDER.

A. In its Carbon Plan Order, the Commission took "special note of the six specific risks to reliability Duke identifies and direct[ed] Duke to address robustly each of those risks, with updated information and modeling where appropriate, in its upcoming CPIRP filing."[25] Those six reliability risks include: (1) resource and energy adequacy from renewables and storage; (2) access to firm interstate

[25] Carbon Plan Order at 56.

transportation of natural gas and new natural gas-fired generating resources; (3) coal-fired generator reliability during the transition; (4) the need for new carbon-free load-following resources that are flexible and dispatchable; (5) the need for adequate and reliable flexible resources to manage the reliable integration of renewables; and (6) system resilience to withstand extreme events such as weather or cyber disruptions.

Q. DOES THE COMPANIES' PROPOSED CPIRP ADDRESS EACH OF THE SIX RELIABILITY RISKS RECOGNIZED BY THE COMMISSION.

A. Yes. As I explain below, the Companies have thoroughly addressed each of the six reliability risks, including by identifying mitigating solutions, throughout its various Chapters and Appendices.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO RESOURCE AND ENERGY ADEQUACY FROM RENEWABLES AND STORAGE.

A. The core risks for energy adequacy from renewables comes from their dependence on variable natural weather to generate energy. To capture and address this uncertainty, the Companies' reliability modeling uses 43 years of historical weather to simulate the availability of generation from renewables prior to and during periods of system stress. Additionally, to capture risks from day-ahead forecast errors, the Reliability Verification process includes such uncertainties in the dispatch simulation. Incorporating unit availability simulations alongside historical weather variability and forecast uncertainty also improves the realism of the ability of storage to charge for use during periods of high loads. The IRP and Near-Term Actions Panel sponsors Appendix C (Quantitative Analysis) which details the reliability verification modeling process. The Resource Adequacy Panel sponsors the CPIRP 2023 Resources Adequacy Study, Attachment I.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO ACCESS TO FIRM INTERSTATE TRANSPORTATION OF NATURAL GAS AND NEW NATURAL GAS-FIRED GENERATING RESOURCES.

A. New natural gas-fired generating resources are necessary for system reliability in all Plan Portfolios, and Appendix M identifies that access to firm fuel supply is critical to maintaining system reliability, particularly during cold weather months when gas needs are highest. The Companies' approach to mitigating this risk through modeling natural gas fired resources and associated transportation issues is discussed in Appendix C (Quantitative Analysis), which is sponsored by the IRP and Near-Term Actions Panel. In addition, Appendix K (Natural Gas, Low Carbon Fuels & Hydrogen), which is sponsored by the Dispatchable Generation and Fuel Supply Panel, provides additional details relating to natural gas supply and the gas asset planning process.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO COAL-FIRED GENERATION RELIABILITY DURING THE TRANSITION.

A. As discussed throughout the CPIRP, the Companies' existing coal fleet is an essential component of reliability through the energy transition. Appendix M explains that the Companies' coal units provide an essential foundation of dispatchable capacity and fuel-security that must be adequately replaced prior to retirement to mitigate reliability concerns. The Companies' approach to maintaining coal-fired generation reliability during the transition is discussed in Appendix F (Coal Retirement Analysis) and Chapter 4 (Execution Plan), both of which are sponsored by the IRP and Near-Term Actions Panel.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO THE NEED FOR NEW CARBON-FREE LOAD-FOLLOWING RESOURCES THAT ARE FLEXIBLE AND DISPATCHABLE.

A. As discussed in Chapter 3, all Plan Portfolios include a mix of flexible, dispatchable, zero carbon-emitting resources, including hydrogen-capable natural gas resources (or other carbon-neutral fuel) as well as dispatchable advanced nuclear technologies. The Companies' approach to reliably planning for new, hydrogen-capable natural gas resources is detailed in Appendix K (Natural Gas, Low Carbon Fuels & Hydrogen), which is sponsored by the Dispatchable Generation and Fuel Supply Panel. Likewise, the Companies' approach to reliably planning for new nuclear resources is discussed in Appendix J (Nuclear), which is sponsored by the Long Lead-Time Generation and Pumped Storage Hydro Panel.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO THE NEED FOR ADEQUATE AND RELIABLE FLEXIBLE RESOURCES TO MANAGE THE RELIABLE INTERGRATION OF RENEWABLES.

A. As discussed in Appendix M, an increasingly renewable grid poses potential integration challenges due to the changing nature of electricity demand net of renewable energy contributions, commonly referred to as "net load." Of particular importance are the deeper day-time net-load "valleys" and much higher morning and evening ramping needs on a system with high penetrations of solar. These challenges from the changing nature of net-load are partly addressed in the capacity expansion modeling, and further investigated in the Reliability Verification stage of the modeling process. By simulating thousands of annual scenarios in 8760-hour detail, the verification modeling validates that the Base Portfolios are capable of reliably matching supply with demand even as the underlying shape of net load changes with the addition of variable renewables. Additional integration concerns related to resource and energy adequacy are also addressed by these modeling processes.

Q. PLEASE DESCRIBE HOW DUKE ENERGY HAS ADDRESSED RELIABILITY RISKS RELATED TO SYSTEM RESILIENCE TO WITHSTAND EXTREME EVENTS SUCH AS WEATHER OR CYBER DISRUPTIONS.

A. System resilience refers to the ability of the grid to withstand or, if necessary, recover from extreme events. As explained in Appendix M, resilience considerations go beyond resource adequacy to identify low-probability, high-impact events that directly affect grid assets. The Companies' approach to mitigating system resilience to withstand extreme events such as weather or cyber events is detailed in Appendix M, which is sponsored by this Panel.

VI. CONCLUSION

Q. PLEASE DISCUSS HOW THE COMPANIES' PRIORITIZATION OF RELIABILITY AS A CORE PLANNING REQUIREMENT WILL TRANSLATE TO REAL-WORLD, RELIABLE OPERATIONS.

A. The resource planning process is a critical step in ensuring future system reliability by identifying the composition and timing of changes to the Companies' resource mix that will enable an orderly energy transition. To do so, this Plan relies upon sophisticated modeling techniques and stakeholder-informed input assumptions to map out multiple Energy Transition Pathways and Portfolios, identified in CPIRP Chapter 2, Figure 2-2 that maintain or improve upon modeled system reliability. In practice, however, the precise timing and technical capabilities of future resource additions are subject to inherent uncertainties. Specific new resources will be dependent on both the projected needs of the Companies' power systems at the time as well as on the future evolution of technology costs, availability, and risks. Ultimately, system operators can only make use of resources on-hand in real-time to maintain reliability, and with these considerations in mind there are three high-level reliability considerations to consider in balancing planning objectives:

- First, for system operators, *Plan execution risks can become operational reliability risks* if adequate resources are not available to meet projected load growth or to replace the energy and capacity contributions of the Companies' coal units prior to their retirement.
- Second, carefully managing *the pace of the energy transition* is essential to allow timely course-correction as uncertainties in technology cost and availability are resolved. A controlled pace is also important to allow on-the-ground system operators to ensure that new resources perform as expected and can contribute fully to power system reliability.
- Lastly, a *balanced, diverse portfolio* of resources limits potential risks of delay or non-performance from any specific type of resource by providing alternative, complementary sources of energy to meet customer demands.

Q. MESSRS. HOLEMAN AND O'CONNOR, DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.