UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Improvements to Generator Interconnection Procedures and Agreements	**)** **)** **)**	**Docket No. RM22-14-000**

COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION, MIDWEST RELIABILITY ORGANIZATION, NORTHEAST POWER COORDINATING COUNCIL, INC., RELIABILITYFIRST CORPORATION, SERC RELIABILITY CORPORATION, TEXAS RELIABILITY ENTITY, INC., AND WESTERN ELECTRICITY COORDINATING COUNCIL ON THE NOTICE OF PROPOSED RULEMAKING

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On June 16, 2022, the Federal Energy Regulatory Commission ("FERC" or the "Commission") issued a Notice of Proposed Rulemaking ("NOPR") proposing to reform the *pro forma* Large Generator Interconnection Procedures ("LGIPs"), the *pro forma* Small Generator Interconnection Procedures ("SGIPs"), the *pro forma* Large Generator Interconnection Agreement ("LGIA"), and the *pro forma* Small Generator Interconnection Agreement ("SGIA") (together, the "Interconnection Agreements and Procedures") to address interconnection queue backlogs, improve certainty, and prevent undue discrimination for new technologies while ensuring these resources support reliability ("Interconnection NOPR").[1] Previously, on April 21, 2022, the Commission issued a NOPR introducing proposals to reform the *pro forma* Open Access Transmission Tariff and the *pro forma* LGIP to update the Commission's existing regional transmission planning and cost allocation requirements ("Transmission Planning NOPR").[2] Both of these proposed rulemakings followed the Advanced Notice of Proposed Rulemaking

[1] *Improvements to Generator Interconnection Procedures and Agreements*, 179 FERC ¶ 61,194 (2022) [hereinafter Interconnection NOPR].

[2] *Bldg. for the Future Through Elec. Reg'l Transmission Plan. & Cost Allocation & Generator Interconnection*, 179 FERC ¶ 61,028 (2022) [hereinafter Transmission Planning NOPR].

("ANOPR") on Transmission Planning and Generator Interconnection[3] that the North American Electric Reliability Corporation ("NERC") and the Regional Entities[4] (together, the "ERO Enterprise") commented on last year.[5] The ERO Enterprise submitted comments on the Transmission Planning NOPR on August 17, 2022. In comments on the Transmission Planning NOPR, the ERO Enterprise indicated that more extensive comments would be forthcoming in response to the Interconnection NOPR to recommend improvements to the Commission's Interconnection Agreements and Procedures.[6]

NERC, as the Commission-certified Electric Reliability Organization ("ERO"),[7] and the Regional Entities hereby submit comments on the Interconnection NOPR. ERO Enterprise assessments demonstrate that modifications to Interconnection Agreements and Procedures are necessary to address present needs associated with newly interconnecting resources. The transforming grid is comprised of diverse technologies, including nonsynchronous/inverter-based resources ("IBRs"). These resources are often small generators and play a significant role in the

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3 *Bldg. for the Future Through Elec. Reg'l Transmission Plan. & Cost Allocation & Generator Interconnection*, 176 FERC ¶ 61,024 (2021) [hereinafter ANOPR].

4 The Regional Entities are (i) Midwest Reliability Organization ("MRO"); (ii) Northeast Power Coordinating Council, Inc. ("NPCC"); (iii) ReliabilityFirst Corporation ("ReliabilityFirst"); (iv) SERC Reliability Corporation ("SERC"); (v) Texas Reliability Entity, Inc. ("Texas RE"); and (vi) Western Electricity Coordinating Council ("WECC"). NERC and the Regional Entities comprise the ERO Enterprise.

5 *Comments of the North Am. Elec. Reliability Corp., Midwest Reliability Organization, Northeast Power Coordinating Council, Inc., ReliabilityFirst Corporation, SERC Reliability Corporation, Texas Reliability Entity, Inc., and Western Electricity Coordinating Counsel on the Advanced Notice of Proposed Rulemaking*, Docket No. RM21-17-000 (Oct. 12, 2021) [hereinafter ANOPR Comments].

6 *Comments of the North Am. Elec. Reliability Corp., Midwest Reliability Organization, Northeast Power Coordinating Council, Inc., ReliabilityFirst Corporation, SERC Reliability Corporation, Texas Reliability Entity, Inc., and Western Electricity Coordinating Counsel on the Notice of Proposed Rulemaking*, Docket No. RM21-17-000 (Aug. 17, 2022) at 9.

7 *Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards*, Order No. 672, 114 FERC 61,104 (2006) [hereinafter Order No. 672], *order on reh'g*, Order No. 672-A, 114 FERC 61,328 (2006). NERC was certified by the Commission as the ERO, pursuant to § 215(c) of the Federal Power Act ("FPA"), by Commission order issued July 20, 2006. *N. Am. Elec. Reliability Corp.*, 116 FERC ¶ 61,062 (2006) [hereinafter Certification Order].

uncertainty of generation availability that is characteristic of the evolving grid.[8] Applying interconnection reforms to all Commission-jurisdictional resources would therefore be just and reasonable. The ERO Enterprise urges the Commission to apply its reforms to both the LGIP/LGIA and SGIP/SGIA.

The ERO Enterprise appreciates the opportunity to support the Commission's efforts to improve the efficiency of the interconnection process, address technological advancements, and update modeling and performance requirements as proposed in the Interconnection NOPR and further proposed in these comments. These enhancements would support a reliable Bulk-Power System ("BPS") that is better prepared to meet the challenges of a transforming grid.

I. SUMMARY

ERO Enterprise assessments demonstrate that the increasing integration of IBRs is changing long-held assumptions regarding operation of the grid and creating new challenges that could pose risks to reliability if not managed. NERC's *Inverter-Based Resource Strategy: Ensuring Reliability of the Bulk Power System with Increased Levels of BPS-Connected IBRs* ("IBR Strategy") describes the four core tenets of the ERO Enterprise approach to mitigate these potential risks.[9] Three of these core tenets relate to ERO Enterprise activities, while one proposes improvements to the Commission's interconnection process. (*See infra* Section IV.A.)

As a result of its assessments, the ERO Enterprise supports the Commission's intent to update its Interconnection Procedures and Agreements, and urges the necessity of revisions to the Commission's interconnection process for both large and small generation resources to (i) enhance

[8] A small generating facility has a Generating Facility Capacity of no more than 20 MW. In addition, references to asynchronous resources in any graphs herein, refer to nonsynchronous/IBR resources interchangeably. All three terms are often used to describe such facilities.

[9] *Inverter-Based Resource Strategy: Ensuring Reliability of the Bulk Power System with Increased Levels of BPS-Connected IBRs* (Sept. 2022), https://www.nerc.com/comm/Documents/NERC_IBR_Strategy.pdf [hereinafter IBR Strategy].

modeling and validation; and (ii) support performance, to ensure continued reliability of the BPS as new resources interconnect.

In particular, NERC and the Regional Entities request that the Commission:

(i) Modify the LGIP/SGIP and LGIA/SGIA to require:

a. Model validation with actual installed equipment prior to interconnection; and

b. A "true-up" of modeling and studies to address any discrepancies between what was studied and what is installed (*see infra* Section IV.B.);

(ii) Modify the LGIP/SGIP and LGIA/SGIA to require inclusion of electromagnetic transient ("EMT") studies to ensure accurate modeling of nonsynchronous generation (*see infra* Section IV.C.);

(iii) Modify the LGIP/SGIP and LGIA/SGIA to incorporate elements of NERC Reliability Guidelines (*see infra* Section IV.D.);[10] and

(iv) Enact enhancements to increase the efficiency and effectiveness of the interconnection queue (*see infra* Section IV.E.).

II. NOTICES AND COMMUNICATIONS

Notices and communications with respect to this filing may be addressed to the following:[11]

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[10] *See* NERC IBR Performance Guideline, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf; NERC IBR Interconnection Requirements Guideline, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf; referenced in Interconnection NOPR at P 313.

[11] Persons to be included on the Commission's service list are identified by an asterisk. NERC respectfully requests a waiver of Rule 203 of the Commission's regulations, 18 C.F.R. § 385.203 (2022), to allow the inclusion of more than two persons on the service list in this proceeding.

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III. THE ERO ENTERPRISE, ITS STATUTORY MISSION, AND RELATIONSHIP TO THE INTERCONNECTION PROCESS

A. Introduction to the ERO Enterprise.

NERC's mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. When Congress enacted the Energy Policy Act of 2005[12] and section 215 of the Federal Power Act ("section 215"),[13] it entrusted the Commission with: (i) approving and

[12] Pub. L. 109–58, title XII, §1211(b), Aug. 8, 2005, 119 Stat. 946.
[13] 16 U.S.C. § 824o [hereafter section 215].

enforcing rules to ensure the reliability of the BPS; and (ii) certifying an ERO that would be charged with a) developing and enforcing mandatory Reliability Standards, subject to Commission approval, and b) assessing reliability and adequacy of the BPS in North America.[14] The Interconnection NOPR recognizes NERC assessments and guidance on reliability issues associated with IBRs.[15] NERC accomplishes its mission with the support of the six Regional Entities. These six Regional Entities help the ERO Enterprise support reliability across differing Interconnections with specific needs and characteristics.

Congressional and Commission statute and regulation reflect certification of an ERO subject to Commission oversight. In 2006, the Commission certified NERC as the ERO pursuant to section 215.[16] Prior to that, Order No. 672 established regulations implementing section 215, including a process for periodic Performance Assessments that would examine how well the ERO is accomplishing its responsibilities.[17] The initial Performance Assessment was due three years after certification, with subsequent ones due on a five-year cycle. Order No. 672 also required that NERC and the Regional Entities submit a detailed annual budget and business plan filing each year for Commission approval, 130 days in advance of the ERO fiscal year.[18] The Commission also reviews and approves the Regional Delegation Agreements ("RDAs") between NERC and the Regional Entities every five years.[19] Through oversight conducted pursuant to the RDAs and NERC Rules of Procedure ("ROP"), NERC evaluates Regional Entity performance and

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14 Section 215(a)(2). *See also* Section 215(c) (providing the ERO certification criteria). *See also* Pub. L. 109–58, title XII, §1211(b), Aug. 8, 2005, 119 Stat. 946 (clarifying, "[t]he Electric Reliability Organization… and any regional entity delegated enforcement authority… are not departments, agencies, or instrumentalities of the United States Government.").

15 Interconnection NOPR at PP 311-317.

16 Certification Order.

17 Order No. 672 at PP 183-191.

18 18 C.F.R. §39.4.

19 18 C.F.R. §39.8. A delegation agreement shall not be effective until it is approved by the Commission.

compliance with the ROP, Commission directives, RDAs, NERC policies or procedures, and guidance and direction issued by the NERC Board of Trustees ("Board").

B. NERC Reliability Standards and Commission Interconnection Procedures Operate Together to Ensure Reliability of the BPS as New Resources Interconnect

To effectively and efficiently reduce risks to reliability, NERC and the Regional Entities develop and enforce Reliability Standards to ensure an adequate level of reliability for the Bulk Electric System ("BES") and assess reliability and adequacy of the BPS. NERC Reliability Standards are developed using a results-based approach that focuses on performance, risk management, and entity capabilities. Reliability Standards obligations apply to entities registered with NERC pursuant to the ROP.[20] NERC and the Regional Entities have the obligation to identify and register all entities that meet the criteria for inclusion in the NERC Compliance Registry ("NCR").[21] Once registered, such entities are subject to Commission-approved Reliability Standards.[22]

NERC's suite of Reliability Standards includes requirements intended to address potential risks associated with interconnecting resources. For example, Reliability Standard FAC-001-3 states that, "[t]o avoid adverse impacts on the reliability of the Bulk Electric System, Transmission Owners and applicable Generator Owners must document and make Facility interconnection requirements available so that entities seeking to interconnect will have the necessary information."[23] Reliability Standard FAC-002-2 requires entities "[t]o study the impact of interconnecting new or materially modified Facilities on the Bulk Electric System."[24] NERC is

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20 *See* NERC Rules of Procedure at Section 500 and Appendices 5A and 5B.

21 The NCR identifies the owners, operators, and users of the BPS that are responsible for complying with approved reliability standards applicable to the functions for which each entity is registered.

22 Transmission Elements operated at 100 kV or higher and Real Power and Reactive Power resources connected at 100 kV or higher (while also considering any Inclusions or Exclusions as detailed in the NERC Glossary).

23 Available at https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-001-3.pdf.

24 Available at https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-002-2.pdf.

also examining potential modifications to other Reliability Standards to better address nonsynchronous resources. Reliability Standard Project 2020-06 Verifications of Models and Data for Generators, for example, is examining revisions to Reliability Standards MOD-026-1 (*Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions*) and MOD-027-1 (*Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions*).[25] The project targets gaps in Reliability Standards identified by the Reliability and Security Technical Committee ("RSTC") NERC Inverter-based Resource Performance Task Force (now Subcommittee or "IRPS"). Similarly, at the September 2022 RSTC meeting, the System Planning Impacts from Distributed Energy Resources Working Group ("SPIDERWG") recommended further examination of Reliability Standards in light of changes impacting the BPS.[26] These existing standards and projects demonstrate how NERC Reliability Standards operate in partnership with Commission Interconnection Procedures and Agreements for efficiency, comprehensiveness, and effectiveness.

The Commission's interconnection process builds on the Reliability Standard obligations referenced above to perform a key function in the regulatory framework to help ensure continued reliability of the BPS as the North American resource mix evolves. The Commission Interconnection Procedures and Agreements provide uniformity for both transmission providers and interconnection customers. These procedures also help prevent undue discrimination and preserve reliability.[27] Moreover, the Commission's procedures have the advantage that they may

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[25] *See* Project 2020-06 webpage, https://www.nerc.com/pa/Stand/Pages/Project-2020_06-Verifications-of-Models-and-Data-for-Generators.aspx.

[26] NERC Reliability Standards Review: *NERC System Planning Impacts from DERs Working Group (SPIDERWG) White Paper – September 2022*, Agenda Item 7, https://www.nerc.com/comm/RSTC/AgendaHighlightsandMinutes/RSTC_Meeting_September_13_2022_Agenda_Package_ATTENDEE.pdf.

[27] *See* Order Nos. 2003 and 2006 (regarding large and small generators, respectively). *Standardization of Generator Interconnection Agreements and Procedures*, Order No. 2003, 104 FERC 61,103 (2003); *Standardization of Small Generator Interconnection Agreements and Procedures*, Order No. 2006, 111 FERC 61,220 (2006).

apply to the resources intended for interconnection prior to their operation. Thus, such obligations may apply prior to an owner or operator's registration on NERC's NCR, after which Reliability Standards become mandatory and enforceable. As a result, the Commission's Interconnection Procedures and Agreements provide an important first line of defense to protect against potential risks to the BPS as new resources interconnect.

IV. COMMENTS

ERO Enterprise reliability assessments demonstrate that the North American electric power grid is facing new challenges due to increasing levels of nonsynchronous resources. These assessments highlight that improper planning and operation of IBRs can pose a significant risk to BPS reliability. Each event has identified new performance issues, such as momentary cessation, unwarranted inverter or plant tripping issues, and controller interactions and instabilities. While the ERO Enterprise has developed risk mitigation measures, these have been inconsistently adopted by industry. NERC has observed, for example, that although its *Reliability Guideline: Improvements to Interconnection Requirements for BPS-Connected Inverter-Based Resources* is influential and a pillar for IEEE 2800-22,[28] applicable entities continue to rely primarily on the *pro forma* LGIA/SGIA with only some modifications. NERC's recently published IBR Strategy outlines how the ERO Enterprise seeks to ensure continued reliability as the BPS evolves under an approach that includes: (i) risk analysis, (ii) interconnection process improvements, (iii) best practices and education, and (iv) regulatory enhancements to NERC rules and procedures.[29]

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[28] IEEE 2800-2022, *IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems*, https://standards.ieee.org/ieee/2800/10453/. IEEE is a leading developer of international standards that underpin many of today's telecommunications, information technology, and power-generation products and services.

[29] *Supra* note 9.

In these comments, the ERO Enterprise supports the Commission's proposed reforms to the interconnection process to improve the reliability issues related to modeling and performance of newly interconnecting resources. These reforms for large and small interconnecting generation resources would modernize Interconnection Procedures and Agreements as appropriate based on the needs of a modern grid. In particular, the ERO Enterprise asks that the Commission:

(i) Modify the LGIP/SGIP and LGIA/SGIA to require:

   a. Model validation with actual installed equipment prior to interconnection; and

   b. A "true-up" of modeling and studies to address any discrepancies between what was studied and what is installed (*see infra* Section IV.B.);

(ii) Modify the LGIP/SGIP and LGIA/SGIA to require inclusion of electromagnetic transient ("EMT") studies to ensure accurate modeling of nonsynchronous generation (*see infra* Section IV.C.);

(iii) Modify the LGIP/SGIP and LGIA/SGIA to incorporate elements of NERC Reliability Standards, Reliability Guidelines, and IEEE standards (*see infra* Section IV.D.);[30] and

(iv) Enact the Commission's proposed enhancements to increase the efficiency and effectiveness of the interconnection queue (*see infra* Section IV.E.).

These proposals may require additional time during the interconnection process, particularly while responsible entities become accustomed to reforms. The ERO Enterprise supports a study process that balances speed and diligence. While the ERO Enterprise agrees it is important to have a fair and transparent expedited study process, there needs to be sufficient time to perform necessary studies and identify any reliability risks prior to interconnection. Together, the Interconnection NOPR's proposed reforms, as supplemented by the ERO Enterprise proposed

[30] *See* NERC IBR Performance Guideline, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf; NERC IBR Interconnection Requirements Guideline, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf; referenced in Interconnection NOPR at P 313.

refinements, would enhance Interconnection Procedure and Agreement efficiency, effectiveness, and overall timeliness.

Further, the reforms proposed by the ERO Enterprise would result in consistent modeling/studies and performance obligations that support reliable operation of the BPS. As the Commission stated in the Interconnection NOPR, "this data submission requirement is intended to result in a comparable level of modeling accuracy among all generating facilities."[31] Moreover, assessments indicate that the proposed reforms should help prevent the types of events that have been documented in NERC disturbance reports and that also impose costs on resources and industry alike. As a result, the ERO Enterprise proposals would reflect a just and reasonable approach to help maintain reliability of the BPS as the resource mix evolves.

A. ERO Enterprise Reliability Assessments Demonstrate that the Commission Must Enhance Interconnection Procedures and Agreements to Address Risks

The Interconnection NOPR recognizes that NERC publications:

> [I]ndicate that transmission system planning and operations entities do not have adequate or accurate information about the actual behavior of non-synchronous generating facilities within their areas under all operating conditions, and further that these same entities continue to experience issues that NERC-issued alerts were intended to address.[32]

The Commission summarizes the ERO Enterprise's extensive reports, alerts, guidance, and RSTC subgroup activities which seek to make the public aware of issues facing the grid and potential mitigating activities that industry can take to target such issues. The Commission highlights that:

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[31] Interconnection NOPR at P 332.

[32] *Id.* at P 313; *see also* P 313 n.443 (citing the following NERC publications: "San Fernando Disturbance Report at vi ("Many of the issues identified in this disturbance appear systemic and are not being widely addressed by the solar PV fleet."); NERC/CAISO Joint Report at 30 ("BPS reliability is a critical factor during the interconnection process and presently plants are being interconnected in an unreliable manner based on studies that inadequately identify possible reliability issues prior to commercial operation"); Odessa Disturbance Report at 29 ("While the IRPWG reliability guidelines are some of the most downloaded guidelines produced and most widely used across the industry, it is clear that industry is not adopting the recommendations contained within NERC reliability guidelines.").")

> Since the large-scale reliability issues related to non-synchronous generating facilities during the Blue Cut Fire Event, NERC has: (1) published multiple disturbance reports documenting the events described above; (2) issued two NERC Alerts; (3) issued two technical reports; (4) issued two reliability guidelines regarding non-synchronous generating facility data collection and performance; and (5) published two white papers about the need to modify Reliability Standards to address this risk.[33]

The Interconnection NOPR then continues to describe work by the IRPS and Reliability Guidelines recommending enhancements to interconnection requirements for non-synchronous generating facilities.

ERO Enterprise comments in Commission proceedings and publicly posted materials demonstrate that the BPS has been planned, built, and operated based on assumptions that are now changing. At the September 2022 RSTC Meeting, NERC Staff presented BPS generation trend analysis that reflected initial ERO Enterprise findings regarding gaps in Reliability Standard coverage associated with the evolving resource mix. This analysis was prepared in light of concerns reflected in the Interconnection NOPR and prior ERO Enterprise comment regarding:

- Continued growth in nonsynchronous resources;
- Different responses to disturbances and dynamic conditions between nonsynchronous and synchronous resources;
- Lack of industry implementation of NERC recommended action to mitigate risks; and

[33] Interconnection NOPR at PP 313 (footnotes omitted) and accompanying footnotes 438-442 (citing Blue Cut Fire Event Report; Canyon 2 Fire Event Report; Angeles Forest and Palmdale Roost Events Report; San Fernando Disturbance Report; Odessa Disturbance Report; and NERC/CAISO Joint Report; NERC, *Industry Recommendation Loss of Solar Resources during Transmission Disturbances due to Inverter Settings* (June 2017); NERC, *Industry Recommendation Loss of Solar Resources During Transmission Disturbances due to Inverter Settings – II* (May 2018).; NERC, *Technical Report* (May 2020) (IRPTF Modeling Report); NERC, *WECC Base Case Review: Inverter-Based Resources* (Aug. 2020); NERC IBR Performance Guideline; NERC IBR Interconnection Requirements Guideline; NERC, *IRPTF Review of NERC Reliability Standards* (Mar. 2020), https://www.nerc.com/comm/PC/InverterBased%20Resource%20Performance%20Task%20Force%20IRPT/Review_of_NERC_Reliability_Standards_White_Paper.pdf; NERC, *Odessa Disturbance Follow-Up* (Oct. 2021), https://www.nerc.com/comm/RSTC_Reliability_Guidelines/White_Paper_Odessa_Disturbance_Follow-Up.pdf.).

- The ability of several regions to manage continuous penetration in their resource mix of nonsynchronous resources at a level greater than 60% and instantaneous penetration as high as 98%.[34]

As a result, ERO Enterprise Staff completed a holistic review of: (i) disturbance and event reports; (ii) Reliability Guidelines; (iii) Reliability Standards; (iv) resource adequacy reports; (v) weather dependence of available nameplate capacity; and (vi) white papers.[35] In addition, the team evaluated BPS trends data based on Energy Information Administration Form 860s submitted between 2017-2021 for generation greater than 1 MW and connected at 40 kV and above. Such data comprised assets that fell within the NERC bright-line BES definition and the greater BPS that forms the full scope of NERC's authority under section 215 of the FPA.

The BPS Trend Analysis demonstrated that there is an increasing gap between Reliability Standards coverage and facilities that could impact reliability. For example, approximately 97% of synchronous BPS assets overlap with the scope of the BES definition and, therefore, Reliability Standards. However, the number of nonsynchronous resources has grown such that only 84% of these BPS facilities overlap with the scope of the BES definition and are subject to Reliability Standards. In other words, while only 3% of synchronous BPS assets are not subject to NERC Reliability Standards, 16% of nonsynchronous resources appear not subject to Reliability Standards. *See* fig. 1 below.[36]

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[34] *Assessment of Generation Trends Across the BPS*, Agenda Item 9, at slide 2 (Sept. 14, 2022), https://www.nerc.com/comm/RSTC/AgendaHighlightsandMinutes/RSTC_Meeting_September_14_2022_Presentations.pdf ("BPS Trend Analysis").

[35] *Id.* at slide 3.

[36] *Id.* at slide 6.

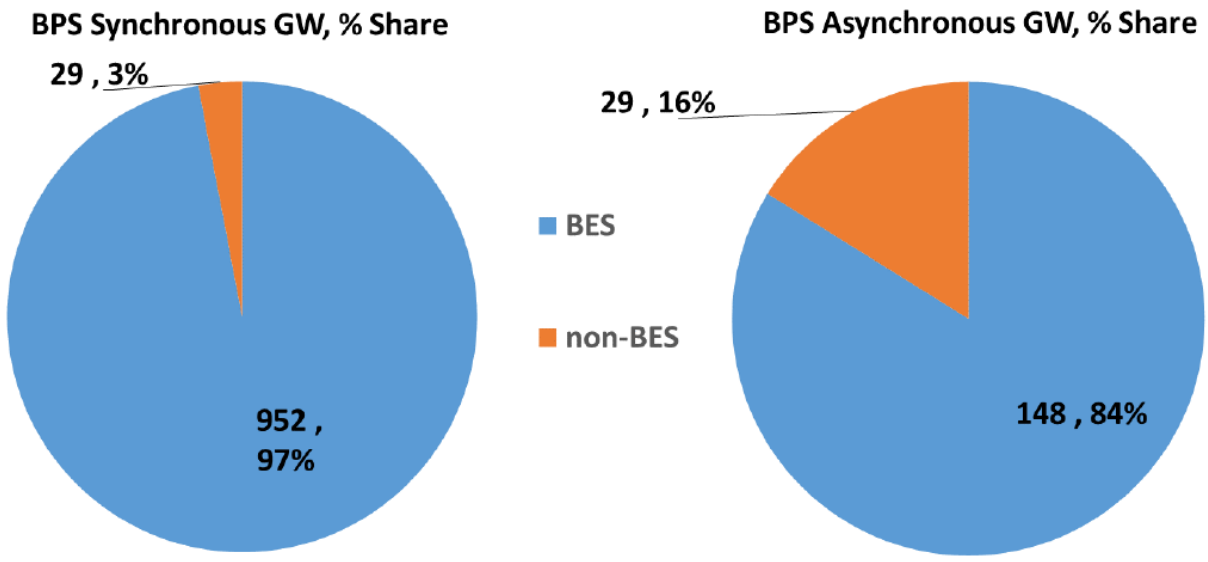

Figure 1

The 2021 interconnection queue shows over [1200 GW] of nonsynchronous resources in the queue, in comparison to the [200 GW] in 2010. *See* fig. 2 below.[37]

[37] *Id.* at slide 8 (presenting chart prepared by Berkley National Laboratory). Not all projects in the interconnection queues will be constructed. However, interconnection queues provide significant trend data. Please note, the reference to 29 GW in both pie charts is a coincidence.

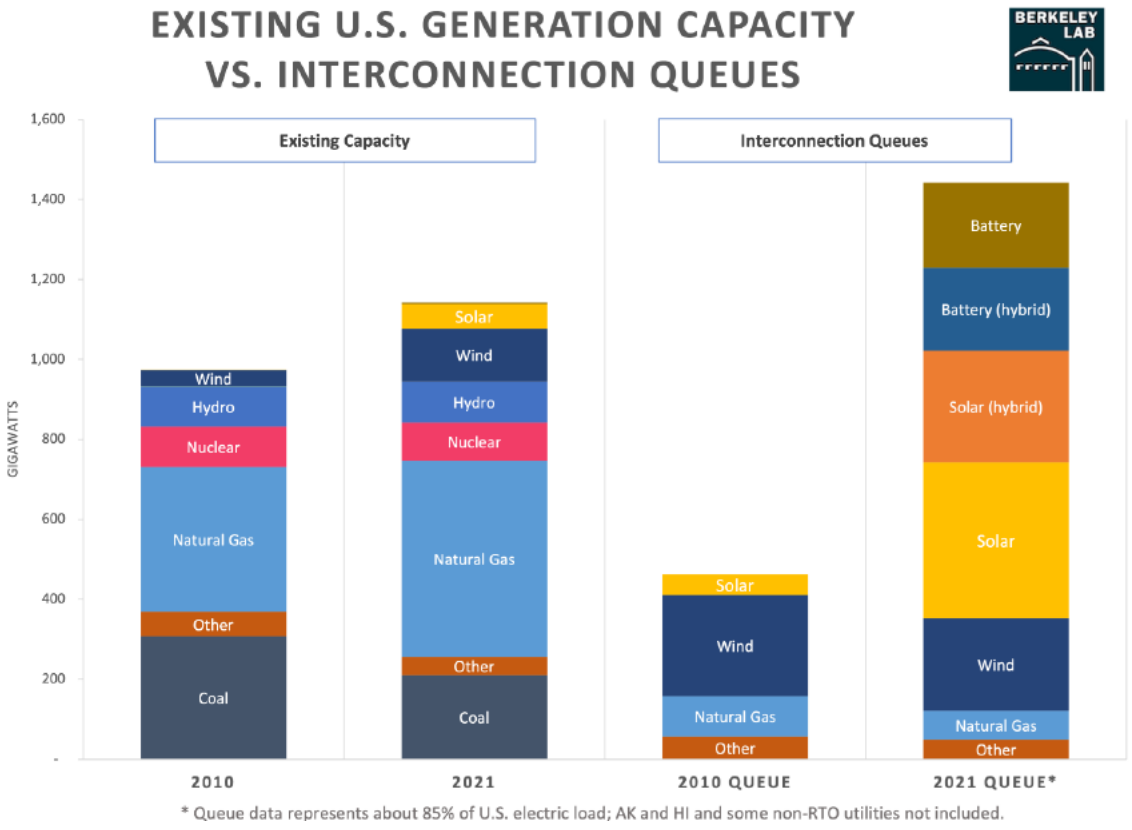

Figure 2

The disturbance reports, alerts, guidelines, and other deliverables developed by the ERO thus far have highlighted that abnormal IBR performance issues pose a significant risk to BPS reliability. Each event analyzed has identified new performance issues, such as momentary cessation, unwarranted inverter or plant-level tripping issues, controller interactions and instabilities, and other critical performance risks that must be mitigated. In light of the continued, unprecedented evolution of the grid and grid-impacting technology, the ERO Enterprise continues evaluating the potential risks created under the transforming grid. Beyond the issues identified in NERC disturbance reports, for example, the ERO Enterprise is becoming increasingly aware of the potential for cross-border operations. Such scenarios might arise between

generation/transmission assets based in the United States and operated by entities/facilities in Canada, or even between assets based in the United States and controlled by entities/facilities outside of North America. Cross-border operations raise potential cybersecurity risks and challenges associated with compliance monitoring and enforcement. The FPA does not appear to contemplate this type of technology, which typifies the variety of potential implications of a transforming grid and unexpected scenarios. The ERO Enterprise intends to investigate this risk more closely and identify any mitigating measures necessary.

To better articulate ERO Enterprise activities to target risks presented by the changing grid, NERC recently published its IBR strategy. The IBR Strategy outlines the four core tenets of its IBR risk mitigation strategy. *See* Fig. 3 below.[38]

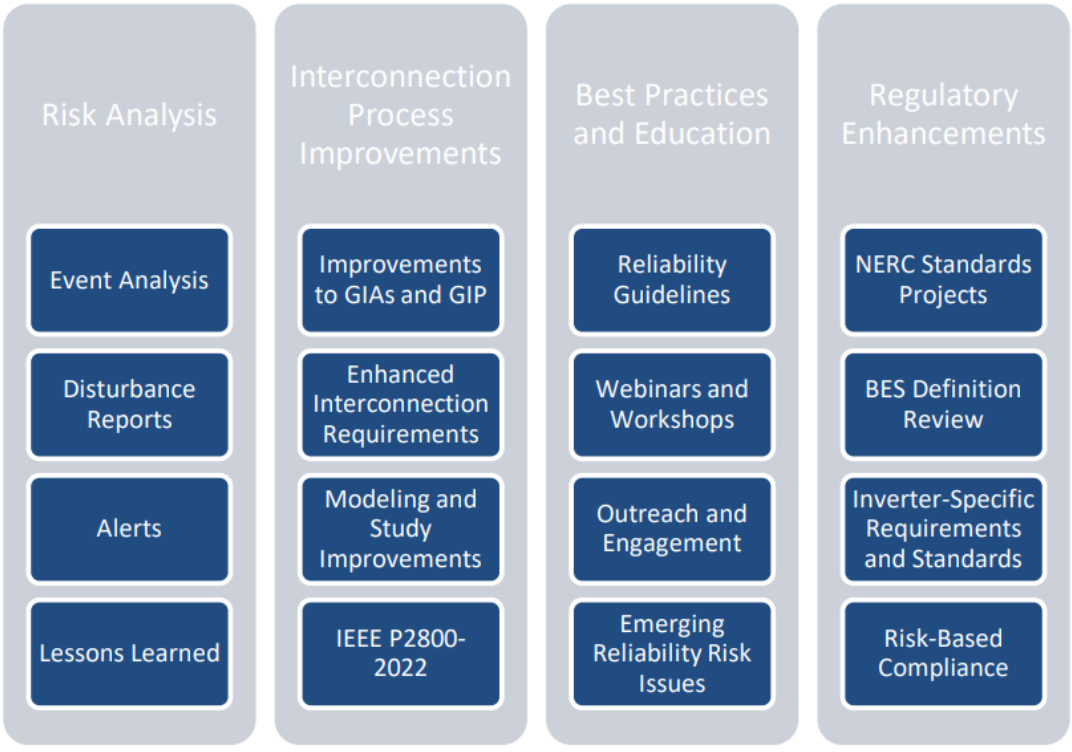

Figure 3: NERC IBR Risk Mitigation Strategy

[38] *See supra* IBR Strategy; Fig. 3.

The core tenets of NERC's IBR Strategy balance near- and long-term approaches to ensure reliable operation of the BPS and map to the NERC Risk Framework detailed in prior filings and the IBR Strategy itself. While the majority of the IBR Strategy focuses on ERO Enterprise activities, the second prong pursues enhancements to the Commission's Interconnection Procedures and Agreements. Many of the reliability risks associated with BPS-connected IBRs (e.g., model discrepancies, inaccurate reliability studies, poor ride-through performance) stem from challenges associated with the generator interconnection process and poor modeling thereunder. The following comments in Sections IV.B.–E., therefore, propose improvements to help the Commission modernize its Interconnection Procedures and Agreements.

B. The Commission Should Modernize Interconnection Procedures and Agreements to Require: a) Model Validation with Actual Installed Equipment; and b) "True-up" of Modeling and Studies Prior to Interconnection

The Interconnection NOPR recognizes that present modeling and studies may be inadequate to address needs associated with the transforming grid. The Commission states:

> [W]e are concerned that the *pro forma* LGIP and *pro forma* SGIP may be inadequate to address certain challenges associated with these changes, which is rendering Commission-jurisdictional rates unjust and unreasonable and unduly discriminatory or preferential through less specific or less strict modeling and performance requirements compared to synchronous generating facilities.[39]

After providing an overview of ERO Enterprise reliability assessments as described in Section IV.A. above and recent industry activities, the Commission concludes:

> We preliminarily find that the *pro forma* LGIP and *pro forma* SGIP may be unduly discriminatory or preferential to the extent that they do not require non-synchronous generating facilities to provide accurate and validated models to transmission providers during the generator interconnection process…. Additionally, we are concerned that, without a reform to require interconnection customers developing non-synchronous generating facilities to provide sufficiently accurate and validated

[39] Interconnection NOPR at P 303.

> models, interconnection studies may not identify the appropriate interconnection facilities and network upgrades needed for that interconnection request.[40]

ERO Enterprise analysis confirms that the interconnection process does not provide sufficiently accurate and validated models. *See supra*, Section IV.A. Reliability assessments indicate that model validation with actual installed equipment and a "true-up" with calculated prior to interconnection would help ensure proper analysis and studies prior to commissioning.

NERC has analyzed multiple system events involving IBRs abnormally responding to grid disturbances, and in many instances analysis shows that the models of the actual equipment did not match the actual system performance.[41] NERC recommends that the Commission also enhance its interconnection process by ensuring more rigorous and thorough plant commissioning, with both the interconnecting customer and the transmission provider signing off on models used in studies as compared with actual installed equipment. NERC continues to document systemic modeling errors in positive sequence dynamic models that are pervasive in interconnection-wide planning cases. The ERO Enterprise supports the Commission's proposed modeling requirements regarding submittal of user-defined root mean square ("RMS") positive sequence dynamic model, an appropriately parameterized standard library RMS positive sequence dynamic model, and an accurate and validated EMT model.[42] The ERO Enterprise uses the term "standard library model" rather than "generic library model" to avoid confusion, as the standard library model should use specific modeling parameters to sufficiently represent installed equipment. The *WECC Base Case*

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40 *Id.* at PP 318-319.

41 See ANOPR Comments at 3-4 (including recommendations and reference to the Odessa Report which "provides ERO Enterprise event analysis of a scenario where performance issues could have been identified during the interconnection process led to a Category 1i event on the BPS.").

42 Interconnection NOPR at P 329.

Review: Inverter-Based Resources found that generic or default parameters can lead to a systemic modeling issue and contributing to risks to reliability of the BPS.[43]

Disturbance analyses have also highlighted material mismatches between modeled and actual performance. Based on such analysis, the ERO Enterprise is concerned that the present process inadvertently creates material risk to reliability by allowing facilities to interconnect to the BPS based on studies conducted using models that do not match the actual performance.[44] Modeling errors are often due to changes that are made to equipment during the interconnection process without an update to the models. This challenge is exacerbated by the lack of quality review of models during the interconnection process or during plant commissioning. Moreover, projects may drop out of the interconnection queue during the interconnection process, causing further delays and gaps in studies. (*See also infra* Section IV.E.) NERC is revising Reliability Standards to enhance modeling, however, the Commission should also update its Interconnection Procedures and Agreements as these operate together with standards as part of the complementary regulatory construct under the FPA. (*See supra* Section III.B.)

To address the concerns summarized in these Comments, the ERO Enterprise requests that Interconnection Procedures and Agreements be revised to require that interconnecting resources and transmission providers conduct: a) model validation with actual installed equipment; and b) a "true-up" of modeling and studies prior to interconnection. Transmission providers should study the potential impacts of any material change to the facility (including, for example, the addition of an energy storage asset) even where the interconnection service level does not change. Material

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[43] *See WECC Base Case Review: Inverter-Based Resources* (Aug. 2020), https://www.nerc.com/comm/PC/InverterBased%20Resource%20Performance%20Task%20Force%20IRPT/NERC-WECC_2020_IBR_Modeling_Report.pdf.

[44] Inverter based resources include sophisticated monitoring and control equipment, which tell the units how to respond like a normal conventional unit would respond. However, oftentimes vendor settings are counter to how the equipment should react. To address this issue, it is important to take the time to do rigorous studies during interconnection processes, including EMT studies (*see infra* Section IV.D.).

modifications to the facility could alter stability and interaction of a resource with the grid, if not studied. For example, adding inverters increases short circuit current and charging batteries from the grid can impact system power flow. In addition to the recommended validation of models and installed equipment prior to interconnection, the Commission should consider process improvements such as increased rigor around project design and modeling data specifications. The Commission should require transmission providers to conduct quality review of models prior to studies and require that interconnection customers satisfy the quality review milestone as part of demonstrating readiness. *See infra* Section IV.E.

The ERO Enterprise encourages clear and consistent improvements to the modeling practices for positive sequence dynamic models as these models play a crucial role in interconnection-wide planning, notwithstanding their limitations. This would require a consistent approach on "netting" (primarily small generator modeling issue), guidance of creation of internal model versus regional models, and clarification on monthly, seasonal, and annual models. The ERO Enterprise believes this will improve the accuracy of study results and minimize discrepancies between the installed equipment and the equipment that was studied.[45] Interconnection customers can also help minimize the need for re-studies or speed of model validation by providing accurate data that incorporates the latest industry guidance.[46] These enhancements to modeling and model validation would help ensure greater reliability as new nonsynchronous resources interconnect.

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[45] This concept of incorporating both validation and increased rigor related to project design and modeling specifications is addressed in the NERC Odessa Disturbance report (Odessa Disturbance Texas Events: May 9, 2021 and June 26, 2021
Joint NERC and Texas RE Staff Report September 2021)

[46] *See, e.g.*, *supra* Section III (regarding NERC Reliability Guidelines); IEEE Std 1547-2018, *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interface*, https://sagroups.ieee.org/scc21/standards/1547rev/ (last updated May 22, 2022); and IEEE 2800-2022, *IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems*, https://standards.ieee.org/ieee/2800/10453/.

C. The Commission Should Require Electromagnetic Transient Modeling/Studies

The Commission states that it proposes to reform the *pro forma* LGIP and SGIP "to ensure that all interconnection customers requesting to interconnect a non-synchronous generating facility must provide the transmission provider with the models needed for accurate interconnection studies, as discussed below."[47] The Commission continues by describing certain studies, including "a validated EMT model, if the transmission provider performs an EMT study as part of the interconnection study process."[48] The Commission seeks comments as to whether its proposal to update modeling and performance requirements for system reliability are "necessary and/or sufficient to ensure that interconnection customers proposing non-synchronous generating facilities submit models during the generator interconnection process that accurately reflect the behavior of their proposed generating facility."[49]

The ERO Enterprise agrees that EMT studies are necessary to ensure accurate and complete models of nonsynchronous resources. The ERO Enterprise recommends that all nonsynchronous resources perform EMT models prior to interconnection for consideration by transmission operators and planners.[50] At present, EMT models are not required and EMT studies are not required to be performed. Event analysis, however, underscores their value to helping manage reliability risks of the modern grid.[51]

The NERC RSTC recently endorsed a standard authorization request ("SAR") proposing to include EMT models and studies in planning-related NERC Standards to ensure reliable

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47 Interconnection NOPR at P 328.

48 *Id.* at P 329.

49 *Id.* at P 335.

50 The Interconnection NOPR appears unclear as to whether EMT studies would consistently be required of nonsynchronous resources.

51 *See, e.g.*, ANOPR Comments at pp. 2-3, 10-11; and Odessa Report at p. vi. *See also* NERC's 2022 Summer Reliability Assessment at p. 6, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2022.pdf (noting that as IBRs continue to increase across North America, "the need for EMT modeling and studies will only grow exponentially").

operation of the BPS. The NERC Standards Committee posted the SAR for informal comment and solicited standard drafting team members. As stated on the project development page, transmission planners and planning coordinators are concerned about the lack of accurate modeling data and need to perform EMT studies during the interconnection process and long-term planning horizon. The growth of inverter technology has pushed conventional planning tools to their limits in many ways, and responsible entities are now grappling with the need for detailed studies using EMT models to evaluate potential issues related to IBR integration.[52]

The Commission should similarly modernize its Interconnection Procedures and Agreements to help ensure accurate, complete, and consistent EMT studies. EMT studies would help manage the reliability risks presented from the integration of IBRs by providing an opportunity for transmission providers to: (i) identify potential performance issues, (ii) work with resources to address potential performance issues and impacts to reliability before interconnection and commercial operation, and (iii) ensure model quality in the future.[53] These improvements to the interconnection study process should help improve potential performance issues, and in turn, allow transmission providers and planners to adjust interconnection-wide models to accurately reflect performance.

D. Interconnection Agreements and Procedures Should Incorporate Recommendations in NERC Reliability Guidelines Pertaining to Interconnecting Inverter-Based Resources.

The Interconnection NOPR proposes incorporating elements from NERC Reliability Guidelines into the *pro forma* LGIA/SGIA and LGIP/SGIP. For example, the Commission states "[w]e propose to require newly interconnecting non-synchronous generating facilities to continue

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[52] *See,* Project 2022-04 EMT Modeling, https://www.nerc.com/pa/Stand/Pages/Project2022-04EMTModeling.aspx (evaluating potential modifications to Reliability Standards FAC-002, MOD-032, and TPL-001).

[53] ANOPR Comments at pp. 2-3, 10-11; Odessa Report at p.vi.

current injection inside the 'no trip zone' of the frequency and voltage ride-through curves of Reliability Standard PRC-024-3 or its successor standards, in accordance with NERC's recommendation in the NERC IBR Guideline."[54] Further, the Commission states when discussing proposed modeling requirements that it:

> [S]eek[s] comment on whether these proposed reforms are necessary and/or sufficient to ensure that interconnection customers proposing non-synchronous generating facilities submit models during the generator interconnection process that accurately reflect the behavior of their proposed generating facility. Further, we seek comment on whether the inclusion of the table based on NERC Guidelines that cite WECC-approved models is appropriate.[55]

The ERO Enterprise supports and appreciates the Commission's proposal to incorporate elements of Reliability Guidelines pertaining to the interconnection of IBRs as part of Interconnection Procedures and Agreements.[56] The IBR Guideline, for example, served as a pillar for IEEE 2800-2022 developments and NERC activities regarding the integration of IBRs as part of the BPS. IEEE standard P2800-2022 is instrumental in advising the adoption of uniform technical minimum requirements for the interconnection, capability, and lifetime performance of IBRs interconnecting with transmission and sub-transmission systems. The recommendations include advised performance requirements for reliable integration of IBRs into the BPS, including, but not limited to, essential reliability services.[57] NERC staff along with industry participated in development of IEEE standard 2800-2022 and believes that it, like NERC's Reliability Guidelines, is of great value as IBRs interconnect.

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54 Interconnection NOPR at P 336.

55 *Id.* at P 335.

56 For example, NERC recommends that Interconnection Agreements include language regarding minimum disturbance monitoring data.

57 These essential reliability services include voltage and frequency ride-through, active power control, reactive power control, dynamic active power support under abnormal frequency conditions, dynamic voltage support under abnormal voltage conditions, power quality, negative sequence current injection, and system protection.

While SARs and standards projects could recommend that standard drafting teams consider IEEE standards and include elements as part of mandatory and enforceable Reliability Standards, the IEEE standards are not themselves mandatory. In addition, as the Interconnection NOPR notes, there has been incomplete adoption of NERC Reliability Guidelines.[58] As a result, in addition to IEEE work supported by industry and ERO Enterprise participants, NERC Reliability Guidelines, and NERC Reliability Standards projects, the time is ripe to include elements of NERC Reliability Guidelines for IBRs within Interconnection Procedures and Agreements as proposed in the Interconnection NOPR.

E. The Commission Should Enact Enhancements to Increase the Efficiency and Effectiveness of the Interconnection Queue

The Interconnection NOPR recognizes that the interconnection queue process is inefficient, and often clogged with speculative or nonviable requests, causing undue delays, costs, and difficulty in modeling potential impacts of viable, newly interconnecting facilities.[59] The Commission states that "this NOPR proposes reforms to remedy several well-established sources of delay, such as speculative interconnection requests, affected systems coordination, and serial interconnection queues."[60] The Commission states that it "preliminarily find[s] that a first-ready, first-served cluster study process, coupled with increased financial commitments and readiness requirements … will address the interconnection queue issues described above…."[61] For example, the Interconnection NOPR states that the minimal requirements to submit interconnection requests

58 *See, e.g.*, Interconnection NOPR at P 313 n.443.
59 *See, e.g.*, *id.* at PP 19, 55, and 167.
60 *Id.* at P 167 (adding a parallel intent to establish mechanisms to hold transmission providers accountable for the timely execution of their duties.)
61 *Id.* at P 64.

and tendency for non-viable projects to linger are contributing to significant backlogs and study delays.[62] The Commission also explains that it is:

> [C]oncerned that the lack of transparency for prospective interconnection customers to obtain information about potential interconnection costs prior to submitting an interconnection request is problematic. Without this information, it is difficult for interconnection customers to assess the viability of a specific proposed generating facility. Subsequently, interconnection customers submit multiple speculative interconnection requests in an attempt to obtain information through the system impact study process about the costs associated with various project configurations.[63]

The ERO Enterprise supports the Commission's proposals to streamline the Interconnection Process and enhance interconnection queue efficiency and effectiveness. NERC and the Regional Entities confirm the Commission's observations that significant backlog, restudies, and uncertainty are contributing to undue cost, delay, and inaccurate interconnection studies. As a result, the ERO Enterprise supports the Interconnection NOPR's proposals to:

(i) Require that transmission providers give prospective interconnection customers greater information regarding possible network upgrades;

(ii) Use a cluster study process; and

(iii) Impose commercial readiness criteria on interconnection requests.

These proposals would help better support reliable operation of the grid as new resources interconnect and enhance the speed of interconnection processing.

The ERO Enterprise supports the Commission's proposal to require that transmission providers give prospective interconnection customers additional information regarding possible network upgrade costs. Greater transparency seems likely to help reduce the number of

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62 *Id.* at P 127 (explaining "[w]e have learned through interconnection queue reform filings that interconnection customers typically do not actually construct generating facilities unless they have entered into an off-take agreement for the output of such facilities, at least in bilateral market areas. On the other hand, interconnection customers that do not enter into such agreements frequently withdraw from the interconnection queue, sometimes late in the study process or even after the conclusion of the study process, triggering the types of delays and re-studies for commercially viable projects that raise concerns for us.").

63 *Id.* at P 40; *see also id.* at P 42.

exploratory and duplicative interconnection requests that can occur under the present serial interconnection queue process. To manage the potential time and burden associated with these additional studies, the Commission could consider cluster-type studies and transmission provider disclosure of study results to all prospective interconnecting customers to the extent reasonable and appropriate. Such studies would not provide all information necessary to understand potential costs; however, these studies could give entities key information early in the process.

The ERO Enterprise supports a cluster study approach, as the existing serial, first-come, first-served interconnection study process is resulting in significant queue backlog, uncertainty, drop-outs, and repetitive work. However, as part of this study process, NERC and the Regional Entities urge the necessity of accurate models. The ERO Enterprise appreciates the potential advantages of installing newer equipment at the time of installation than was initially considered. As noted in the Interconnection NOPR, grid forming technology, for example, could provide reliability benefits as the penetration of IBRs continues.[64] However, models that do not reflect installed equipment are not useful for ascertaining potential reliability risks. Therefore, ERO Enterprise support for cluster studies is predicated upon parallel enhancements for model validation with actual installed equipment and a true-up prior to interconnection. *See supra* Section IV.B.

Finally, the ERO Enterprise supports enhancing commercial readiness criteria as another means of helping to minimize the number of speculative or exploratory projects in the interconnection queue. This is a significant issue and a critical component to achieving a streamlined interconnection queue process. As part of such enhancements, the ERO Enterprise recommends that commercial readiness criteria require evidence of due diligence and readiness to

[64] *Id.* at P 309 (discussing grid-following inverters).

procure necessary equipment with appropriate types of controls and devices. This criterion would leave room for change management as necessary and appropriate, while introducing greater certainty surrounding intended equipment earlier during studies and thereby reducing the likelihood of significant changes at time of interconnection and commercial operation.

V. CONCLUSION

The ERO Enterprise looks forward to the Commission's continued efforts to modernize Interconnection Procedures and Agreements. NERC and the Regional Entities take this opportunity to support the Interconnection NOPR and request: (i) model validation and "true-up" prior to interconnection; (ii) EMT studies; (iii) the incorporation of elements from NERC Reliability Guidelines associated with IBRs as part of the *pro forma* LGIP/SGIP and LGIA/SGIA; and (iv) enhancements to the interconnection queue process.

Respectfully submitted,

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