UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Reliability Standards to Address Inverter-Based Resources	**)** **)** **)**	**Docket No. RM22-12-000**

JOINT COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION AND THE REGIONAL ENTITIES IN RESPONSE TO NOTICE OF PROPOSED RULEMAKING

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The North American Electric Reliability Corporation ("NERC") and the six Regional Entities,[1] collectively the "Electric Reliability Organization ("ERO") Enterprise," submit comments on the Federal Energy Regulatory Commission ("FERC" or "Commission") Notice of Proposed Rulemaking ("NOPR") proposing to direct NERC to develop new or modified Reliability Standards that address concerns in four topic areas related to the impacts of inverter-based resources ("IBR") on the reliable operation of the Bulk-Power System ("BPS").[2] The Commission proposes to direct NERC to submit a compliance filing within 90 days of the effective date of a final rule containing a detailed plan explaining how NERC will develop and submit new and revised Reliability Standards to the Commission within 36 months of Commission approval of the plan.

The ERO Enterprise appreciates the Commission's attention to addressing the reliability risks associated with the rapid growth of IBRs on the BPS. The speed of IBR resource deployment

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[1] The six Regional Entities include the following: Midwest Reliability Organization, Northeast Power Coordinating Council, Inc., ReliabilityFirst Corporation, SERC Reliability Corporation, Texas Reliability Entity, Inc. ("Texas RE"), and Western Electricity Coordinating Council ("WECC").

[2] *Reliability Standards to Address Inverter-Based Resources,* Notice of Proposed Rulemaking, 181 FERC ¶ 61,125 (2022) [hereinafter NOPR].

Unless otherwise indicated, all capitalized terms used herein shall have the meaning in the *Glossary of Terms Used in NERC Reliability Standards*, available at https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

continues to challenge grid planners, operators, protection engineers, and many other facets of the electricity sector. While inverter-based technology can provide significant benefits to the BPS, this technology can also introduce significant risks to the system if it is not integrated properly. These risks have been highlighted in multiple ERO Enterprise disturbance reports issued over the last several years.[3] Addressing these risks in a timely and comprehensive manner continues to be a high priority for the ERO Enterprise. The ERO Enterprise therefore supports the Commission's NOPR as complementary to the work the ERO Enterprise is presently undertaking and offers comment on several aspects of the NOPR proposals. The ERO Enterprise also offers an alternative proposed timeline for standards development that it believes will better leverage existing and planned projects to address high priority risks. The ERO Enterprise respectfully requests that the Commission take these comments into consideration when issuing a final rule in this proceeding.

I. NOTICES AND COMMUNIATIONS

Notices and communications with respect to this filing may be addressed to the following:[4]

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[3] These disturbance event reports are available on NERC's website at https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx.

[4] Persons to be included on the Commission's service list are identified below 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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II. SUMMARY OF THE NOPR

In the NOPR, the Commission proposes to direct NERC, the Commission-certified Electric Reliability Organization,[5] to develop new or revised Reliability Standards that address reliability gaps in the present Reliability Standards on four key issues the Commission believes are critical toward reliable integration of increasing levels of IBR resources. The Commission proposes

[5] NERC was certified by the Commission as the ERO, pursuant to Section 215(c) of the Federal Power Act, by Commission order issued July 20, 2006. *N. Am. Elec. Reliability Corp.,* 116 FERC ¶ 61,062 (2006).

different action depending on whether the IBRs meet NERC's Bulk Electric System ("BES") definition and are registered with NERC for compliance purposes (registered IBRs), whether the IBRs are connected directly to the BPS but are not registered with NERC (unregistered IBRs),[6] or whether the IBRs are distributed energy resources (i.e. connected to the distribution system) (IBR-DER). The proposed topic areas and related considerations are summarized as follows:

Topic Areas for Reliability Standards Enhancements

1. **data sharing requirements**, including:[7]
    - the provision of complete and accurate data and parameters (including control settings for momentary cessation and ramp rates) needed to create and maintain models used to perform steady-state, dynamic, and short circuit studies regarding registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate; and
    - enhanced requirements for disturbance monitoring data for registered IBRs;
2. **model validation requirements**, including:[8]
    - the provision of validated models of registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate, at a sufficient fidelity and accuracy for planners and operators to perform valid facility interconnection, planning, and operational studies comparable to synchronous generation resources;
    - requirements for the coordination of interconnection-wide cases that accurately reflect real-world interconnection-wide IBR behavior; and
    - requirements for the use of approved industry IBR models that accurately reflect the behavior of IBRs during both steady state and dynamic conditions;
3. **requirements for planning and operational studies**, including:[9]
    - requirements for planning assessments to include the study and evaluation of performance and behavior of individual and aggregate registered IBRs and unregistered IBRs, as well as IBR-DERs in the aggregate, under normal and contingency system conditions in the planning area, taking into consideration the ride through performance of such IBRs in the planning area; and

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6 As discussed later in these comments, the Commission recently directed NERC to submit a work plan by February 15, 2023 to address how it will identify and register owners and operators of IBRs that are connected to the BPS, but are not currently required to register with NERC under the definition of Bulk Electric System. *Registration of Inverter-Based Resources*, 181 FERC ¶ 61,124 (2022). Thus, the scope of what is considered "registered IBR" and "unregistered IBR" would change following the completion of registration efforts under the directed work plan.

7 NOPR at PP 76-81.

8 NOPR at PP 82-86.

9 NOPR at PP 87-89.

- requirements for operational analysis, real-time monitoring, and real-time assessments to include the performance and behavior of individual and aggregate registered IBRs and unregistered IBRs, as well as IBR-DERs in the aggregate, including non-bulk electric system data and external power system network data identified in their data specifications; and

4. **performance requirements for registered IBRs**, including:[10]
    - frequency ride through requirements that address the unique characteristics of IBRs;
    - voltage ride through requirements, depending on system capability, or requirements for compensatory measures; and
    - requirements addressing post-disturbance IBR ramp rate interactions and phase lock loop synchronization.

In support for its proposals, the Commission cites multiple ERO resources on IBR issues, including reliability guidelines, white papers, reliability assessments, technical reports, event reports, NERC alerts, and other resources.[11] The Commission also notes NERC's extensive efforts on IBR issues to date, including committee work, as well as other industry efforts underway.[12] The Commission states that, despite efforts to address IBR reliability issues at the state, local, or individual entity level, "the continuing events across the Bulk-Power System and the risks that they pose to its reliable operation underscore the need for mandatory Reliability Standards to address these issues on a nationwide basis."[13]

The Commission proposes to direct NERC to submit a compliance filing, within 90 days of the effective date of a final rule in this proceeding, that includes a "detailed, comprehensive standards development and implementation plan" for developing and implementing the new and revised Reliability Standards addressing the issues identified above, taking into consideration BPS

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10 NOPR at PP 90-97.

11 *See* NOPR app. A, NERC IBR Resources Cited in the NOPR.

12 NOPR at PP 19-23.

13 *Id.* at P 26.

risks, projects already underway, resource constraints, and other factors if necessary.[14] The Commission further proposes to direct NERC to submit new or modified Reliability Standards addressing the four key areas on a staggered approach, beginning 12 months from Commission approval of NERC's standards development and implementation plan, as follows:[15]

- Reliability Standards to address registered IBR failures to ride through frequency and voltage variations during normally-cleared BPS faults: within 12 months of Commission approval of the standards development and implementation plan;

- Reliability Standards to address the interrelated proposed directives related to registered IBR, unregistered IBR, and IBR-DER data sharing, model validation, and planning and operational studies, and registered IBR disturbance monitoring data sharing: within 24 months of Commission approval of the standards development and implementation plan; and

- Reliability Standards to address directives for post-disturbance performance (including, but not limited to, post-disturbance ramp rates and phase-locked loop synchronization): within 36 months of Commission approval of the standards development and implementation plan.

The Commission seeks comments on its proposals.

III. ERO ENTERPRISE COMMENTS

The ERO Enterprise supports the Commission's efforts to strengthen reliability of the BPS by recognizing the elevated risks that IBRs may pose to reliable operation of the BPS if not addressed appropriately. As the Commission notes in the NOPR, the ERO Enterprise has taken an active role in developing reliability guidelines, disturbance reports, technical reports, white papers, alerts, and other materials to raise awareness of possible IBR risk issues and to provide industry with best practices to mitigate those issues. Despite these efforts, the ERO Enterprise has identified that there are gaps in the IBR space that are not being addressed adequately by registered entities,

[14] *Id.* at P 7.

[15] *Id.* at P 73.

and that additional action is necessary to enhance the NERC Reliability Standards to address reliability risks.

The ERO Enterprise supports the four topic areas for Reliability Standards enhancements outlined by the Commission in the NOPR. These four topic areas align very well with NERC's identification of risk areas. The ERO Enterprise offers comments regarding the details of several of the Commission's proposals, organized by topic area identified in the NOPR (data sharing, data modeling and validation, planning and operational studies, and performance), as well as a separate discussion of considerations related to IBR-DERs. The ERO Enterprise comments on the Commission's proposed timeline for Reliability Standards development and suggests changes that would facilitate the effective development of Reliability Standards in those topic areas. The ERO Enterprise also notes that, while Reliability Standards play an important role in addressing the challenges of the transforming grid, standards development will be informed by Commission action on NERC's proposed IBR registration work plan and the Commission's proposed interconnection reforms.[16] Close coordination in the timing of these actions will be required to ensure that standards development can proceed in a timely and efficient fashion.

Last, the ERO Enterprise highlights other work underway to address topic areas related to IBRs. While the ERO Enterprise is not requesting any specific Commission action regarding these other topic areas at this time, it is important to recognize that the work to identify and address IBR risks remains ongoing, and efforts to address any newly-identified risks may continue past the completion of the standards development and implementation plan contemplated by the NOPR.

[16] *See Registration of Inverter-Based Resources*, 181 FERC 61,124 (2022) (directing NERC to submit a work plan for registering IBRs) and *Improvements to Generator Interconnection Procedures and Agreements*, Notice of Proposed Rulemaking, 179 FERC ¶ 61,194 (2022).

The ERO Enterprise appreciates the opportunity to provide these comments and respectfully requests the Commission take these comments into consideration in issuing a final rule in this proceeding.

A. Proposed Directives Regarding Data Sharing

The ERO Enterprise supports the topics outlined in the NOPR regarding IBR data sharing, including the provision of complete and accurate data and parameters for modeling and enhanced requirements for disturbance monitoring data. The ERO Enterprise offers the following comments on this aspect of the NOPR for the Commission's consideration.

1. Proposed Directives for Requirements Addressing Data Accuracy, Completeness, and Sharing (NOPR PP 77-78)

In the NOPR, the Commission states that the current Reliability Standards do not require applicable entities to provide data that represents the behavior of IBRs at a sufficient level of accuracy and fidelity for planners and operators to accurately plan, operate, and analyze disturbances on the BPS.[17] The importance of data accuracy for IBRs cannot be understated, as poor or inadequate data, models, and information has proven to be a significant issue in a number of areas related to IBRs. For example, Generator Owners may provide modeling data and information; however, that data may be generic or based on default parameters that do not reflect the as-built facility. Data quality is critical to reliable operation of the BPS, and entities must use data and models that reflect the as-built facility for accurate reliability studies. The ERO Enterprise therefore agrees that additional emphasis must be placed on modeling data quality and accuracy in the Reliability Standards. Data accuracy, completeness, usability, and fidelity should be

[17] NOPR at P 76.

explicitly defined, tested, and verified by all applicable entities, particularly for modeling information used in reliability studies.

2. Proposed Directive for Requirements Addressing Disturbance Monitoring Data (NOPR P 78)

The ERO Enterprise agrees that enhanced requirements for disturbance monitoring data for registered IBRs are warranted. Adequate disturbance monitoring data is fundamental to model validation and post-mortem event analysis activities, and it is used extensively to identify possible reliability risks for the IBR fleet. Therefore, the ERO Enterprise supports the establishment of minimum disturbance monitoring data requirements for registered IBRs.

The current PRC-002 standard was written with synchronous generation in mind, as that was the predominant form of generation in use at the time. With the growth of IBRs, it is important to update the PRC-002 standard so that it is applicable to IBRs in terms of disturbance monitoring data collection (e.g., sequence of events recording, digital fault recording, synchronized phasor measurement unit recording, inverter oscillography recording data, and inverter and plant-level fault codes) and data retention. NERC currently has a standards development project underway, Project 2021-04 Modifications to PRC-002,[18] to ensure that disturbance monitoring data is available and provided by Generator Owners of IBR facilities.

3. Proposed Directive for Requirements Addressing Data from Unregistered IBRs and IBR-DERs (NOPR P 79)

The ERO Enterprise agrees that the Reliability Standards should be enhanced to ensure adequate and quality data is available from all BPS-connected resources to ensure the accuracy of reliability studies used to plan and operate the BPS. Data from unregistered IBRs and IBR-DERs is critical for accurate and complete reliability studies in the long-term planning horizon, short-

[18] More information on Project 2021-04 Modifications to PRC-002-2 is available on the NERC standards project page, https://www.nerc.com/pa/Stand/Pages/Project-2021-04-Modifications-to-PRC-002-2.aspx.

term planning horizon, and operations horizon. Potential Reliability Standards revisions may include modifications to the applicable Transmission Operations ("TOP") and Interconnection Reliability Operations and Coordination ("IRO") standards in the operations planning and real-time horizons, as well as to the applicable Modeling, Data, and Analysis ("MOD") Reliability Standards in the long-term planning horizon.

IBR-DERs will also play an increasing role in BPS reliability. Therefore, the ERO Enterprise agrees that Distribution Providers[19] should be required to provide adequate and accurate data to represent the IBR-DERs in the aggregate (and possible individual larger DERs, as deemed necessary) in studies. Further considerations regarding data and modeling for IBR-DERs are discussed in Section III.G, below.

B. Proposed Directives Regarding Modeling and Validation

The ERO Enterprise generally supports the Commission's proposals for enhanced Reliability Standards requirements for IBR modeling and validation. The ERO Enterprise has highlighted systemic modeling issues with IBRs in multiple reports[20] and agrees that the Reliability Standards must be enhanced to address these issues. The ERO Enterprise agrees that Transmission Planners, Planning Coordinators, and Reliability Coordinators should have planning and operational models that represent all generating resources, including registered and unregistered IBRs, as well as aggregate representation of distributed energy resources (both synchronous and inverter-based). The ERO Enterprise also agrees that enhanced requirements to

[19] In some cases, this responsibility may need to fall to the Transmission Owner, such as where a Distribution Provider is not registered for a distribution system served by the Transmission Owner.

[20] *See* NERC and Texas RE Staff, *Odessa Disturbance: Texas Events: May 9, 2021 and June 26, 2021* (Sep. 2021), https://www.nerc.com/pa/rrm/ea/Pages/May-June-2021-Odessa-Disturbance.aspx; *see also* NERC and WECC, *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.

ensure model accuracy are necessary. Enhanced Reliability Standards requirements would help drive improvements to models and studies and minimize model and study result inaccuracies that could threaten BPS reliability. NERC has a number of projects underway in this area, including Project 2020-06 Verifications of Models and Data for Generators[21] as well as Project 2022-04 EMT Modeling.[22] Additional projects may be needed to ensure clarity and adequate requirements for model accuracy in the future, including projects to address Commission directives included in a final rule in this proceeding. These projects would be reflected in any standards development and implementation plan NERC is required to submit under a final rule in this proceeding. NERC is also planning to issue a modeling-focused NERC Alert[23] later in 2023 to better understand the extent of condition of modeling issues across the IBR fleet; the results of this Alert may be used to inform future standards development efforts.

The ERO Enterprise offers the following comments on the Commission's proposed directives for new and revised Reliability Standards regarding modeling and validation for IBRs.

1. Proposed Directive for Requirements Addressing Model Validation and Dynamic Modeling (NOPR PP 83-84)

The ERO Enterprise supports the Commission's proposal for standards revisions to address more directly model validation for IBRs, including through Reliability Standards requirements that

[21] For more information on this project, *see* Project 2020-06 Verifications of Models and Data for Generators, https://www.nerc.com/pa/Stand/Pages/Project-2020_06-Verifications-of-Models-and-Data-for-Generators.aspx. As part of its standard development efforts, NERC has been made aware of industry concerns regarding the ability to obtain validated models or data from existing IBRs that would be within the scope of the Commission's proposed directive, but are themselves not subject to NERC Reliability Standards. To the extent concerns are raised in this proceeding regarding requirements to obtain validated models or data from unregistered IBR or IBR-DER, the Commission should provide further guidance in a final rule.

[22] For more information on this project, *see* Project 2022-04 EMT Modeling, https://www.nerc.com/pa/Stand/Pages/Project2022-04EMTModeling.aspx.

[23] NERC issues alerts under Section 810 of the NERC Rules of Procedure, Information Exchange and Issuance of NERC Advisories, Recommendations, and Essential Actions. The nature of information being conveyed and required entity response vary depending on the type of alert being issued (Level 1 Alert, Level 2 Alert, or Level 3 Alert).

account for the technological differences between IBRs and synchronous resources. Reliability Standards enhancements could include explicit requirements for Generator Owners to provide accurate, validated models and sufficient supporting documentation to ensure model quality. Reliability Standards enhancements could also include requiring the receiving entities to: (1) verify that the models are of sufficient accuracy through model quality checks and supporting documentation establishing model accuracy; and (2) initiate corrections in a timely fashion. Model accuracy should be ensured throughout the interconnection study process and reaffirmed as part of required activities under the MOD-026 and MOD-027 Reliability Standards.[24] It is important for BPS reliability that: (1) the studies conducted during the interconnection process are using models that reflect the equipment to be built in the field; and (2) the equipment be parameterized such that control and protections match what was studied. Any discrepancies should be addressed prior to commercial operation, with the appropriate corrective measures directed at the Generator Owner. Enhancements such as these would help to address the root causes of modeling issues identified by the ERO Enterprise to date. It is also important that there be consistency between interconnection requirements and Reliability Standard requirements.

In issuing a final rule in this proceeding, the Commission should consider that the entire model should be an accurate reflection of the as-built facility throughout the life cycle of the project. Accurate modeling would reflect all relevant dynamic performance characteristics, including ride-through modes and settings, inverter and plant-level protections, and representation of other elements in the facility such as supplemental reactive devices, and not just specific controls or modes of operation of the IBR such as momentary cessation or ramp rates. Validated dynamic models should be kept up to date and should fully represent the facility and all of its dynamic

[24] As noted elsewhere in these comments, NERC Project 2020-06 Verifications of Models and Data for Generators is currently developing revisions to these standards to enhance requirements for model verification.

controls and protections that could result in tripping, unexpected reduction of power output, or changes in facility dynamic performance. Experience has demonstrated that, without all of the relevant protections and controls being modeled and validated, the resulting interconnection and long-term planning studies will not identify possible performance issues.[25]

Close coordination among the relevant entities will be required where the owners of the resources are not subject to NERC Reliability Standards. With respect to IBRs-DERs in particular, the ERO Enterprise recommends that the relevant entity, whether that is the Distribution Provider or the Transmission Owner (if no Distribution Provider is registered for that system) coordinate with the Transmission Planner, Planning Coordinator, Balancing Authority, Transmission Operator, and Reliability Coordinator for developing, submitting, and validating aggregate DER models (inclusive of IBR-DER) in planning or operational studies. As the Distribution Provider and Transmission Owner are not the owners of the assets they would be required to address (and may be using other data sources than those provided by the asset owners[26]), validation could be difficult and would require close coordination. IBR-DERs should be modeled in aggregate to help ensure accurate BPS reliability studies; sharing of modeling data and information with the Transmission Planner and Planning Coordinator is of critical importance.

Last, while not specifically referenced in the Commission's proposal, the ERO Enterprise would support the Commission expanding the scope of its proposed directive to require the development of Reliability Standards addressing electromagnetic transient ("EMT") models. This

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[25] *See, e.g.*, NERC and Texas RE Staff, *Panhandle Wind Disturbance Texas Event: March 22, 2022* (Aug. 2022), https://www.nerc.com/pa/rrm/ea/Documents/Panhandle_Wind_Disturbance_Report.pdf; *see also* NERC and Texas RE Staff, *2022 Odessa Disturbance Texas Event: June 4, 2022*, (Dec. 2022), https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_2022_Odessa_Disturbance_Report%20(1).pdf [hereinafter 2022 Odessa Report].

[26] Other data sources may include, for example, resource or load forecasts provided by Resource Planners or state authorities.

is due to their growing prevalence and the need to ensure reliable operation of the BPS with increasing levels of IBRs.[27] NERC currently has a standard project underway, Project 2022-04 EMT Modeling, to address the inclusion of EMT modeling and studies in the respective Facilities Design, Connections, and Maintenance ("FAC"), MOD, and Transmission Planning ("TPL") Reliability Standards.[28] NERC is also establishing an EMT Task Force as well as publishing EMT modeling reliability guidelines to support industry in this area. The ERO Enterprise would support further Commission action as complementing NERC's existing work in this area.

2. Proposed Directive for Requirements Regarding Coordination of Interconnection-Wide Cases (NOPR P 85)

The ERO Enterprise agrees that closer ties and coordination are needed regarding MOD-032 and MOD-033 activities to ensure that the models are tested more regularly and any modifications or updates to the models are provided to the Transmission Planner, Planning Coordinator, Balancing Authority, Transmission Operator, and Reliability Coordinator. Entities use steady-state and dynamic models that need to be kept up-to-date to reflect expected operating conditions. The MOD-032 and MOD-033 Reliability Standards should be updated to address this need directly, such as through requirements to employ a more comprehensive practice for system model validation that ensures models are rigorously tested for any deficiencies. The ERO Enterprise supports enhancing the minimum requirements for benchmarking events in the MOD-033 Reliability Standard, such as by including a requirement that all plant models be validated

[27] *See* further discussion in 2022 Odessa Report, *supra* note 25, at ch. 3.

[28] *See supra* note 22. This work is supported by technical resources. *See* NERC Inverter-Based Resource Performance Subcommittee (IRPS), *Supporting Paper: EMT Models in NERC MOD, TPL, and FAC Standards* (Apr. 2022), https://www.nerc.com/pa/Stand/Project202204EMTModelingDL/2022-04%20IRPS%20Supporting%20Paper_082022.pdf.

through MOD-033 activities. This would require coordination among the Generator Owners and Transmission Planners.

In the NOPR, the Commission notes the need for entities to "validate and update resource models by comparing the provided data and resulting models against actual operational behavior."[29] NERC currently has a standard development project underway, Project 2020-06 Verifications of Models and Data for Generators,[30] to address model validation for registered IBRs. NERC, however, has identified that reliance solely on validation activities that compare modeled response to actual operation (e.g., staged test or grid disturbance) are prone to not actually validating the entire model. Therefore, NERC has recommended that the Project 2020-06 standard drafting team employ a more comprehensive model validation process that includes engagement from the equipment manufacturers (e.g., model quality attestations), submittal of as-built protection and controls, hardware-in-the-loop testing, testing/operational data, and consideration of future IEEE P2800.2 model validation and verification procedures. The ERO Enterprise would therefore support the Commission expanding its proposed directive to contemplate more comprehensive model validation approaches. At a minimum, the Commission should not foreclose consideration of more comprehensive model validation and updating approaches for the included IBR classes in a final rule issued in this proceeding.

3. Proposed Directive for Requirements Regarding the Use of Approved Industry IBR Models (NOPR P 86)

The ERO Enterprise supports a flexible approach by which entities would use the best model data available at the time to perform their studies. Therefore, the ERO Enterprise would not support the Commission's proposal for new or modified Reliability Standards to require the use

[29] NOPR at P 35.

[30] *See supra* note 21.

of approved industry (standard library) IBR models, insofar as it would require sole reliance on standardized library models. Often, standard library IBR models are not the most representative of actual IBR behavior and have shortcomings that do not allow those models to fully represent the dynamic behavior of an IBR. Local reliability studies (e.g., TPL planning assessments) and interconnection system impact studies should be conducted using the most detailed and accurate model available, which in many cases would be a user-defined model. Recognizing that needs vary across the different types of studies being performed, the ERO Enterprise would support the use of an acceptable (or unacceptable) model list[31] that defines which models can be used for specific types of studies. Such a requirement would advance uniformity and consistency across planning areas.

In the NOPR, the Commission identifies the need for accurate models that represent the dynamic behavior of IBRs at a sufficient level of fidelity for interconnection studies, planning assessments, and operational studies. Entities rely on different modeling practices and allow different types of models. NERC has recommended a modeling approach that requires the following: 1) a positive sequence standard library model (accurately parameterized and benchmarked) used for interconnection-wide base cases that are paramount to transmission planning studies; 2) a positive sequence user-defined model used for interconnection studies and local reliability analyses; 3) a detailed EMT model used for IBR-specific reliability issues that are becoming increasingly prevalent today; and 4) a model benchmarking report that compares all models against each other and documents any discrepancies across the models, including those due to platform limitations. When performing benchmarking testing, all of these models should be

[31] NERC is currently updating its Acceptable Model List for Interconnection-Wide Modeling to reflect the considerations discussed in these comments. The Acceptable Model List is available at https://www.nerc.com/pa/RAPA/ModelAssessment/Pages/default.aspx.

correctly parameterized to reflect the as-built equipment installed in the field, with appropriate modeling limitations documented for the receiving entity to understand any limitations with those models.[32]

While not without their own shortcomings and complexities,[33] user-defined models are often the most accurate representation of the facility and should be used when assessing reliable operation of that specific facility when connected to the BPS. User-defined models may also be used for benchmarking any standard library models in interconnection-wide base cases. They could also be used in interconnection-wide base cases, subject to the MOD-032 designees (i.e., the Regional Entities) and the planning entities defining the appropriate parameters for such use. For these reasons, the ERO Enterprise does not support the Commission's proposal insofar as it could be interpreted to preclude the use of user-defined models where appropriate for accurate and reliable modeling of IBRs.

C. Proposed Directives Regarding Planning and Operational Studies

The ERO Enterprise supports the proposed directives in the NOPR regarding enhanced Reliability Standards requirements for planning and operational studies to address IBRs. The ERO Enterprise offers the following comments for the Commission to consider in issuing a final rule in this proceeding.

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[32] NERC, *Reliability Guideline: Improvements to Interconnection Requirements for BPS-Connected Inverter-Based Resources* (Sep. 2019) at ch. 3, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf.

[33] User-defined models often use "blackboxing," which masks detailed controls or features of the model to protect intellectual property for the equipment manufacturers. This is most commonly done in EMT models and some positive sequence user-defined models. Software version control, model transparency, and usability issues also present additional complexities.

1. Proposed Directive for Requirements Addressing Planning Studies (NOPR P 88)

The ERO Enterprise supports the Commission's proposed directive for new or modified Reliability Standards that would require the study and evaluation of performance and behavior of IBRs under normal and contingency system planning conditions in their planning areas, including study and evaluation of ride through performance. The current transmission planning Reliability Standard, Reliability Standard TPL-001-5.1, is intended to plan the future BPS to be reliable under normal and contingency conditions; however, there may be gaps in these assessments if they are performed without accurate models and the appropriate breadth of studies regarding IBRs.

The ERO Enterprise expects that any standard development project to address such a directive would need to include a wider set of operating conditions than simply "peak" and "off-peak" conditions. With the growth of IBRs and IBR-DERs, the grid experiences vastly wider operating conditions that should be studied to ensure reliable operation of the BPS under normal and contingency conditions. For example, production cost or other simulation methods could help inform planning assessments (often referred to as "roundtrip studies") by identifying operating conditions that would result in the most extreme expected grid stress conditions, both during on-peak load conditions but also off-peak, high renewables conditions (e.g., low inertia). Similarly, some systems may have conventionally studied off-peak conditions during nighttime hours, but they are also experiencing a rapid growth of solar photovoltaic resources. These operating conditions are both "minimum net load" or "off peak" conditions that should be studied separately due to the vastly different generation dispatch. Seasonal studies may present other considerations. Planning entities should have some flexibility in determining sufficient stress scenarios to study; however, the ERO Enterprise agrees that the NERC Reliability Standards should be enhanced to establish additional minimum requirements in this area.

The ERO Enterprise observes that enhanced planning studies alone cannot address all issues; ensuring accurate and complete models is highly important as well. The TPL Reliability Standards presently require dynamic simulations; such simulations perturb the system at many different fault locations across the BPS. Bolted three-phase faults are used as a conservative assumption for "worst case" fault conditions. These simulations should identify IBRs that would fail to ride through the fault; however, many IBRs do not include those protections and controls in the models that would trip the inverters or balance of plant protections and cause an IBR to fail to ride through. Without sufficient model fidelity (including those protections and controls), the resulting studies will fail to identify potential issues. Moreover, many forms of protection in IBR facilities cannot be represented with positive sequence simulation tools (e.g., DC bus protections, instantaneous voltage and current protections, etc.). Unbalanced faults that often trigger inverter protection cannot generally be studied on positive sequence simulation platforms. Those types of ride-through studies must be done using EMT simulations. As noted previously, NERC has a project underway, Project 2022-04 EMT Modeling, to revise the FAC, MOD, and TPL standards to include EMT modeling and studies where appropriate.

The ERO Enterprise agrees that studies conducted by Transmission Planners and Planning Coordinators should be coordinated with neighboring entities to ensure that accurate models of registered and unregistered IBRs as well as IBR-DERs are represented appropriately for the operating conditions under study. NERC Project 2022-02 Modifications to TPL-001-5.1 and MOD-032-1[34] is addressing some issues regarding appropriate inclusion of IBRs and DERs (IBR-

[34] More information on Project 2022-02 Modifications to TPL-001-5.1 and MOD-032-1 is available on the NERC standards project page, https://www.nerc.com/pa/Stand/Pages/Project2022-02ModificationstoTPL-001-5-1andMOD-032-1.aspx.

DERs and synchronous DERs) in planning assessments; however, additional modifications may be required to adequately address the issues presented in this NOPR.

The ERO Enterprise recognizes that DERs may be subject to differing ride-through requirements, and that could result in the failure of these resources to ride through system disturbances. DER tripping has been observed in multiple disturbance analyses to date. It is important for models to accurately reflect the possibility of tripping, and for aggregate amounts of DERs to be represented in planning studies.

2. Proposed Directive for Requirements Addressing Operational Studies (NOPR P 89)

The ERO Enterprise supports the Commission's proposed directive for enhanced Reliability Standards requirements addressing the performance and behavior of IBRs in Operational Planning Analysis, Real-time monitoring, and Real-time Assessments, as well as Balancing Authority operational analysis functions and real-time monitoring. Operational studies should use models of IBRs and aggregate levels of IBR-DERs that are commensurate in terms of accuracy and fidelity compared with the planning models. All resources on the BPS should be represented in these models.

Opportunities exist to enhance the Reliability Standards to address the issues identified by the ERO Enterprise and the Commission. The models used by the Balancing Authorities, Transmission Operators, and Reliability Coordinators should be coordinated across footprints to ensure that faults in one area do not result in unexpected tripping issues in another area. This issue has been observed in the California system, where faults in one Balancing Authority Area trigger

tripping of IBRs in a neighboring Balancing Authority Area.[35] Without coordination in both the operations and planning horizons, these studies could not reflect accurately the potential resource losses. Further, entities may need to take additional action if dynamic models are not representing issues associated with facilities that routinely fail to ride through disturbances. For example, an entity may manually remove additional resources during fault simulations if there are known resources that cannot be relied upon for providing essential reliability services during grid faults due to their poor ride through performance. The NERC System Planning Impacts from Distributed Energy Resources Working Group (SPIDERWG) is actively developing proposed standards authorization requests to address some of the operational study issues identified in the NOPR; however, additional standards modifications may be needed to address the issues raised in a comprehensive manner.

D. Proposed Directives Regarding Performance Requirements

The ERO Enterprise supports the Commission's proposed directive for NERC to develop Reliability Standards enhancements addressing system frequency and voltage ride through requirements for registered IBRs, as well as requirements addressing ramp rate interactions and phase lock loop synchronization.[36]

Many ERO Enterprise disturbance reports have highlighted the failure to ride through grid events.[37] A comprehensive, performance-based ride-through standard is needed to assure future

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35 *See* NERC and WECC Staff, *Multiple Solar PV Disturbances in CAISO: Disturbances between June and August 2021* (Apr. 2022), https://www.nerc.com/pa/rrm/ea/Documents/NERC_2021_California_Solar_PV_Disturbances_Report.pdf. *See also* NERC and WECC Staff, *San Fernando Disturbance Southern California Event: July 7, 2020* (Nov. 2020), https://www.nerc.com/pa/rrm/ea/Documents/San_Fernando_Disturbance_Report.pdf.

36 NOPR at PP 90-91.

37 *See, e.g.,* 2022 Odessa Report, *supra* note 25; NERC and WECC Staff, *April and May 2018 Fault Induced Solar Photovoltaic Resource Interruption Disturbances Report Southern California Events: April 20, 2018 and May 11, 2018* (Jan. 2019), https://www.nerc.com/pa/rrm/ea/April_May_2018_Fault_Induced_Solar_PV_Resource_Int/April_May_2018_Solar

grid reliability. To that end, NERC re-scoped an existing project, Project 2020-02 Modifications to PRC-024 (Generator Ride-through), to revise or replace current Reliability Standard PRC-024-3 with a standard that will require ride-through performance from all generating resources.[38] This project would largely address the directives proposed by the Commission in the NOPR, through consideration of the following:

- Requirements to continue disallowing momentary cessation within the no trip zone specified, as with the currently approved Reliability Standard PRC-024-3;[39]
- Requirements to disallow abnormal tripping (both frequency and voltage) on instantaneous quantities or single measurement samples as they would fail to meet the performance-based ride-through requirements;
- Requirements to disallow phase lock loop loss of synchronism and other phase angle-based tripping within acceptable bounds;
- Requirements addressing other forms of tripping, such as DC bus protection and overcurrent protection; and
- Requirements to ride through unbalanced grid faults.

Additionally, NERC Staff is considering amending the project scope for this project to include consideration of post-fault recovery times, ramp rate interactions, or the injection of certain levels of currents (and powers) during grid disturbances. NERC has reported in multiple disturbance reports abnormal performance issues for plants that are riding through. Large changes in active power are invoked for relatively minor grid fault events, presenting potential challenges to future grid stability and reliability. The ERO Enterprise would support the Commission

_PV_Disturbance_Report.pdf; NERC and WECC Staff, *900 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report Southern California Event: October 9, 2017* (Feb. 2018), https://www.nerc.com/pa/rrm/ea/Pages/October-9-2017-Canyon-2-Fire-Disturbance-Report.aspx.

[38] More information on Project 2020-02 Modifications to PRC-024 (Generator Ride-through) is available on the NERC standards project page, https://www.nerc.com/pa/Stand/Pages/Project_2020-02_Transmission-connected_Resources.aspx.

[39] A notable caveat is that IEEE 2800 allows momentary cessation (referred to as current blocking) at very low voltages (i.e., < 0.1 pu voltage). This nuance could be addressed by the standard drafting team and should be considered by regulatory bodies to ensure alignment.

expanding its directive to include these additional performance considerations in a final rule issued in this proceeding.

E. Proposed Directive for Compliance Filing

The ERO Enterprise generally supports the Commission's proposal to direct NERC to submit a compliance filing within 90 days of the effective date of a final rule in this proceeding subject to the clarification requested below. The Commission states that NERC should include a "detailed, comprehensive standards development and implementation plan explaining how NERC will prioritize the development and implementation of new or modified Reliability Standards" to address the Commission's directives, taking into account the risks to be addressed, standards development projects already underway, resource constraints, and other relevant factors.[40]

The ERO Enterprise supports the proposed directive for a compliance filing including a standards development plan, as it would provide the Commission and NERC's stakeholders with visibility into how NERC plans to address the important reliability issues identified in the NOPR. The ERO Enterprise, however, requests clarification on what is meant by the phrase "implementation plan" in the proposed directive. The ERO Enterprise understands this phrase to refer to a proposed timeline for developing and submitting to the Commission responsive Reliability Standards, and the ERO Enterprise would support a final rule containing such a directive. However, the term "implementation plan" may also have a second meaning that would be relevant in this context; specifically, the time for an entity to implement a new or revised Reliability Standard. Implementation plans for proposed Reliability Standards are developed in accordance with NERC's Commission-approved Reliability Standard development process,[41]

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[40] NOPR at P 72.

[41] *See* Appendix 3A to the NERC Rules of Procedure, Standard Processes Manual, https://www.nerc.com/AboutNERC/RulesOfProcedure/Appendix_3A_SPM_Clean_Mar2019.pdf.

taking into consideration standard-specific factors identified by the Commission in Order No. 672.[42] Therefore, NERC would not be able to provide meaningful information regarding implementation plans for Reliability Standards still in development where a reasonable timeframe for implementation has not yet been ascertained. The ERO Enterprise respectfully requests the Commission clarify this aspect of its proposal in a final rule issued in this proceeding.

F. Proposed Deadlines for Reliability Standards Development

The ERO Enterprise appreciates the flexibility the Commission proposes to give NERC to address the Reliability Standards development activities proposed in the NOPR.[43] The ERO Enterprise also generally supports the Commission's proposal for a phased development timeline completing within 36 months of Commission approval of NERC's standards development and implementation plan, as it would help focus and prioritize development efforts and ensure that demonstrated reliability risks are being addressed in a deliberate but reasonably expeditious manner.

The ERO Enterprise suggests that an alternative timeline, proposed below, would leverage existing and planned activities more efficiently and address higher priority risks more expeditiously, while allowing sufficient time to develop consensus approaches on other issues. The ERO Enterprise also notes that several initiatives are presently underway regarding IBRs which could affect standards development. For example, the Commission has directed NERC to

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[42] *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, *order on reh'g*, Order No. 672-A, 114 FERC ¶ 61,328 (2006) at P 333 ("In considering whether a proposed Reliability Standard is just and reasonable, the Commission will consider also the timetable for implementation of the new requirements, including how the proposal balances any urgency in the need to implement it against the reasonableness of the time allowed for those who must comply to develop the necessary procedures, software, facilities, staffing or other relevant capability.")

[43] *See* NOPR at P 72.

submit a work plan by February 15, 2023 to address how it will identify and register owners and operators of IBRs that are connected to the BPS, but are not currently required to register with NERC under the definition of Bulk Electric System.[44] The Commission has also proposed reforms to the *pro forma* Large Generator Interconnection Procedures, the *pro forma* Small Generator Interconnection Procedures, the *pro forma* Large Generator Interconnection Agreement, and the *pro forma* Small Generator Interconnection Agreement to address interconnection queue backlogs, improve certainty, and prevent undue discrimination for new technologies while ensuring these resources support reliability.[45] In its comments on those proposed reforms, the ERO Enterprise has stressed the need for improved modeling and validation and performance requirements for IBRs.[46] In the interest of promoting efficient standards development and consistency across related areas, the ERO Enterprise respectfully requests the Commission consider the sequencing of its actions in these various proceedings when establishing a timetable for action regarding Reliability Standards development in the instant proceeding.

In the NOPR, the Commission proposes to direct NERC to submit new or revised Reliability Standards addressing IBR issues as follows as follows:[47]

- Within 12 months of Commission approval of the standards development and implementation plan: submit proposed Reliability Standards to address registered IBR failures to ride through frequency and voltage variations during normally-cleared BPS faults;

- Within 24 months of Commission approval of the standards development and implementation plan: submit proposed Reliability Standards to address the interrelated proposed directives related to registered IBR, unregistered IBR, and IBR-DER data

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44 *Registration of Inverter-Based Resources*, 181 FERC ¶ 61,124 (2022).

45 *Improvements to Generator Interconnection Procedures and Agreements*, Notice of Proposed Rulemaking, 179 FERC ¶ 61,194 (2022).

46 Comments of the ERO Enterprise on Notice of Proposed Rulemaking, Docket No. RM22-14-000 (Oct. 13, 2022).

47 *Id.* at P 73.

sharing, model validation, and planning and operational studies, and registered IBR disturbance monitoring data sharing; and

- Within 36 months of Commission approval of the standards development and implementation plan: submit proposed Reliability Standards to address directives for post-disturbance ramp rates and phase-locked loop synchronization.

The ERO Enterprise proposes that the Commission consider the following alternative timeline in a final rule issued in this proceeding:

- Within 12 months of Commission approval of the standards development and implementation plan, submit:
    - Proposed Reliability Standards addressing comprehensive ride-through requirements for registered IBRs, including all topics identified in the NOPR (frequency, voltage, post-disturbance ramp rates, and phase-locked loop synchronization), and addressing other known causes of IBR tripping;
    - Proposed Reliability Standards addressing post-event performance validation for registered IBRs;
    - Proposed Reliability Standards addressing disturbance monitoring data for registered IBRs;
- Within 24 months of Commission approval of the standards development and implementation plan, submit:
    - Proposed Reliability Standards addressing data sharing issues identified in the NOPR, other than disturbance monitoring data, for registered IBR, unregistered IBR, and IBR-DER;
    - Proposed Reliability Standards addressing data and model validation for registered IBR, unregistered IBR, and IBR-DER; and
- Within 36 months of Commission approval of the standards development and implementation plan, submit:
    - Proposed Reliability Standards addressing planning and operational studies for registered IBR, unregistered IBR, and IBR-DER.

This proposed timeline is appropriate and preferable to the Commission's proposed timeline for standards development for the reasons discussed below.

1. Reliability Standards to be Developed within 12 Months

The ERO Enterprise proposes that Reliability Standards addressing the Commission's proposed directives for performance requirements for registered IBRs (to include comprehensive ride-through requirements for registered IBRs) and disturbance monitoring data for registered IBRs, as well as a NERC project addressing post-event performance validation for registered IBRs, be developed and submitted to the Commission within 12 months of Commission approval of NERC's standards development and implementation plan.

As noted previously, NERC has initiated a standards development project, Project 2020-02 Modifications to PRC-024 (Generator Ride-Through), to revise the PRC-024 Reliability Standard to provide a comprehensive suite of ride-through requirements for registered IBRs. This project contemplates revisions that would account for not just frequency and voltage protection, but all forms of protection and controls that could trip inverters/turbines/generators (excluding auxiliary load components). To be clear, the revised standard is expected to address the momentary cessation and phase lock-loop loss of synchronism issues raised by the Commission, as well as a number of other known causes of IBR tripping. NERC is also presently considering expanding the scope of the project to address the post-disturbance ramp rate issues raised by the Commission. Including these interrelated issues on the same 12-month timeline as the ride through requirements would allow for a more efficient use of standards development resources.

Additionally, NERC has two other high-priority projects underway which can be accomplished within the 12 month timeline contemplated by the NOPR. NERC currently has a project underway, Project 2021-04 Modifications to PRC-002, to consider revisions to PRC-002 to ensure sufficient disturbance monitoring for generating facilities is available, with a focus on ensuring adequate monitoring data and data sharing for registered IBRs. This project was initiated based on key findings and recommendations from multiple disturbance reports. A second project,

Project 2023-02 PRC-004 IBR Performance, would address post-event performance validation, ensuring that resources perform the way they are expected or required to perform. This project would consider Reliability Standard enhancements that would require owners of registered IBR to analyze any identified abnormal performance and develop corrective actions to address those issues. These issues could be identified by either the Generator Owner or the Transmission Operator, Balancing Authority, or Reliability Coordinator. The Generator Owner would be responsible for the analysis and mitigation, as applicable. This project is expected to address issues that may not be adequately addressed during interconnection studies or commissioning, such as plant controller ramp rate interactions or other intra-plant or inter-plant control interactions.

Given the clear reliability need, and the fact that standards development is already underway or soon to be underway on these projects, the ERO Enterprise believes that these projects should be prioritized and addressed on a faster timeframe than other enhanced requirements contemplated in the NOPR for IBRs.

2. Reliability Standards to be Developed within 24 Months

The ERO Enterprise proposes that, consistent with the Commission's proposal, Reliability Standards to address the Commission's proposed directives regarding registered IBR, unregistered IBR, and IBR-DER data sharing, with the exception of data monitoring disturbance data as discussed above, be developed and submitted to the Commission within 24 months of Commission approval of NERC's standards development and implementation plan. The ERO Enterprise also proposes that, consistent with the Commission's proposal, Reliability Standards to address registered IBR, unregistered IBR, and IBR-DER model validation be developed within 24 months of Commission approval of NERC's standards development and implementation plan.

This proposed timeline would leverage existing development projects most effectively and would support the effective development of Reliability Standards addressing planning and

operational studies within the 36 month development window, as discussed below. As noted previously, there are a number of modeling-related standards enhancements underway presently. Specifically, Project 2020-06 Verification of Models and Data for Generators is considering enhancements to the MOD-026 Reliability Standard to ensure that accurate, validated, and verified models are provided by registered IBRs. Project 2021-01 Modifications to MOD-025 and PRC-019 is considering enhancements to the MOD-025 and PRC-019 Reliability Standards, to include aspects to ensure that plant active and reactive power capabilities are accurately provided to planning entities for use in studies.[48] Project 2022-04 EMT Modeling is addressing the use of EMT modeling and studies in the appropriate FAC, MOD, and TPL standards. Project 2022-02 Modifications to TPL-001-5.1 and MOD-032-1 is addressing other modeling improvements related to the inclusion of aggregate DER data in MOD-032.

While these projects address many of the Commission's proposals, additional standards work may be needed to address all components. Additional flexibility may be required, both in timing and content, for Reliability Standards enhancements addressing model validation requirements for unregistered IBRs given potential challenges in obtaining the necessary data (see discussion in Section III.G below). The Commission should therefore allow for such flexibility in a final rule issued in this proceeding. NERC would explain how it proposes to address each of the Commission's directives through standards development in any compliance filing it is required to submit under a final rule issued in this proceeding.

[48] More information about Project 2021-01 Modifications to MOD-025 and PRC-019 is available on the NERC standards development page, https://www.nerc.com/pa/Stand/Pages/Project_2021-01_Modifications_to_MOD-025_and_PRC-019.aspx.

3. Reliability Standards to be Developed within 36 Months

The ERO Enterprise proposes that Reliability Standards to address the Commission's proposed directives regarding registered IBR, unregistered IBR, and IBR-DER planning and operational studies be developed and submitted within 36 months of Commission approval of the NERC's standards development and implementation plan, rather than the 24 months proposed by the Commission. Without accurate models, any Reliability Standards enhancements addressing study requirements would be fraught with the same issues that have been identified to date. Therefore, the schedule should provide adequate time after the underlying modeling deficiencies are addressed to complete the development of Reliability Standards to address the study-related aspects of the Commission's proposed directives.

G. Special Considerations for IBR-DER

The ERO Enterprise generally supports the Commission's proposals for enhanced Reliability Standards to address IBRs, including IBR-DER, as discussed in the preceding section. While these resources are located on the distribution system and not the BPS, at an aggregate level they can affect the reliable operation of the BPS and therefore must be accounted for in system models and studies. The ERO Enterprise, however, has identified some special considerations for implementing the Commission's proposed directives related to IBR-DER and requests the Commission address these considerations in any final rule issued in this proceeding.

1. Data Modeling and Validation Considerations

Regarding IBR-DER and DER as a whole, the relevant entity (whether the Distribution Provider or Transmission Owner) should coordinate with the Planning Coordinator, Transmission Planner, Reliability Coordinator, Transmission Operator, and Balancing Authority to obtain and validate DER specific modeling data. EMT models representing the aggregate DER impact should be addressed by the relevant entities in data submission requirements for areas of the system where

EMT modeling of a transmission to distribution interface is part of the EMT study. These EMT models should be used to validate the performance of positive sequence models that represent the same transmission to distribution interface. However, validation of IBR-DER EMT or positive sequence models, particularly for aggregate representation of retail-scale DER (e.g., rooftop solar), may be difficult to accomplish for the following reasons.

Distribution interconnection requirements are likely to play a major role in the modeling and verification of aggregate IBR-DER. These interconnection requirements typically follow equipment standards, which are a good proxy for modeling information. However, state regulations may dictate variations in the settings, control flags, and other functions allowable for IBR-DER, which are required for an accurate model to study the impacts on the BPS. Coordination with these regulators may be necessary to resolve performance-based risks posed by aggregate IBR-DER in the future, as the Reliability Standards address only the BPS and not the distribution system. The ERO Enterprise further observes that capture of electrical measurements to verify the aggregate IBR-DER model may require equipment installed on the distribution system. Measurement devices would need to be installed at various locations on the distribution system in order to verify the model at the transmission to distribution interface. State regulators would need to collaborate on and approve the location of this equipment on the distribution system they regulate.

There are complexities in the validation or verification of an aggregate DER model in a planning realm due to the need to project the growth and variability of the DER components making up the aggregate DER model. There is a different, yet also important, complexity to verify an aggregate DER model in a study in the operations horizon. These complexities could affect the

ability of a Distribution Provider (or a Transmission Owner) to provide a validated model representing aggregate IBR-DER as proposed by the NOPR.

For these reasons, the ERO Enterprise requests that the Commission provide NERC with flexibility to determine the appropriate requirements for registered entities interfacing with aggregate IBR-DER. For example, in lieu of requirements for an entity to provide a validated model, one approach may be to require coordination among the Transmission Owner, Distribution Provider, Transmission Planner, or Planning Coordinator to work collaboratively with state regulators to identify, implement, and perform an effective model validation approach for aggregate DER. Additionally, the Planning Coordinator could, as part of system validation in MOD-033, work with the Distribution Provider, Transmission Planner, Reliability Coordinator, Transmission Operator, and Balancing Authority to capture disturbance information such that the aggregate representation of IBR-DER in their models can be validated against system performance. Each Planning Coordinator could also develop and apply criteria to determine if a model is sufficiently verified, subject to minimum performance requirements.

NERC has already identified opportunities to improve the Reliability Standards, including revising the facilities interconnection Reliability Standards FAC-001 and FAC-002, to ensure reliability at the transmission to distribution interface. The NERC SPIDERWG is presently drafting a Standard Authorization Request to initiate a project to revise the FAC-001 and FAC-002 Reliability Standards to address thresholds, provision of interconnection requirements, and requirements for the Transmission Planner to define "qualified changes" that require a study of impact to the transmission to distribution interface. Revisions such as these would address several of the Commission's proposed directives for IBR-DER. The NERC SPIDERWG also included in its work plan the development of one or more additional reliability guidelines related to planning

studies of aggregate DER (including aggregate IBR-DER). NERC will monitor the effectiveness of such reliability guideline(s) to ensure IBR-DER are adequately studied at these interfaces as well as assess if further actions are needed. More information on these efforts would be provided in a compliance filing required in a final rule in this proceeding.

2. Relationship with Order No. 2222

The record would benefit from further clarity regarding the relationship, if any, between the proposals in this order and FERC Order No. 2222, which introduces the participation of distributed energy resource aggregators in the organized market. Order No. 2222 defines a "distributed energy resource" as "any resource located on the distribution system, any subsystem thereof or behind a customer meter."[49] Order No. 2222 further clarifies that, "these resources may include, but are not limited to, resources that are in front of and behind the customer meter, electric storage resources, intermittent generation, distributed generation, demand response, energy efficiency, thermal storage, and electric vehicles and their supply equipment."[50] DER aggregators may be sources of modeling data and information; however, it is not clear that they would be able to provide all required parameters or whether they could separate generation from load. The mechanism for obtaining reliability data from them in the absence of mandatory standards is also unclear. Moreover, whereas the Commission's Order No. 2222 includes both load and generation components, the ERO Enterprise has used a reliability-based definition of DER that aligns with IEEE 1547-2018: "any source of electric power located on the distribution system."[51] For purposes

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49 Order No. 2222, *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 172 FERC ¶ 61,247 at P 114 (2020), *order on reh'g*, Order No. 2222-A, 174 FERC ¶ 61,197 (2021), *order on reh'g*, Order No. 2222-B, 175 FERC ¶ 61,227 (2021).

50 *Id.*

51 Institute of Electrical and Electronics Engineers (IEEE), *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, IEEE 1547-2018.

of the Reliability Standards, the ERO Enterprise recommends defining DER to separate the generation models (including IBR-DER) from load. In issuing a final rule in this proceeding, the ERO Enterprise respectfully requests that the Commission provide clarity on issues that relate to the potential overlap of Order No. 2222 and implementation of the proposed directives for Reliability Standards for IBR-DER in a final rule issued in this proceeding.

H. Additional Work on IBR Issues

The Commission has proposed in the NOPR a reasonably comprehensive framework for addressing IBR data and modeling issues identified to date. The ERO Enterprise recognizes, however, that newly identified issues and challenges associated with IBRs may continue to require attention for years to come. The ERO Enterprise identified offshore wind, commissioning processes for IBRs, and employing forward-looking approaches for managing the risks of the rapidly changing grid as potential areas for further study and action.

The ERO Enterprise has also identified security concerns as worthy of further study and action. While security concerns are not the focus of this NOPR, accurate and validated models for DER (including IBR-DER) may be useful for planning entities in studying a growing attack surface where potential coordinated attack on multiple DERs or DER aggregators can impact the BPS. This includes the potential impacts of threats to the BPS from attacks on DER directly as well as an attack on DER aggregators controlling aggregate IBR-DER. This security use further supports the reliability need for the Commission's NOPR proposals regarding IBR-DER; however, the additional data required to conduct these security-centered studies may differ from the reliability studies identified in the Commission's NOPR. Additional standards work may be necessary to fully account for an integrated approach to security risks in system planning studies.

The ERO Enterprise highlights these areas to demonstrate the breadth of the challenges regarding IBRs, and it is not requesting any specific Commission action on these areas at this time.

The ERO Enterprise will keep Commission staff apprised of these and other efforts to improve reliability with respect to IBRs.

IV. CONCLUSION

The ERO Enterprise supports the Commission's efforts to strengthen the reliability of the BPS by addressing the risks posed by the growing use of IBRs, both on and affecting the BPS. The ERO Enterprise generally supports the Commission's proposed directives as addressing the reliability issues identified to date. NERC's open and inclusive stakeholder process is well positioned to develop cost effective, consensus Reliability Standard requirements addressing the IBR topics identified in the NOPR.

The ERO Enterprise appreciates the opportunity to provide comments in this proceeding highlighting further issues for the Commission's consideration. The ERO Enterprise also appreciates the opportunity to propose an alternate timeline for developing Reliability Standards that would more effectively leverage existing and planned Reliability Standards development projects to address known reliability issues. The ERO Enterprise respectfully requests that the Commission consider these comments in issuing a final rule in this proceeding.

Respectfully submitted,

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Date: February 6, 2023

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service list compiled by the Secretary in the above-referenced proceeding.

Dated at Washington, D.C. this 6th day of February, 2023.

/s/ Lauren A. Perotti

Lauren A. Perotti
Counsel for North American Electric Reliability Corporation