

**STATE OF NORTH CAROLINA  
UTILITIES COMMISSION  
RALEIGH**

DOCKET NO. E-100, SUB 101

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of		
Petition for Approval of Revisions to	)	ORDER CLARIFYING GENERATOR
Generator Interconnection Standards	)	INTERCONNECTION STANDARDS
	)	AND REQUIRING PERIODIC FILING
	)	OF INFORMATION REGARDING
	)	RISKS POSED BY INVERTER-BASED
	)	RESOURCES

BY THE COMMISSION: On November 22, 2021, the Commission issued its Order Requiring Comments and Filings Regarding Risks Posed By Inverter-Based Resources (the Order). The Order required electric utilities to address certain questions related to issues described in a Staff Report published in September 2021 by the North American Electric Reliability Corporation (NERC) and the Texas Reliability Entity<sup>1</sup> entitled “Odessa Disturbance” (the Joint Report).<sup>2</sup> The Joint Report analyzed two disturbances that occurred on the bulk power system in Texas during the summer of 2021. Both events involved normal power system disturbances — due to transmission line equipment failures — which caused abnormal power production reductions of significant levels of solar and wind generation on the Texas system. Many wind facilities and nearly all solar facilities utilize inverter-based resources (IBR) in their design.

The Joint Report concluded that despite several guidelines published by NERC, the electric industry had not been sufficiently implementing the guidelines and that further action would be needed to address gaps in the performance of IBR. The Joint Report further recommended improvements in NERC’s reliability standards and recommended significant updates and improvements to the interconnection agreements that are subject to the jurisdiction of the Federal Energy Regulatory Commission (FERC).

On December 22, 2021, Duke Energy Carolinas, LLC (DEC), Duke Energy Progress, LLC (DEP) (together, Duke), and Dominion Energy North Carolina (DENC) filed responses to the Order.

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<sup>1</sup> The Texas Reliability Entity is the regional electric reliability council under NERC that is tasked with compliance, monitoring, and enforcement of NERC’s reliability standards for most of Texas.

<sup>2</sup> See [https://www.nerc.com/pa/rrm/ea/Documents/Odessa\\_Disturbance\\_Report.pdf](https://www.nerc.com/pa/rrm/ea/Documents/Odessa_Disturbance_Report.pdf).

The Public Staff filed its Comments on Risks Posed by Inverter-Based Resources on January 26, 2022. No other party filed comments.

### Comments of the Parties

In its comments, Duke acknowledged that the risks identified by NERC were increasingly present on its systems in North Carolina and that evolving Good Utility Practice<sup>3</sup> would be critical to maintaining adequate reliability. Duke outlined the three categories of IBR which could impact reliability: (1) those subject to NERC guidelines, which are generally those connecting to the transmission system at a voltage of 100 kV or above and have a gross aggregate nameplate rating greater than 75 MVA; (2) state-jurisdictional, transmission-connected IBR which do not meet the NERC voltage and MVA criteria; and (3) state-jurisdictional IBR connecting to the Distribution System.

Duke explained that its response to the Commission would focus on the second category, state-jurisdictional, transmission-connected IBR. The first category, NERC-regulated Generating Facilities, will continue to be subject to NERC oversight. As for the third category, IBR connected to the distribution system, Duke stated that the process in the North Carolina Interconnection Procedures (NCIP) that implements IEEE 1547-2018 should appropriately address related but distinct issues specific to those IBR.

Duke noted that the Commission recognized in its October 8, 2021 Order Clarifying Interconnection Standards, Requesting Comments, and Requiring Filing of Remediation Information issued in this docket that a primary purpose of the NCIP and North Carolina Interconnection Agreement (NCIA) are to protect system reliability, ensure safe parallel operations of generating facilities, and ensure the integrity of utility systems in North Carolina. Accordingly, Duke asserted that for state-jurisdictional, transmission-connected IBR, Appendix 5 and Articles 2.2 and 1.6 of the NCIA give the Utility significant latitude in adopting new standards consistent with Good Utility Practice and subject to Commission oversight. For IBR in the planning stages, Duke is enhancing its NCIA Appendix 5 templates to directly reference each Utility's NERC-required FAC-001 Facility Interconnection Requirements (FIR).

In response to the Commission's question as to the adequacy of NCIP and/or NCIA in addressing generator ride-through, electromagnetic transient (EMT) modeling, and on-going monitoring of IBR, Duke described the developing technical understanding and requirements in the industry around each of these issues and reported on how it is addressing them. Duke concluded that the NCIP and/or NCIA are indeed currently adequate to address these issues because the NCIP requires Duke to follow Good Utility Practice, because Section 1.6 of the NCIA incorporates by reference all rules and procedures pertaining to the parallel operation of the Generating

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<sup>3</sup> Capitalized terms not otherwise defined in this Order are defined in the North Carolina Interconnection Procedures (NCIP).

Facility, and because Duke has the ability to update the NCIA Appendix 5 to address reliability issues.

Regarding IBR already in operation, findings in the Joint Report indicate the need for robust protections and control review, modeling, and monitoring of these transmission-connected Generating Facilities. Duke opined that “it will take some time for inverter, power plant controllers, and plant designs specifications to mature . . . before the collection and verification of [EMT] models can be streamlined.” Duke stated its intent to develop the scope and timing of this finding and to do so through the Interconnection Technical Standards Review Group (TSRG).

Duke plans to implement EPRI openXDA software to monitor individual IBR site performance.

Duke believes that requiring electric utilities to adopt all NERC guidelines may not be consistent with Good Utility Practice until the cost and implementation details of various guidelines are better understood and accepted. Duke offered Florida Power & Light (FPL) as an example of a utility that adopted portions of the draft IEEE P2800<sup>4</sup> standard as a pragmatic approach rather than wholesale adoption of it or other optional standards or guidelines.

Regarding desired next steps to aid in reliability, Duke stated the following:

As an initial step towards ensuring the Companies have the ability to integrate NERC Performance Guidelines and operational requirements for state-jurisdictional Interconnection Customers interconnecting to the BPS in North Carolina, the Companies would support action by the Commission to clarify that the FIR, discussed above, constitutes NCIA Section 1.6 “rules and procedures pertaining to the parallel operation of the Generating Facility in the applicable control area” for all NCIP Generating Facilities connecting to the Transmission System. This clarification would allow the Companies to work collaboratively with IBR Generating Facility owners to detail these minimum requirements and work to align requirements for transmission-connected projects regardless of NERC registration or jurisdiction.

DENC stated in its filing that it believes that the North Carolina state jurisdictional interconnection standards and agreements (NCIP/NCIA) adequately address generator ride-through, EMT modeling, and on-going monitoring of IBR from a utility distribution perspective at the present time.<sup>5</sup> DENC does not believe that ride-through

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<sup>4</sup> Prior to April 2022: IEEE P2800, draft Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

<sup>5</sup> In its comments, the Public Staff noted that the responses of Duke and DENC are notably different because Duke Energy and DENC have different capacity limits on state-jurisdiction generators; for Duke the limit is 80 MW, whereas for DENC it is 20 MW. The Public Staff pointed out that the 20 MW

is necessary due to the low levels of DER penetration on its system at this time. DENC also believes that EMT modeling for distribution interconnections is not feasible or cost-effective, as it is currently not commonly done for such interconnections and is unlikely to bring added benefit, again due to the low levels of DER penetration on its system. With respect to on-going monitoring of IBR, DENC interprets Good Utility Practice to install monitoring devices at the points of interconnection with DERs. DENC believes its level of monitoring is sufficient and that it does not need to add additional monitoring for system faults.

DENC states that the NERC guidelines are more applicable to the Bulk Electric System (BES) than to distribution-connected resources, and thus it does not believe those guidelines should be mandatory in North Carolina.

The Public Staff commented that the Joint Report found that the industry has not followed current NERC standards and that current ride-through standards are not effectively addressing the reliability gap of IBRs shutting down during a transmission disturbance. In meetings with staff of the SERC Reliability Corporation (SERC), SERC staff confirmed Duke's conclusion that problems similar to those described in the Joint Report could occur in North Carolina. SERC staff recommended that the Commission continue to require IEEE Standard 1547 to be part of the NCIP. The Public Staff noted that SERC has created the Variable Energy Resources Working Group to study the effects of increased IBRs on power quality and grid reliability.

The Public Staff believes that Duke and the TSRG should review EMT modeling and the planned revisions to IEEE P2800. The Public Staff further recommends that Duke discuss potential implementation IEEE P2800 and EMT modeling for state jurisdictional projects.

The Public Staff recommended the following actions:

- That the Commission require Duke to bring before the TSRG both the revised IEEE Standard P2800 and the potential for effective EMT modeling for IBR;
- That following the TSRG process, the Commission request comments on the extent to which the information should be incorporated into NCIP and NCIA; and
- That the Commission require Duke to bring before the TSRG all relevant NERC standards after their release to determine the extent to which these standards should become part of the NCIP and NCIA.

#### Relevant Regulatory and Industry Action

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limit for DENC effectively assures that DENC's state-jurisdictional interconnections will be only on its distribution system.

Both before and after the Commission issued the Order, FERC and NERC have actively investigated and assessed the risks of IBRs. The Joint Report from the Odessa Disturbance is one of seven disturbance reports published by NERC covering twelve events which occurred between 2016 and 2022, all in Texas or California. In addition to these seven disturbance reports, NERC has issued two alerts, four reliability guidelines, five white papers, two technical reports, nine standards projects, and four other related activities, all addressing this topic and all spanning the period June 2017 – August 2022. Also, under its Reliability and Security Technical Committee, NERC has established the Inverter-Based Resource Performance Subcommittee (IRPTF/IRPS) in 2018 and the System Planning Impacts from Distributed Energy Resources Working Group (SPIDERWG) in 2019.

In April of 2022, the Institute of Electrical and Electronics Engineers (IEEE) published IEEE 2800-2022, IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems. This had been a draft standard prior to April 2022.

On November 17, 2022, FERC made three issuances related to IBRs: (1) an order directing NERC to develop a plan to register the entities that own and operate IBRs (RD22-4); (2) a Notice of Proposed Rulemaking to direct NERC to develop reliability standards for IBRs that cover data sharing, model validation, planning and operational studies, and performance requirements (RM22-12); and an order approving reliability standards that are related to IBRs, which NERC proposed earlier in 2022 (RD22-5).

### Conclusion

The Commission is concerned that following at least twelve abnormal events, ample guidance from NERC, and new IEEE standards have not yet provided assurances that Interconnected Generating Facilities with IBRs will be designed and configured to properly and consistently operate as expected in order to assure a reliable power system.

The Commission sees that since its Order was issued, FERC and NERC have taken further actions to address reliability of the Bulk Electric System. It is appropriate for this Commission and the public utilities it regulates to learn from and build upon those actions. The Commission fully supports all work done by Duke and DENC to assure that state-jurisdictional Generating Facilities work in concert with larger FERC-jurisdictional, NERC-regulated Generating Facilities. To that end, the Commission supports Duke and DENC applying their respective FIRs, as applicable, to state-jurisdictional facilities connected to their transmission systems.

Due to the significant penetration of distribution-connected DER in North Carolina, both in Duke's and DENC's systems, the Commission also supports Duke's and DENC's taking continued and active steps to advance and develop their use of IEEE 1547-2018; to be involved in applicable working groups such as the NERC

SPIDERWG and the SERC Variable Energy Resources Working Group; and to engage in any other activities which further assure that distribution-connected DER in North Carolina do not present a reliability liability for Duke's or DENC's systems, whether at the Bulk Electric System level or at local levels. Ordering Paragraph 4 of the Order required Duke and DENC to include IEEE 1547 implementation information specific to generator ride-through capabilities and associated inverter settings in their March 2022 IEEE 1547 report in docket E-100, Sub 101B. The Commission now supports Duke's and DENC's supplying this information in every annual IEEE 1547 report to be filed in docket E-100 Sub 101B.

The Commission appreciates the thoroughness of the responses of Duke, DENC, and the Public Staff. The Commission recognizes that reliability risks associated with IBRs involve highly technical issues with several matters that have not yet seen industry-wide standardization or well-developed best practices. The Commission finds that the utilities are, to date, aware of the risks and are taking appropriate pragmatic approaches to reduce the chances of impacts to system reliability.

At the same time, the Commission has concerns similar to those voiced by NERC that the proper elements to assure robust management of inverter configurations are not nearly as mature as they need to be, considering the capacity of IBRs being added to the system. The Commission takes note of the fact that unlike NERC standards, for which compliance is mandatory, NERC does not monitor or enforce compliance with its reliability guidelines. However, "[r]eviewing, revising, or developing a program using these practices is highly encouraged" by NERC.<sup>6</sup> The Commission enjoins active engagement and updates by Duke and DENC, as appropriate, to assure the Commission is kept fully apprised of issue developments and risks as they continue to develop.

The Commission also instructs Duke, DENC, and the Public Staff to inform the Commission promptly at any time the parties come to believe that changes to the NCIP or the NCIA may be needed to address IBR risks.

IT IS, THEREFORE, ORDERED as follows:

1. The Facility Interconnection Requirements used for FERC-jurisdictional interconnections may, at the utility's option, constitute NCIA Section 1.6 "rules and procedures pertaining to the parallel operation of the Generating Facility in the applicable control area" for all NCIP Generating Facilities connecting to the Transmission System;
2. That Duke and DENC shall include, in every annual IEEE Standard 1547 report required to be filed in Docket E-100, Sub 101B, the implementation plan and schedule for mitigating the reliability risk of distribution-connected DER, specific to

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<sup>6</sup> See NERC's statement on Reliability Guidelines, Security Guidelines, Technical Reference Documents, and White Papers, <https://www.nerc.com/comm/Pages/Reliability-and-Security-Guidelines.aspx> (accessed March 7, 2023).

generator ride-through capabilities, associated inverter settings, and any other identified reliability risks associated with distribution-connected DER; and

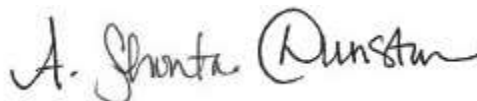
3. That Duke and DENC are to include in their next and subsequent CIPRP and IRP filings, respectively, as an Appendix to other information on system reliability planning, the following information:

- a. A risk assessment that outlines the risk posed to Duke's or DENC's system by existing and future Interconnected Generating Facilities, regardless of FERC or state jurisdiction and regardless of interconnection to transmission or distribution;
- b. A description of Duke's and DENC's existing programs and processes which seek to assure, on a periodic basis, that inverters at state-jurisdictional IBR continue to have all settings configured as intended by the utility;
- c. For Duke, a summary of TSRG activity related to these issues, such as generator ride-through, electromagnetic transient (EMT) modeling, and on-going monitoring of IBR, and how well these and any other reliability-related issues are being adopted in existing and new IBR, as appropriate.

ISSUED BY ORDER OF THE COMMISSION.

This the 13th day of April, 2023.

NORTH CAROLINA UTILITIES COMMISSION

A handwritten signature in black ink, reading "A. Shonta Dunston". The signature is fluid and cursive, with the first name "A." and last name "Dunston" clearly legible.

A. Shonta Dunston, Chief Clerk