
**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

**Reliability Standards to Address
Inverter-Based Resources**

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)

Docket No. RM22-12-000

**INFORMATIONAL FILING OF THE NORTH AMERICAN RELIABILITY
CORPORATION REGARDING THE DEVELOPMENT OF RELIABILITY
STANDARDS RESPONSIVE TO ORDER NO. 901**

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January 17, 2024

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Attachment 1 Order No. 901 Work Plan

NERC has multiple standards development projects planned or underway to address IBR-related risks.³ NERC's Order No. 901 Work Plan explains how NERC will leverage these planned or existing projects, and add new projects as necessary, to ensure that the reliability issues identified by the Commission in Order No. 901 are addressed appropriately through the standards development process and that this process proceeds in an orderly and timely manner.

While NERC intends for the Order No. 901 Work Plan to provide a roadmap to guide the effective development of Reliability Standards addressing IBR issues through November 2026, work remains to be done to initiate specific projects to address certain Order No. 901 directives, and to adjust formally the scope of other existing projects. NERC will maintain an up-to-date copy of the Order No. 901 Work Plan on the NERC web site.

NERC respectfully requests that the Commission accept this informational filing, including the Order No. 901 Work Plan included as **Attachment 1**, in compliance with paragraph 222 of Order No. 901.⁴

³ See, e.g., Order No. 901 at P 223.

⁴ As the Commission has previously found approval to be unnecessary, NERC is not seeking Commission approval of the Order No. 901 Work Plan and submits it for informational purposes only. See Order No. 901 at P 224 ("In the interest of time... and as NERC appears to have already expended considerable effort in thinking through how it would address IBR-related gaps through its Reliability Standard projects, we do not find it necessary to approve NERC's final work plan.").

I. NOTICES AND COMMUNICATIONS

Notices and communications with respect to this filing may be addressed to the following:⁵

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II. SUMMARY OF ORDER NO. 901

On October 19, 2023, the Commission issued a final rule, Order No. 901, directing the development of new or revised Reliability Standards to address certain reliability issues regarding IBRs.⁶ In the order, and in the preceding notice of proposed rulemaking, the Commission cited multiple NERC and Regional Entity resources on inverter-based resource issues, including reliability guidelines, white papers, reliability assessments, technical reports, event reports, NERC alerts, and other resources, as underscoring the need for mandatory Reliability Standards to address reliability concerns related to IBRs at “all stages of interconnection, planning, and operations.”⁷

⁵ NERC respectfully requests a waiver of Rule 203 of the Commission’s regulations, 18 C.F.R. § 385.203, to allow the inclusion of more than two persons on the service list in this proceeding.

⁶ Order No. 901, *supra* note 1.

⁷ *Id.* at P 25.

The Commission therefore directed NERC to develop new and revised Reliability Standards to address the following four broad topic areas for which it determined reliability gaps exist in the current Reliability Standards with respect to IBRs: (1) data sharing requirements;⁸ (2) data and model validation requirements;⁹ (3) planning and operational studies requirements;¹⁰ and (4) performance requirements.¹¹ Within these four topic areas, the Commission identified the specific reliability issues that must be addressed. In so doing, the Commission distinguished between the performance that must be required depending on whether the IBRs are currently registered with NERC for compliance purposes, or will be in the future under planned revisions to NERC’s Rules of Procedure (“registered IBRs”);¹² IBRs that are not registered with NERC (“unregistered IBRs”) but which need to be modeled for reliability; and IBRs that are connected to the distribution system, but, in the aggregate, can impact BES reliability (“IBR-DERs”).¹³ The Commission directed NERC to develop responsive standards addressing these issues and to submit them to the Commission on a three-year, staggered timeframe.¹⁴

Relevant to the instant filing, the Commission also directed NERC to submit an informational filing including “a detailed, comprehensive standards development plan and explanation of how NERC will prioritize the development of new or modified Reliability

⁸ See Order No. 901 at PP 66-109 (discussion of directives related to data sharing requirements).

⁹ See *id.* at PP 110-161 (discussion of directives related to data and model validation requirements)

¹⁰ See *id.* at PP 162-177 (discussion of directives related to planning and operational studies requirements).

¹¹ See *id.* at PP 178-211 (discussion of directives related to performance requirements).

¹² *Registration of Inverter-based Resources*, 181 FERC ¶ 61,124 (2022) [hereinafter IBR Registration Order].

¹³ See Order No. 901 P 4 n.14 (general discussion of how the Commission differentiated between IBR types where necessary to describe its directives).

¹⁴ Under this timeframe, NERC is to submit new or revised Reliability Standards addressing IBR performance requirements and IBR disturbance monitoring data sharing and post-event performance validation by November 4 2024; new or revised Reliability Standards addressing IBR data sharing and data and modeling validation by November 4, 2025; and new or revised Reliability Standards addressing IBR planning and operational studies by November 4, 2026. *Id.* at P 229.

Standards” directed by the Commission.¹⁵ The Commission stated that NERC “should take into account the risk to the reliability of the Bulk-Power System, standard development projects already underway, resource constraints, its ongoing registration of Bulk-Power System-connected IBR generator owners and operators, and other factors as necessary” in developing its plan.¹⁶ The Commission directed NERC to submit this plan within 90 days of the issuance of Order No. 901.¹⁷

III. OVERVIEW OF THE ORDER NO. 901 WORK PLAN

In accordance with paragraph 222 of Order No. 901, NERC submits its Order No. 901 Work Plan, attached to this filing as **Attachment 1**. The Order No. 901 Work Plan provides a detailed, comprehensive plan for how NERC will develop new or revised Reliability Standards responsive to the Commission’s directives in Order No. 901, and how it will prioritize the development of responsive Reliability Standards in accordance with the three-year staggered timeframe directed by the Commission.

As discussed further in the plan, NERC contemplates a broad, cross-functional effort drawing on the expertise of NERC staff and stakeholder subject matter experts to identify gaps in the current Reliability Standards, help ensure that standard development projects are properly scoped to address the Commission’s directives, initiate new projects as needed, and provide additional support and analysis to the resulting standards development efforts. As NERC has multiple projects ongoing to address IBRs and other planning and modeling issues beyond the specific revisions directed in Order No. 901, NERC anticipates that significant work will be needed to coordinate revisions among the same or related standards. This will include any standards

¹⁵ Order No. 901 at P 222.

¹⁶ *Id.* at P 223.

¹⁷ *Id.*

projects that are initiated to implement the IBR entity registration changes directed by the Commission in the IBR Registration Order.¹⁸

As a foundational matter, NERC plans to complete work in the first half of 2024 to establish a clear and consistent understanding of defined terms to be used in the new and revised Reliability Standards addressing the Order No. 901 directives. This will include defining what is an “inverter-based resource” and “distributed energy resource” from a technological standpoint. NERC has determined that this approach is necessary for development among multiple related projects addressing IBR issues to proceed in an orderly and coordinated manner. With a consistent technical understanding established, each drafting team will then be charged with determining the appropriate requirements, including identifying the appropriate applicable entities and applicable facilities which shall be consistent with any of the Commission’s directives for such applicability in Order No. 901.

The Order No. 901 Work Plan consists of four key milestones with associated dates for completion, which are consistent with the Commission’s direction in Order No. 901. These milestones, summarized below, are discussed in further detail in the plan:

- **Milestone 1:** Submission of Order No. 901 Work Plan (completion: January 2024)
- **Milestone 2:** Development and Filing of Reliability Standards to Address Performance Requirements and Post-Event Performance Validation for Registered IBRs (completion: November 4, 2024)
- **Milestone 3:** Development and Filing of Reliability Standards to Address Data Sharing and Model Validation for all IBRs (completion: November 4, 2025)
- **Milestone 4:** Development and Filing of Reliability Standards to Address Planning and Operational Studies Requirements for all IBRs (completion: November 4, 2026)

¹⁸ IBR Registration Order, *supra* note 12.

Projects under Milestone 2 are assigned the highest priority in the Order No. 901 Work Plan, as they are addressing matters for which the Commission directed Reliability Standards be submitted for approval by November 4, 2024. This high prioritization is also reflected in NERC's annual Reliability Standards Development Plan, which was filed with the Commission on December 15, 2023.¹⁹ NERC has not designated active projects under Milestone 3 and Milestone 4 as high priority for 2024; however, as high priority projects from Milestone 2 are advanced and completed, other active or new projects addressing Milestone 3 and 4 will be elevated in priority to assure timely completion.

The Order No. 901 Work Plan contemplates that individual projects will be charged with addressing the Order No. 901 directives relevant to their defined scope of work; in some cases, NERC may need to amend the scope of work for existing projects, or initiate new projects, to ensure all relevant directives are addressed. All drafting teams will be advised of the need for timely and orderly implementation of the resulting Reliability Standards consistent with the Commission's direction and guidance in Order No. 901.²⁰

As noted above, NERC intends for the Order No. 901 Work Plan to provide a detailed roadmap to guide the effective and orderly development of Reliability Standards addressing IBR issues through 2026. However, work remains underway to identify and initiate specific projects to address certain Order No. 901 directives, and to adjust formally the scope of other existing projects.

¹⁹ *N. Am. Elec. Reliability Corp.*, NERC Informational Filing of Reliability Standards Development Plan 2024-2026, Docket Nos. RM05-17-000, RM05-25-000, RM06-16-000 (Dec. 15, 2023).

²⁰ *See* Order No. 901 at P 226 (“The number of events, NERC Alerts, reports, whitepapers, guidelines, and ongoing standards projects more than demonstrate the need for the expeditious implementation of new or modified Reliability Standards addressing IBR data sharing, data and model validation, planning and operational studies, and performance requirements. Thus, in that light, the Commission will consider the justness and reasonableness of each new or modified Reliability Standard’s implementation plan when it is submitted for Commission approval. Further, we believe that there is a need to have all of the directed Reliability Standards effective and enforceable well in advance of 2030 and direct NERC to ensure that the associated implementation plans sequentially stagger the effective and enforceable dates to ensure an orderly industry transition for complying with the IBR directives in this final rule prior to that date.” (citation omitted).)

To the extent more effective approaches for development are identified through the NERC standards development or other stakeholder engagement processes, NERC may update this plan accordingly. NERC will maintain an up-to-date copy of the Order No. 901 Work Plan on the NERC web site.

IV. CONCLUSION

NERC respectfully requests that the Commission accept this informational filing and Order No. 901 Work Plan in accordance with paragraph 222 of Order No. 901.

Respectfully submitted,

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Date: January 17, 2024

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 17th day of January, 2024.

/s/ Lauren A. Perotti

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NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Work Plan to Address FERC Order 901

Standards Development

January 17, 2024

RELIABILITY | RESILIENCE | SECURITY



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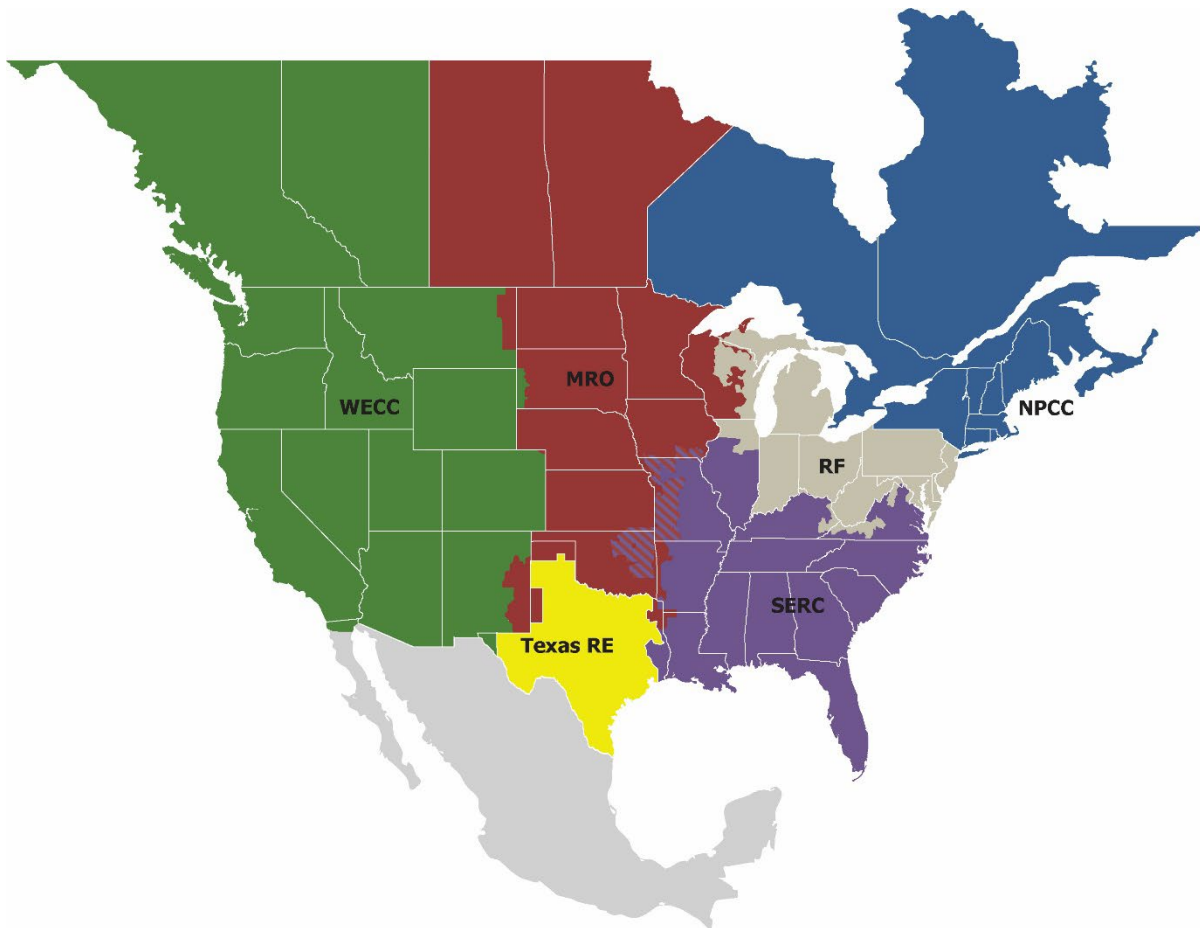
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Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entities as shown on the map and in the corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Regional Entity while associated Transmission Owners/Operators participate in another.



MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

Statement of Purpose

The Federal Energy Regulatory Commission (FERC) issued Order No. 901 on October 19, 2023,¹ which includes directives on new or modified NERC Reliability Standard projects. Order No. 901 addresses a wide spectrum of reliability risks to the grid from the application of inverter-based technology; including both utility scale and behind-the-meter or distributed energy resources.

This document outlines a single, comprehensive approach to effectively address all directives of Order No. 901. Included in this work plan is an overarching general approach to NERC Standards Development and prioritization, more granular details for assuring that directives are grouped in the framework of existing NERC Reliability Standards and active projects, and detailed technical specifics that must be considered during development.

The full document should be used with Standards Development, the Reliability and Security Technical Committee (RSTC), and RSTC applicable subcommittees established work plans. The detail herein may be used to inform future work plans or strategies, or to develop presentation material. Other readers of this work plan should be aware that the technical details within each chapter are provided to maintain a single source document for NERC's approach to this work plan.

¹ *Reliability Standards to Address Inverter-Based Resources*, Order No. 901, 185 FERC ¶ 61,064 (2023), <https://www.ferc.gov/media/e-1-rm22-12-000>.

Executive Summary

On October 19, 2023, FERC issued Order No. 901 directing NERC to develop² new or modified Reliability Standard projects to address a wide spectrum of reliability risks to the bulk power system (BPS) from the application of inverter-based technology; including requirements for inverter-based resources (IBR) that are owned or operated by NERC registered entities, as well as by those that are anticipated to be registered by NERC under pending new registration criteria. Additional requirements are directed for registered entities on effective data sharing and model validation for non-Bulk Electric System (BES) resource data (i.e., unregistered IBR and distributed energy resources (DER)) as these resources continue to contribute to increasing impacts on the reliable planning and operation of the BPS.

The issues raised in Order No. 901 regarding increasing inverter-based resources and the inadequate model quality for those resources are well known and documented in NERC Reliability Guidelines and reports. Many of these issues are already incorporated into active Reliability Standard projects and are identified in this work plan. Others are known issues and are in draft Standard Authorization Requests (SARs) that will soon be submitted to NERC Standards Development for acceptance and authorization to begin development per the NERC Standard Processes Manual.³ This work plan will be reviewed and adjusted as additional SARs are created and coordinated with other established work plans. Over the next few years, other NERC corporate goals and regulatory directives will similarly need to be coordinated to assure that other high priority projects result in new or modified Reliability Standards, are developed.

Ongoing Approach to Prioritization

NERC's Standards Development has emphasized the need for project prioritization to account for a growing number of projects, and has recognized the need to address high-risk issues at a more expedited rate. This topic has been frequently discussed by the NERC Standards Committee as well as the Board of Trustees. The method used to prioritize is an active and agile process that periodically reevaluates all active and incoming projects to assure an appropriate allocation of resources and balancing of various influencing factors. "Risk to the BPS" is a primary factor to increasing a project's priority, as is "residual risk," supports the determination to reallocate resources from one project to another. Changes to how projects are prioritized and what priorities mean for a standard's development have been implemented and will continue to be evaluated on a periodic basis. In Fall 2023, Standards Development updated the Reliability Standards Under Development webpage to provide a priority list as well as to provide current updates on each project's priority status.⁴ IBR related projects will be identified as high priority through the project pages, in discussions with team members for active projects, and communications during the initiation of a new projects, such as during the solicitation of standard drafting member nominations.

Three active Standards Development projects are identified as essential for meeting directives from Order No. 901 pertaining to IBR Performance and Post-Event Performance Validation. More detail for these projects and the associated directives are discussed in **Chapter 2: Performance Requirements and Post-Event Performance Validation (Milestone 2)** of this work plan. To assure a timely completion of these projects to meet the November 4, 2024 milestone deadline, each of these projects are currently identified by Standards Development as high priority. As these and other high priority projects are completed, resources will be shifted to the development of other active and new projects related to regulatory directives from FERC as well as directives from the NERC Board of Trustees, corporate goals, and other higher risk projects.

Other projects associated with directives from Order No. 901, such as those for model validation, are currently not identified as high priority. As discussed in more detail throughout this work plan, additional gap analyses and coordination are required to ensure that currently active projects related to later milestones in Order No. 901 are complete or incorporated into a single holistic solution for the wide spectrum of IBR related directives. Further, they

² *Id.*

³ https://www.nerc.com/AboutNERC/RulesOfProcedure/Appendix_3A_SPM_Clean_Mar2019.pdf

⁴ NERC Reliability Standards Under Development; <https://www.nerc.com/pa/Stand/Pages/Standards-Under-Development.aspx>

may be some need to ensure that any “prerequisite” projects are completed before reevaluating other projects to high priority. Once a project is moved into a higher priority, work should be expected to advance at an expediated pacing while maintaining a continual coordination with interrelated requirements or project scopes. Standards Development will continue to refine this approach throughout 2024.

Milestone Summaries

Order No. 901 includes several milestone dates that NERC is required to meet. As Milestone 1 is this informational filing, this summary focuses on the details of the remaining milestones. To effectively implement this work plan, ongoing prioritization of Reliability Standards projects, continual coordination between NERC Engineering, Legal, and Standards Development, and ongoing communication to industry will be pursued. The scope of this work plan is extensive and necessitates inclusions of an overarching general approach to NERC Standards Development and prioritization, more granular details for assuring that directives are grouped in the framework of existing NERC Reliability Standards and active projects, and detailed technical specifics that must be considered during development. Further, the approach to developing implementation plans for each of the modified Reliability Standards will be an ongoing effort to assure alignment with individual project revisions and the need for timely and orderly implementation of the resulting Reliability Standards consistent with the Commission’s direction and guidance in Order No. 901. All drafting teams will be advised of this need and Standards Development will continue to guide a cohesive strategy to those plans.

Timeline for 2024

As demonstrated in Figure 1 below, new Reliability Standards SARs and projects for upcoming milestones are anticipated to be developed within the first part of 2024. The timeline for new SARs in 2024 is approximated and target dates are provided as indicators for NERC’s ability to assure timely completion of the remainder of Order No. 901 directives. Revisions to some technical specifics in this workplan for Milestone 3 and Milestone 4 may occur as SARs are developed, projects are created, and other projects are completed.

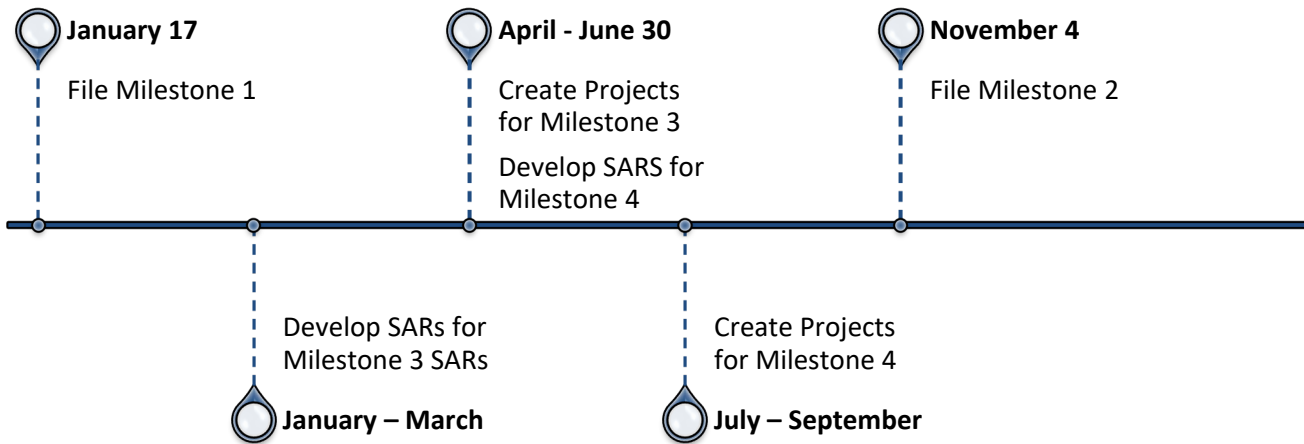


Figure 1: Target 2024 Dates for Standards Development

Milestone 2: Performance Requirements and Post-Event Performance Validation

- Related Active Standard Development Projects:** Project 2021-04 Modifications to PRC-002-2 Disturbance Monitoring, Project 2020-02 Modifications to PRC-024 (Generator Ride-through), 2023-02 Analysis and Mitigation of BES Inverter-Based Resource Performance Issues.
- Overall Strategy:** Complete the three identified related projects in 2024. Make small adjustments to each of these projects, ensure a timely completion, and ensure alignment for how each drafting team is expected to resolve discrete aspects of this single solution for IBR performance directives during grid disturbances (see **Figure 2**). These three active projects are identified as high priority by Standards Development. The project developers and leadership from each drafting team will assure drafts are coordinated throughout 2024.
- Additional Details:** IBR performance is to be evaluated using disturbance monitoring data rather than through an evaluation of equipment settings for potential, or expected, capabilities, such as how ride-through, is currently addressed in PRC-024-3. Analytical requirements and corrective action plans to improve upon poor performance will be addressed within these projects. Some data sharing requirements for disturbance monitoring will be pursued at this time to assure that future modeling validation requirements, as well as planning and operational studies that must leverage data of actual IBR performance during experienced grid disturbances, are more effectively addressed during those later milestones.
- Date to be filed:** 11/04/2024

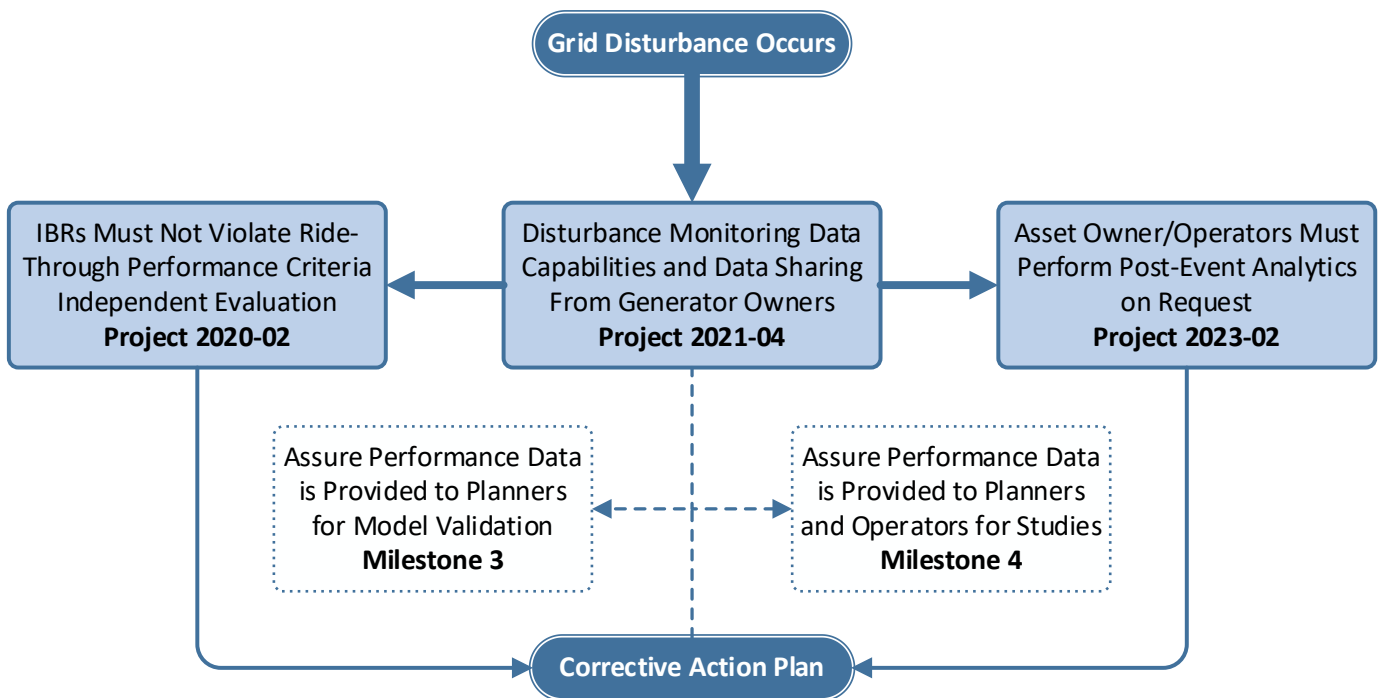


Figure 2: Flowchart of Interactions Between IBR Performance Requirements and Post-Event Performance Validation Standards Projects

Milestone 3 - Part 1: Data Sharing

- Related Active Standard Development Projects:** Several currently active projects do address some specific data sharing for IBRs (see **Figure 3**). There will be some need to modify current projects to align with the scope of this work plan.
- Overall Strategy:** Collaborate between NERC Standards Development, Engineering, and the RSTC. The scope of this collaboration is to cross check active projects, draft SARs, and pending SARs from RSTC-associated work plans and identify which of those will address aspects of this milestone. Some revisions to draft SARs or active projects will be necessary to focus development on directives in Order No. 901 or to include additional objectives to mitigate newly identified risks. RSTC support will be needed to provide technical supporting work for an approved model library. SARs pertaining to Milestone 3 must be submitted to the Standards Committee in the first part of 2024 to assure projects can be expedited and completed in 2025.
- Additional Details:** As often discussed within NERC recommendations and outlined in more detail within this work plan, additional model types must be represented during the interconnection process as well as for ongoing use by Planning Coordinators and Transmission Planners to conduct accurate studies. To ensure that developed projects address model data sharing for each model type, some currently active projects may need to be reworked to align with the directives within Order No. 901 as well as with the NERC recommendations for dynamic modeling.
- Date to be filed: 11/04/2025**

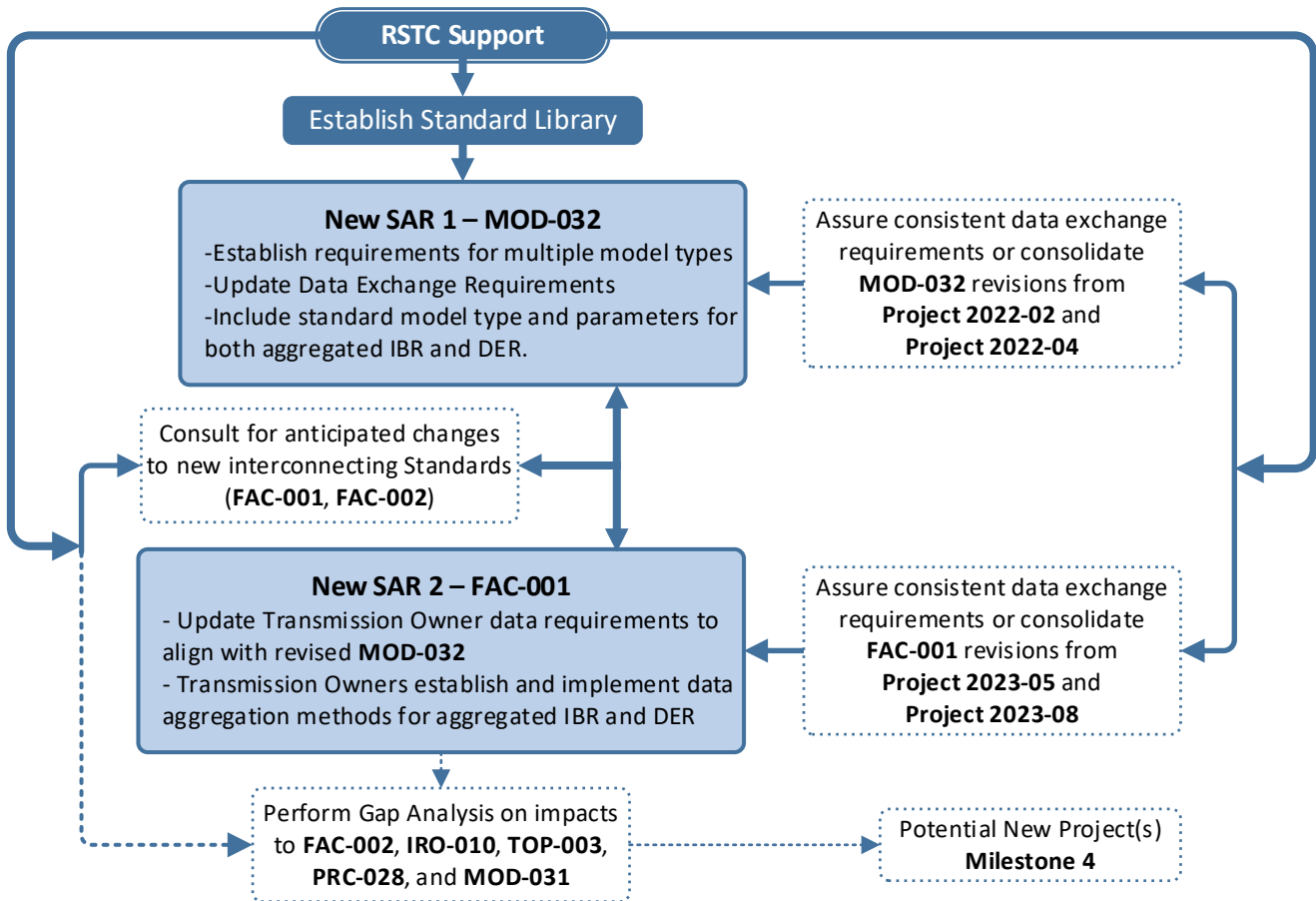


Figure 3: Approach to Developing Data Sharing Requirements

Milestone 3 Part 2: Model Validation

- Related Active Standards Development Projects:** Several active projects do address some specific model validation for IBRs (see **Figure 4**). Currently, the paradigm of model validation is based on periodic stage testing of singular interconnection-wide base cases rather than through evaluations of performance by planners and assignment of model quality improvement to owner/operators of associated equipment. There will be some need to modify currently active projects to align with the scope of this work plan.
- Overall Strategy:** Collaborate between NERC Standards Development, Engineering, and the RSTC. The scope of this collaboration is to cross check active projects, draft SARs, and pending SARs from those RSTC associated work plans and identify which of those address aspects of this milestone. Some revisions to draft SARs or active projects will be necessary to focus development on directives in Order No. 901 or to include pertinent model validation objectives identified by the RSTC and NERC work plans. SARs pertaining to Milestone 3 must be submitted to Standards Development in the first part of 2024 to assure projects can be expedited and completed in 2025.
- Additional Details:** The deficiencies within the current state of model quality are well documented. The inability of current mechanisms to compensate for poor model quality are well defined and necessitate moving towards a more agile and risk-based approach using performance data to validate system planner and operator studies. It will be essential to identify what planning and operational studies must be conducted to evaluate model data quality with performance data. As such, some aspects of Milestone 4 may need to be initiated in concert with Milestone 3.
- Date to be filed: 11/04/2025**

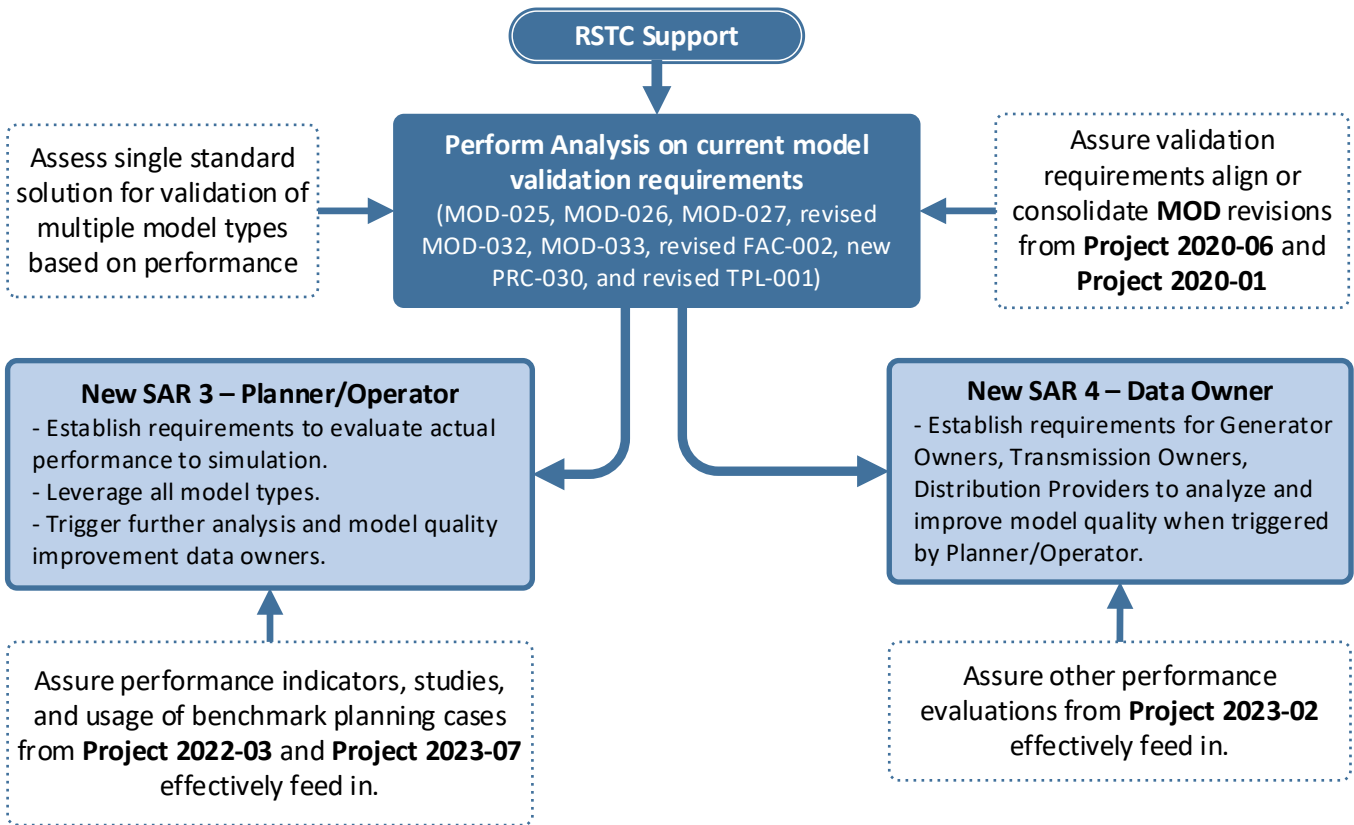


Figure 4: Approach to Developing Model Validation Requirements

Milestone 4: Planning and Operational Studies

- **Related Active Standards Development Projects:** Project 2022-02 (Modifications to TPL-001-5.1 and MOD-032-1), Project 2022-03 (Energy Assurance with Energy-Constrained Resources), Project 2022-04 (EMT Modeling), and Project 2023-07 (Transmission System Planning Performance Requirements for Extreme Weather).
- **Overall Strategy:** Build upon modeling practices and validation requirements developed per revisions conducted within Milestone 3. Identify which planning and operational studies must be leveraged to evaluate model data quality with performance data and ensure that future studies reflect any model changes. Specifically, to ensure that all planning and operational studies accurately represent ride-through performance, the developed PRC-030 within Project 2023-02 (Analysis and Mitigation of BES Inverter-Based Resource Performance Issues) may require modifications to assure that any resulting changes to models (such as the result of an implemented corrective action plan) are provided to planners and operators in a timely manner. SARs pertaining to Milestone 4 must be submitted to Standards Development in the second part of 2024 to assure projects can be expedited and completed in 2026.
- **Additional Strategy Details:** The approach to Milestone 4 must ensure that all identified operational and planning study requirements are revised to streamline ongoing model improvements into those associated studies. This must include Real-time monitoring, Real-time Assessments, Operational Planning Assessments, Transmission Planning studies, and others. Several active projects are in progress that address planning and operational studies using new benchmark planning cases; Project 2022-03 (Energy Assurance with Energy-Constrained Resources) and extreme weather in Project 2023-07 (Transmission System Planning Performance Requirements for Extreme Weather). These studies must also be revised to ensure the most appropriate and accurate models are used.
- **Date to be filed: 11/04/2026**

Chapter 1: File Informational Plan (Milestone 1)

All aspects of NERC’s Standards Development plan must be filed with FERC by **January 17, 2024**. Summarily from Order No. 901:

“Pursuant to § 39.2(d) of the Commission’s regulations, we direct NERC to submit an informational filing within 90 days of the issuance of the final rule in this proceeding. NERC’s filing shall include a detailed and comprehensive standards development plan explaining how NERC will prioritize the development of new or modified Reliability Standards to meet the deadlines set forth in this final rule. We direct NERC to explain in its filing how it is prioritizing its IBR Reliability Standard projects to meet the directives in this final rule, taking into account the risk posed to the reliability of the Bulk-Power System, standard development projects already underway, resource constraints, and other factors if necessary.”⁵

This section includes details on the Standards Development approach for prioritization, accounting for currently active projects, proposed adjustments for known or pending SARs, and coordination between projects with interrelated scopes and shared terminology.

Prioritization

NERC’s Standards Development department has emphasized the need for project prioritization to account for a growing number of standard projects and has recognized the need to address high risk issues at a more expedited rate. This topic has been frequently discussed by the NERC Standards Committee as well as the Board of Trustees. Changes to how projects are prioritized and what priorities mean for a standard’s development have been implemented and will continue to be evaluated on a periodic basis. In Fall 2023, Standards Development updated the Reliability Standards Under Development webpage to provide a priority list as well as to provide current updates on each project’s priority status.⁶ IBR related projects will be identified as high priority through the project pages, in discussions with team members for active projects, and communications during the initiation of a new standard projects, such as during the solicitation of standard drafting member nominations.

Directives Associated with Active Projects

This document includes a list of every directive from Order No. 901 and identifies if the directive is applicable to or already associated with an active Standards Development project.

All active projects with applicable directives from Order No. 901 that are projected for completion in 2024 are currently designated as high priority.

All active projects with applicable directives from Order No. 901 that are required to be filed in 2025 or 2026 are not yet assigned as high priority. As high priority projects are advanced and closed, Standards Development will elevate other active or new projects to high priority to assure timely completion of projects related to Order No. 901.

Directives Not Yet Associated with Active Projects

Any directives that are not yet associated with an active project are detailed in the sections below. Continued collaboration will occur between NERC Standards Development, Engineering, and the RSTC to assure prioritized SAR development for objectives that address relevant sections of Order No. 901. Summarized impacts to other plans (as of the date of this filing) are included within Appendix A: [Impacts to/from Other FERC Filings or NERC Strategic Work Plans](#).

⁵ Order No. 901 at P 6.

⁶ NERC Reliability Standards Under Development; <https://www.nerc.com/pa/Stand/Pages/Standards-Under-Development.aspx>

Advancement of Consistent Terminology for “IBR” and “DER”

As part of this effort, and consistent with NERC’s effort to identify and register owners and operators of IBRs not meeting the criteria under NERC’s definition of Bulk Electric System, Standards Development will advance new defined terms for the NERC glossary of terms. These terms will be developed through collaboration between individual standard drafting teams that are tasked with creating specific definitions, and NERC Engineering, Registration, Compliance Assurance, and Legal staffs.

In the Fall of 2023, the drafting team for **Project 2020-06** (Verifications of Models and Data for Generators)⁷ was tasked with creating definitions for inverter-based technology. These terms are posted for initial ballot from 11/16/23 to 01/09/24 and may be subject to additional revisions depending on ballot responses. Each of the IBR related projects identified below may be subject to revision based on this initial work plan or the Order pertaining to “unregistered IBRs”. Consistent with Order No. 901, unregistered IBRs intends to encompass those owners and operators of IBRs which are neither (a) registered under Registry Criteria in effect as of January 2024; nor (b) anticipated to be registered under the Registry Criteria revisions that NERC plans to file in Q1, 2024. The standard developers of projects identified with completing Order No. 901 related directives in 2024 are aware of these proposed definitions and will actively adjust their drafts as they are developed.

In November of 2023, the drafting team for **Project 2022-02** (Modifications to TPL-001-5.1 and MOD-032-1) posted a draft of MOD-032-2 that included a proposed definition for Distributed Energy Resources (DER). Standards Development will continue to advance new definitions for DER to assure consistent usage within NERC Reliability Standards.

Use of Term “Unregistered IBRs”

The term “Unregistered IBR” is used in Order No. 901 frequently. These IBRs are types of resources that may only be known in aggregate and not anticipated to be subject to upcoming inclusions of new IBR per the changes to registration. In the November 17, 2022 Order requiring NERC to 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 bulk electric system (BES) definition, those IBRs were also previously referred to as “unregistered IBRs.” When used in this plan, “unregistered IBRs” are now to account for any additional resources and data that are not covered with the new IBR registrations. This term is used within this work plan to assure consistency and the completeness of responses. Filings related to Registration revisions will also update its terminology.

⁷ https://www.nerc.com/pa/Stand/Pages/Project-2020_06-Verifications-of-Models-and-Data-for-Generators.aspx

Chapter 2: Performance Requirements and Post-Event Performance Validation (Milestone 2)

NERC's Standards Development must ensure that new or modified Reliability Standards for disturbance monitoring data sharing, IBR performance requirements, and post-event performance validation must be filed with FERC by **November 4, 2024**. From Order No. 901:

"First, by November 4, 2024, NERC must submit new or modified Reliability Standards that establish IBR performance requirements, including requirements addressing frequency and voltage ride through, post-disturbance ramp rates, phase lock loop synchronization, and other known causes of IBR tripping or momentary cessation. NERC must also submit, by November 4, 2024, new or modified Reliability Standards that require disturbance monitoring data sharing and post-event performance validation for registered IBRs."⁸

The plan to effectively address this milestone includes completing the three projects identified in this chapter. Each project may require some small adjustment to assure a timely completion and alignment for how each drafting team is expected to resolve discrete aspects of a single solution for IBR performance during grid disturbances. All three known active projects are identified as high priority by Standards Development and the project developers will be routinely coordinating throughout 2024.

Part 1: Disturbance Monitoring Data Sharing

All data recording requirements for IBR are established within active **Project 2021-04** (Modifications to PRC-002-02).⁹ No additional project will be needed to address these directives. Some additional modifications to **Project 2021-04** will be needed to meet all associated directives. The standard developer on this project will work their drafting team to ensure each of the associated directives identified in Appendix B: **Milestone 2 Part 1: Disturbance Monitoring Data Sharing**.

Part 2: IBR Performance Requirements

Criteria for evaluating IBR performance will be established through the completion of active **Project 2020-02** (Modifications to PRC-024 Generator Ride-through).¹⁰ No additional project will be needed to address these directives. Some modifications may be needed by the team to ensure all directives from Order No. 901 are effectively addressed. The standard developer on this project will work their drafting team to review and update their projects as appropriate to address the directives identified in Appendix B: **Milestone 2 Part 2: Performance Requirements**.

Additional Notes for this Drafting Team

- The Generator Operator function was not previously identified in earlier drafts. Both drafting teams will ensure that the drafts include clear expectations for Generator Owners (to assure control systems are set in accordance with criteria) and for Generator Operators (to assure the applicable facilities adhere to criteria during a system disturbance). Clarity regarding who is responsible for implementing corrective action plans will be addressed.
- The 2020-02 team must ensure that the entire IBR facility does not automatically trip like a synchronous generator if only some inverters would need to trip for local protection.
- The 2020-02 team will ensure the following statement from Order No. 901 is addressed:
 - "When such existing equipment is replaced, the exemption would no longer apply, and the new equipment must comply with the appropriate IBR performance requirements specified in the Reliability Standards (e.g., voltage and frequency ride through, phase lock loop, ramp rates, etc.)."¹¹

⁸ Order No. 901 at P 7.

⁹ <https://www.nerc.com/pa/Stand/Pages/Project-2021-04-Modifications-to-PRC-002-2.aspx>

¹⁰ https://www.nerc.com/pa/Stand/Pages/Project_2020-02_Transmission-connected_Resources.aspx

¹¹ Order No. 901 at P 193.

Part 3: Post-Event Performance Validation

Responsibilities for triggering and conducting a post-event analysis by functional registrations with a wider view and the establishment of corrective action plans will be identified through the completion of active **Project 2023-02** (Analysis and Mitigation of BES Inverter-Based Resource Performance Issues).¹² Some modifications may be needed by the team to assure all directives from Order No. 901 are effectively addressed. The standard developer on this project will work their drafting team to review and update their project as appropriate to address the directives identified in Appendix B: **Milestone 2 Part 3: Post-Event Performance Validation**.

Additional Notes for this Drafting Team

- The Generator Operator function was not previously identified in earlier drafts. Both drafting teams will ensure that the drafts include clear expectations for Generator Owners (to assure control systems are set in accordance with criteria) and for Generator Operators (to assure the applicable facilities adhere to criteria during a system disturbance). Clarity regarding who is responsible for implementing corrective action plans will be addressed.
- Corrective Action Plans, as required for entities in **Project 2023-02** (Analysis and Mitigation of BES Inverter-Based Resource Performance Issues), could include other system or facility enhancements that are irrespective of individual IBR plant level exemptions from **Project 2020-02** (Modifications to PRC-024 Generator Ride-through). It would be the responsibility of these wider area entities to resolve larger issues resulting from IBRs not meeting performance expectations.

Directives Expected to be Addressed through Later Milestones

The following directive was included in the section for disturbance monitoring but is expected to be addressed through conversations on model validation (2025). To assure this is effectively addressed and included during model validation project discussions, this directive is included in the model validation section later in this work plan.

“[R]egarding CAISO’s request that the Commission direct NERC to consider requiring registered IBRs to provide additional data, we agree that such data collections may be warranted, and direct NERC to consider through its standards development process whether additional IBR data points (e.g., telemetry collections or other automated platform integrations) are needed to further enhance real-time visibility of Bulk-Power System operations.”¹³

IBRs not meeting performance criteria would still be addressed through Milestone 2 in 2024.

¹² <https://www.nerc.com/pa/Stand/Pages/Project-2023-02-Performance-of-IBRs.aspx>

¹³ Order No. 901 at P 86.

Chapter 3: Data Sharing and Model Validation (Milestone 3)

NERC's Standards Development must ensure that new or modified Reliability Standards for data sharing and model validation must be filed with FERC by **November 4, 2025**. From Order No. 901:

“[B]y November 4, 2025, NERC must submit new or modified Reliability Standards addressing the interrelated directives concerning: (1) data sharing for registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate; and (2) data and model validation for registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate.”¹⁴

The plan to address this milestone includes conducting an initial collaboration between NERC Standards Development with Engineering, the RSTC, the Inverter-Based Resource Performance Subcommittee (IRPS), and the System Planning Impacts from Distributed Energy Resources Working Group (SPIDERWG). The goal of this collaboration is to cross check active projects, draft SARs, and pending SARs from those RSTC associated work plans and identify which of those address aspects of this milestone. Some revisions to draft SARs or active projects will be necessary to focus development on directives in Order No. 901 or to include additional objectives to mitigate other risks.

As often discussed within NERC recommendations and outlined in more detail within this work plan, additional model types must be used for local reliability studies, during the interconnection process and following commissioning to validate as-built performance – as well as through ongoing validation of performance. The deficiencies within the current state of model quality are well documented. The inability of current mechanisms to compensate for poor model quality necessitates moving toward a more agile and risk-based approach using performance data to validate system planner and operator studies. To assure that developed projects address model data sharing and model validation using performance, some currently active projects may need to be reworked to align with the directives within Order No. 901 as well as with the NERC recommendations for dynamic modeling. Additional factors to consider during SAR reviews include:

- The completeness of data sharing tasks by functional entity to prevent compliance gaps/overlaps,
- The allowance of some entity flexibility for data sharing or model validation requirements where reasonable – specifically for data estimation methods, and
- Additional guidance for aggregated data methods may be needed to further inform acceptable practices as well as reasonable compliance expectations. Use of existing RSTC approved Reliability Guidelines should be leveraged.¹⁵

Finally, some other gap analyses may be needed as the associated projects are completed to provide assurance of completeness; those are discussed further in this section.

Part 1: Data Sharing (all IBRs)

As required by Order No. 901, the development of positive sequence models based on an approved (standard) library of model types must be built into Interconnection-wide cases. As recommended by NERC, additional model types are needed to effectively triage model quality issues and accurately represent IBR and DER technologies which often use proprietary control functions not captured in standard library models. These recent model and validation recommendations by NERC should be considered as potential additions by the SAR review groups (as detailed below) to assure additional model types and validation (using newer benchmark planning cases) can be built in.¹⁶ The use and sharing of User-Defined Models (UDM) in addition to approved library models for use in positive sequence local reliability studies, interconnection process studies, and interconnection-wide models is recommended practice and consistent with the directives within Order No. 901.

¹⁴ Order No. 901 at P 7.

¹⁵ See approved Reliability and Security Guidelines contributed by the SPIDERWG; <https://www.nerc.com/comm/Pages/Reliability-and-Security-Guidelines.aspx>.

¹⁶ See [NERC Modeling Assessments](#); Dynamic Modeling Recommendations – Recommended Modeling Practices and List of Unacceptable Models, <https://www.nerc.com/pa/RAPA/ModelAssessment/Documents/Dynamic%20Modeling%20Recommendations.pdf> [hereinafter NERC Modeling Assessments].

As shown in **Table 1: Data Sharing and Groupings** individual issues were consolidated by functional registrations and the expected action for data types. The “group” numbers used are proposed as an initial way to consolidate objectives/issues either into one SAR or into one project. Multiple grouped items may be assigned to a single drafting team as deemed appropriate through the Standards Committee. Group 1 deals primarily with the requirement of an approved model library for interconnection wide cases, data exchange expectations, updates to modeling data exchanges based on those changes, and other requirements identified as needed to assure all models are initially shared during the interconnection process and effectively maintained through ongoing data quality improvements based on performance.

Beyond the requirement language of Order No. 901 are the needs of each expected model type to be included as part of Group 1 revisions to data sharing requirements. Ideally, Group 1 should initiate first and update both Groups 2 and 3 on any pertinent revisions to the exchange of data for each model type. Groups 2 and 3 are highly dependent on having the approved model types reflected in revisions to MOD-032 made by Group 1. Both groups have very similar expectations but may have different technical subject matter experts (SMEs) or challenges. Depending on the availability of resources, Groups 2 and 3 could run in parallel or be done by the same team. Should these be developed by different teams, the developers would frequently communicate to assure consistency in scope and development.

Each groups’ associated directives are included in Appendix B: **Milestone 3 Part 1: Data Sharing**.

Table 1: Data Sharing and Groupings

Group	IBR/DER	Entity Responsible ¹⁷	Action	Data Type
1	IBR/DER	PC, TP, RC, TOP, BA	Establish models and data exchange requirements	All models
	IBR/DER	GO	Use Industry approved models	All models
	IBR	GO/GOP	Provide to PC, TP, RC, TOP, BA	All modeling data and parameters (including control settings)
	DER	GO/GOP	Provide to PC, TP, RC, TOP, BA	All modeling data and parameters
2	IBR	TO	Provide to GO/GOPs	Data requirements or specifications
	Unregistered IBR	TO	Provide to PC, TP, RC, TOP, BA	Model data and parameters – individually or in aggregate
	Unregistered IBR	TO	Provide to PC, TP, RC, TOP, BA	Estimated data – Explanations on limitations – and estimation methods
3	DER	DP	Provide to PC, TP, RC, TOP, BA	Model data and parameters – in the aggregate
	DER	TO	Provide to GO/GOPs	Data requirements or specifications

¹⁷ Planning Coordinator (PC), Transmission Planner (TP), Reliability Coordinator (RC), Transmission Operator (TOP), Balancing Authority (BA), Generator Owner (GO), Generator Operator (GOP), Transmission Owner (TO), Distribution Provider (DP), To Be Determined – contingent on the SAR and determinations of the SAR submitters or drafting team(s) (TBD).

Group	IBR/DER	Entity Responsible ¹⁷	Action	Data Type
	DER	DP	Provide to PC, TP, RC, TOP, BA	Estimated data – Explanations on limitations – and estimation methods
	DER	TBD	Provide to PC, TP, RC, TOP, BA	Estimated data – Explanations on limitations – and estimation methods

Additional Notes for SAR Reviews Group 1

Group 1 is tasked with assuring that models are set in accordance with a library of approved models and that each GO/GOP follows those PC/TP/RC/TOP/BA approved models. Changes here should consider the interconnection-wide cases developed in MOD-032 and pending changes to the interconnection process (anticipated FAC-001 SAR). Other updates are needed to assure GO/GOP follow updated data specifications and include model data needed to validate performance data, such as adequate control settings data, that must be part of the acceptable models. If a model in the standard library is unable to accurately represent the performance and parameterization of the technology, a sufficiently accurate User-Defined model would be leveraged.

Currently, **Project 2022-02** (Modifications to TPL-001-5.1 and MOD-032-1)¹⁸ addresses some DER aspects for MOD-032. However, that project currently only covers changes from LSE to DP and inclusion of DER but may not update entirely depending on the changes to approved models. That team may need additional tasks to ensure all necessary model parameters are appropriately communicated following the creation of that library. Furthermore, **Project 2022-02** is not required to define aggregated DER data but should consider including data sharing aspects, keeping in line with the full expectations of Group 1.

Data for operations such as energy data, Real-time data, and post-event disturbance monitoring data are not covered in Group 1 but are likely to be impacted by changes to the approved model types. Following the revisions expected by Group 1, a gap analysis is needed to identify if revisions to IRO-010, TOP-003, PRC-028, and MOD-031 are needed to ensure there are no inconsistent data exchange expectations introduced following the revisions to acceptable model types and inclusion of IBR control settings. Results of that gap analysis could inform work done by Groups 2 and 3. Similarly **Project 2022-04** (EMT Modeling)¹⁹ is establishing new EMT models, but those that are currently not identified in Order No. 901. **Project 2022-04** may require adjustments depending on Group 1 developments to assure alignment with model use requirements. The results of this gap analysis will also be necessary to inform changes to operational assessments and any additional SARs for completion in Milestone 4.

Additional Notes for SAR Reviews Group 2

Group 2 is tasked with assuring updated TO responsibilities for data sharing of registered and unregistered IBRs. While data sharing expectations set by Group 1 may necessitate some revisions to TO data sharing requirements, there may not be many changes to that as TOs are required to submit data to their TPs (as established in MOD-032). However, TO specifications would need to be addressed in requirements for interconnection of new generation – such as expected for pending FAC-001 revisions.

NERC will need to thoroughly define this scope before creating a project. An approved library model for an unregistered “plant” using some form of aggregated values will need both guidance and a clear performance-based model development/validation process. The most challenging aspect of this Group’s efforts could be mitigated through early proposed estimation methods that a drafting team could consider during development.

¹⁸ <https://www.nerc.com/pa/Stand/Pages/Project2022-02ModificationstoTPL-001-5-1andMOD-032-1.aspx>

¹⁹ <https://www.nerc.com/pa/Stand/Pages/Project2022-04EMTModeling.aspx>

Additional Notes for SAR Reviews Group 3

Group 3 is like Group 2's tasks, but will be focused on DP and TO efforts with DER. This group's efforts may overlap slightly with active **Project 2023-05** (Modifications to FAC-001 and FAC-002)²⁰ and **Project 2023-08** (Modifications of MOD-031 Demand and Energy Data)²¹ and should be folded into a single DER effort. In addition to early proposed estimation methods, Group 3 should review the associated directives along with definitions in FERC Order 2222 to mitigate issues with terminology as appropriate for NERC Reliability Standards.

Part 2: Model Validation

The strategy to address all items in this part will be to initiate an analysis of existing Reliability Standards and directives associated with items in Group 1 from **Table 2: Model Validation and Groupings**. The team conducting the analysis should include consultation from additional NERC staff (Compliance Assurance, Engineering, and Standards Development) to ensure any other IBR related work plan updates are adequately reflected in those results. Essential to this analysis is collaboration with the IRPS and SPIDERWG to account for issues already identified in pending SARS or their associated work plans. If the results of the analysis identify that additional Standard revisions are needed to complement the directives associated with items in Group from **Table 2: Model Validation and Groupings**, those additional revisions must be detailed in a SAR.

Holistic changes are needed to model validation Reliability Standards (MOD-025, MOD-026, MOD-027, MOD-032, MOD-033) to account for additional model validation expectations during interconnection (FAC-001) with post-disturbance monitoring data (PRC-028), and during ongoing planning and operational studies that assist in identifying performance. As stated in the NOPR preceding Order No. 901,²² currently effective MOD Reliability Standards require owners to verify certain components for synchronous generators but not IBR-specific controls. **Project 2020-06** (Verifications of Models and Data for Generators) and **Project 2021-01** (Modifications to MOD-025 and PRC-019)²³ are expected to include updates to IBR-specific controls validation; these projects may need to be placed on hold until SARs are developed that incorporate modeling validation using actual performance data. Further, there may be a more straightforward approach to a single updated MOD-033 that could be pursued as a singular solution that replaces several current MOD Reliability Standards. This approach to a new performance-based modeling Reliability Standard should:

- include a complete set of validation expectations using performance data,
- use the most accurate and highest quality model type available,
- ensure post-interconnection validations are not based on staged testing but instead are periodically validated using performance data,
- be designed to follow and be able to leverage new performance validations done during the interconnection process,
- include minimum criteria for performing validation (*e.g.*, time, tolerance, impact),
- include some planner/operator flexibility in determining specific performance criteria,
 - These are necessary to ensure that performance criteria are risk-based and region-specific
 - These should consider parallel criteria developed for TPL-001 and the new PRC-030
- allow corrective action plans to be created by planners and operators that require the GO/TO to identify and improve model performance characteristics to align with performance.

²⁰ <https://www.nerc.com/pa/Stand/Pages/Project-2023-05-Modifications-to-FAC-001-and-FAC-002.aspx>

²¹ <https://www.nerc.com/pa/Stand/Pages/Project2023-08-Modifications-of-MOD-031-Demand-and-Energy-Data.aspx>

²² *Reliability Standards to Address Inverter-Based Resources*, Notice of Proposed Rulemaking, 181 FERC ¶ 61,125 (2002), <https://www.ferc.gov/media/e-2-rm22-12-000>.

²³ https://www.nerc.com/pa/Stand/Pages/Project_2021-01_Modifications_to_MOD-025_and_PRC-019.aspx

Finally, additional model types must be leveraged to effectively triage data quality issues²⁴ in dynamic models, other model validation must be conducted using performance data (see Milestone 4), and additional benchmark cases are anticipated to be developed per the following directive from Order No. 901:

“With respect to NERC’s recommendation for model benchmarking, we direct NERC to determine through its standards development process whether the development of benchmark cases to test model performance and a subsequent report comparing model performance are needed and at what periodicity.”²⁵

Coordinated with this effort, should be a review of other benchmark planning cases developed for the new energy assurance assessments in **Project 2022-03** (Energy Assurance with Energy-Constrained Resources)²⁶ and extreme weather in **Project 2023-07** (Transmission System Planning Performance Requirements for Extreme Weather).²⁷

Both groups’ associated directives are included in Appendix B: **Milestone 3 Part 2: Model Validation**.

Table 2: Model Validation and Groupings

Group	IBR/DER	Entity Responsible	Action	Data Type
1	IBR/DER	PC, TP, RC, TOP, BA	Validate models with performance	All models
	IBR	PC, TP, RC, TOP, BA	Validate models with performance	Post-event disturbance monitoring data
2	IBR/DER	GO/TO/DP	Validate models with performance	All models
	IBR	GO/TO	Validate models with performance	Post-event disturbance monitoring data

Additional Notes for SAR Reviews Group 1

Group 1 primarily deals with the establishment of adequate validation processes of models by planners and operators. These validation processes must include the identification of adequate validation measures identified through an analysis. Wider area validation methods (such as through the current MOD-033) generally can only focus on wider area issues and any individual plant issues have been difficult to identify. That difficulty has been exacerbated without the implementation of a single set of approved model types and validation of actual performance at the end of the interconnection process to verify if changes to originally supplied models do not match generation performance “as-built.”

Finally, implementation plans for data sharing should precede validation expectations – especially for newly registered resources.

Additional Notes for SAR Reviews Group 2

Group 2 deals with the validation of IBR/DER following modifications to the model validation process, as outlined by Group 1. Validation using disturbance monitoring data is brought forward to this group from Milestone 2. Additional modifications from the analysis could also be expected and should be confirmed prior to moving forward.

²⁴ See NERC Modeling Assessments, *supra* note 16.

²⁵ Order No. 901 at P 126.

²⁶ <https://www.nerc.com/pa/Stand/Pages/Project2022-03EnergyAssurancewithEnergy-ConstrainedResources.aspx>

²⁷ <https://www.nerc.com/pa/Stand/Pages/Project-2023-07-Mod-to-TPL00151.aspx>

Chapter 4: Planning and Operational Studies (Milestone 4)

Standards Development must ensure that new or modified Reliability Standards for planning and operational studies must be filed with FERC by **November 4, 2026**. From Order No. 901:

“[B]y November 4, 2026, NERC must submit new or modified Reliability Standards addressing planning and operational studies for registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate.”²⁸

The strategy to address all aspects of Order No. 901 related to planning and operational studies is built on dynamic modeling recommendations from NERC²⁹ as well as modifications to NERC Reliability Standards, as conducted through Milestone 3 of this work plan. It will be essential near the end of Milestone 3 to identify which planning and operational studies must be leveraged to evaluate model data quality with performance data. Specifically, to ensure that all planning and operational studies accurately represent ride-through performance, the new standard PRC-030 within **Project 2023-02** (Analysis and Mitigation of BES Inverter-Based Resource Performance Issues) may require modifications to assure that any resulting changes to models (such as the result of an implemented corrective action plan) are provided to planners and operators in a timely manner.

The approach to Milestone 4 must ensure that all identified operational and planning study requirements are revised to streamline ongoing model improvements into those associated studies. This must include Real-time Monitoring, Real-time Assessments, Operational Planning Assessments, Transmission Planning studies, and others. Several active projects are in progress that address planning and operational studies using new benchmark planning cases; **Project 2022-03** (Energy Assurance with Energy-Constrained Resources) and extreme weather in **Project 2023-07** (Transmission System Planning Performance Requirements for Extreme Weather). These studies must also be revised to ensure that studies are using the most appropriate and accurate models.

This section proposes separating operational study directives (Group 1) from planning study directives (Group 2). Each group’s associated directives are included in Appendix B: **Milestone 4: Operations and Planning Assessments**.

Table 3 : Planning And Operational Assessments

Group	IBR/DER	Entity Responsible	Study Type	Changes to Studies
1	IBR/DER	RC, TOP	Real-time Monitoring, Real-time Assessments, Operational Planning Assessment	Updated Modeling per Milestone 3 data changes and inclusion of ride-through performance
	IBR/DER	BA	Real-time Assessments and Operational analyses	Updated Modeling per Milestone 3 and inclusion of ride-through performance
2	IBR/DER	PC, TP	Transmission Planning Studies and wide-area studies (Energy Assurance, Extreme weather, etc.)	Updated Modeling per Milestone 3 changes and inclusion of validated ride-through performance
	IBR/DER	PC, TP	Transmission Planning Studies and wide-area studies (Energy Assurance, Extreme weather, etc.)	Potential ride-through performance impacts and inclusion of validated ride-through performance

²⁸ Order No. 901 at P 7.

²⁹ See NERC Modeling Assessments, *supra* note 16.

Additional Notes for SAR Reviews Group 1

As discussed in the *Additional Notes for SAR Reviews Group 1* for Milestone 3: Data Sharing, an analysis for operationally impactful data sharing requirements will need to be conducted to assure that all changes to model and data sharing requirements are effectively modified in advance of this section and effort. Those results should be leveraged to inform how changes to operations (Real-time monitoring, Real-time Assessments, Operational Planning Assessments, and any other operational studies) are effectively updated. This group should also review new operational energy assurance studies as are developed for currently active **Project 2022-03** (Energy Assurance with Energy-Constrained Resources).

Additional Notes for SAR Reviews Group 2

Group 2 will need to review currently active **Project 2022-03** (Energy Assurance with Energy-Constrained Resources), **Project 2023-07** (Transmission System Planning Performance Requirements for Extreme Weather), and **Project 2022-02** (Modifications to TPL-001-5.1 and MOD-032-1) to assure that those planning assessments are similarly updated to reflect the same objectives of the associated directives.

Appendix A: Impacts to/from Other FERC Filings or NERC Strategic Work Plans

Recent IBR Registrations –Periodic Work Plan Filing

As part of the Order directing NERC to identify and register unregistered IBRs (as that term was used in 2022) that, in the aggregate, have a material impact on the reliable operation of the Bulk-Power System,³⁰ NERC is directed to continue filing work plan updates every 90 days; including on the progress. From that Order:

“The work plan should explain how NERC will modify its processes to encompass unregistered IBRs (whether by working with stakeholders to change the BES definition, a change to its registration program, or some other solution) within 12 months of approval of the work plan. The work plan should also include implementation milestones ensuring that unregistered IBR owners and operators meeting the new registration criteria are identified within 24 months of the approval date of the work plan, and that they are registered and required to comply with applicable Reliability Standards within 36 months of the approval date of the work plan.”

Details from this work plan for Standards Development, any pending or accepted SARs for this new set of registering IBRs, could be included in that periodic filing. Registration work plan updates may cross reference initiatives such as this one which pertain to broader risk mitigation.

FERC Order 2222³¹ on Market Changes to DER Tariffs

While not directly a directive for NERC, NERC plans to consider aligning terminology with DER data collection, where reasonable, to reduce introducing compliance gaps or undue burden on Distribution Providers. FERC SMEs on the 2222 Order should be consulted during development of DER data related projects in the Data Sharing section of this work plan. Such experts may also be able to provide feedback during the SAR development, although there could be rationale for slightly different usage in terms in the context of reliability-related discussions as opposed to market discussions.

Potential New IBR Cyber or Physical Protections

Additionally, Order No. 901 did seek to identify if additional cyber or physical security protections were needed. NERC will continue to examine internally and in coordination with stakeholders under the RSTC what, if any, new Standards may be appropriate. From Order No. 901:

“The Commission did not propose in the NOPR to address new cyber or physical security protections of IBRs beyond those in existing applicable Reliability Standards. Therefore, while we decline to direct NERC to develop IBR-specific cyber or physical security Reliability Standards for IBRs in this effort, NERC should evaluate whether there are gaps that must be addressed.”³²

³⁰ Registration of Inverter-Based Resources, 181 FERC ¶ 61,124 (2022), <https://www.ferc.gov/media/e-1-rd22-4-000>.

³¹ *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 2022, 172 FERC ¶ 61,247 (2022), https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf.

³² Order No. 901 at P 80.

Appendix B: List of Associated Directives

There are some components of directives from Order No. 901 which include multiple items and are expected to be addressed through multiple milestones. For clarity, the full language for those directives is included for each of the applicable milestone sections below but only the pertinent component should be addressed as appropriate.

Milestone 2 Part 1: Disturbance Monitoring Data Sharing

Associated directives include:

1. “NERC must also submit, by November 4, 2024, new or modified Reliability Standards that require disturbance monitoring data sharing and post-event performance validation for registered IBRs.”³³
2. “Further, the Reliability Standards must require generator owners to communicate to the relevant planning coordinators, transmission planners, reliability coordinators, transmission operators, and balancing authorities the actual post-disturbance ramp rates and the ramp rates to meet expected dispatch levels (i.e., generation-load balance).”³⁴
3. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal to direct NERC to include in the new or modified Reliability Standards technical criteria to require registered IBR generator owners to install disturbance monitoring equipment at their buses and elements, to require registered IBR generator owners to provide disturbance monitoring data to Bulk-Power System planners and operators for analyzing disturbances on the Bulk-Power System, and to require Bulk-Power System planners and operators to validate registered IBR models using disturbance monitoring data from installed registered IBR generator owners’ disturbance monitoring equipment.”³⁵
4. “We further agree with the findings in NERC reports (e.g., a lack of high-speed data captured at the IBR or plant-level controller and low-resolution time stamping of inverter sequence of event recorder information has hindered event analysis) and direct NERC through its standard development process to address these findings.”^{36, 37}
5. “Thus, in developing the directed data collection requirements, we direct NERC to consider the burdens of generators collecting and providing data, while assuring that Bulk-Power System operators and planners have the data they need for accurate disturbance monitoring and analysis.”^{38, 39}

Milestone 2 Part 2: Performance Requirements

Associated directives include:

1. “First, by November 4, 2024, NERC must submit new or modified Reliability Standards that establish IBR performance requirements, including requirements addressing frequency and voltage ride through, post-disturbance ramp rates, phase lock loop synchronization, and other known causes of IBR tripping or momentary cessation.”⁴⁰
2. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require registered IBR generator owners and operators to use appropriate settings (i.e., inverter, plant controller, and protection) to ride through frequency and voltage system disturbances and that permit IBR tripping only to protect the IBR equipment in scenarios similar to when synchronous generation resources use tripping as protection from internal faults.”⁴¹

³³ Order No. 901 at P 7.

³⁴ *Id.* at P 208.

³⁵ *Id.* at P 85.

³⁶ *Id.* at P 85.

³⁷ This will be addressed during the development of Project 2021-04. The drafting team is advised to assure that any comments regarding overreach here are addressed appropriately during ballot.

³⁸ Order No. 901 at P 86.

³⁹ This will be addressed during the development of Project 2021-04. The drafting team is advised to assure that any comments regarding unreasonable burden are addressed appropriately during ballot.

⁴⁰ Order No. 901 at P 7.

⁴¹ *Id.* at P 190.

3. “The new or modified Reliability Standards must require registered IBRs to continue to inject current and perform frequency support during a Bulk-Power System disturbance.”⁴²
4. “Any new or modified Reliability Standard must also require registered IBR generator owners and operators to prohibit momentary cessation in the no-trip zone during disturbances.”⁴³
5. “NERC must submit new or modified Reliability Standards that establish IBR performance requirements, including requirements addressing frequency and voltage ride through, post-disturbance ramp rates, phase lock loop synchronization, and other known causes of IBR tripping or momentary cessation.”⁴⁴
6. “Therefore, we direct NERC through its standard development process to determine whether the new or modified Reliability Standards should provide for a limited and documented exemption for certain registered IBRs from voltage ride through performance requirements.”⁴⁵
7. “Finally, we direct NERC, through its standard development process, to require the limited and documented exemption list (i.e., IBR generator owner and operator exemptions) to be communicated with their respective Bulk-Power System planners and operators (e.g., the IBR generator owner’s or operator’s planning coordinator, transmission planner, reliability coordinator, transmission operator, and balancing authority).”⁴⁶
8. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop and submit to the Commission for approval new or modified Reliability Standards that require post-disturbance ramp rates for registered IBRs to be unrestricted and not programmed to artificially interfere with the resource returning to a pre-disturbance output level in a quick and stable manner after a Bulk-Power System.”⁴⁷
9. “The proposed new or modified Reliability Standards must require registered IBRs to ride through momentary loss of synchronism during Bulk-Power System disturbances and require registered IBRs to continue to inject current into the Bulk-Power System at pre-disturbance levels during a disturbance, consistent with the IBR Interconnection Requirements Guideline and Canyon 2 Fire Event Report recommendations.”⁴⁸
10. “Related to ACP/SEIA’s comment recommending to revise the directive to require generators to maintain synchronism where possible and continue to inject current to support system stability, we direct NERC, through its standard development process, to consider whether there are conditions that may limit generators to maintain synchronism.”^{49, 50}

Milestone 2 Part 3: Post-Event Performance Validation

Associated directives include:

1. “Pursuant to section 215(d)(5) of the FPA, we modify the NOPR proposal. To the extent NERC determines that a limited and documented exemption for those registered IBRs currently in operation and unable to meet voltage ride-through requirements is appropriate due to their inability to modify their coordinated protection and control settings, we direct NERC to develop new or modified Reliability Standards to mitigate the reliability impacts to the Bulk-Power System of such an exemption.”⁵¹
2. “We direct NERC to submit to the Commission for approval new or modified Reliability Standards that would require registered IBRs to ride through any conditions not addressed by the proposed new or modified Reliability Standards that address frequency or voltage ride through, including phase lock loop loss of synchronism.”⁵²

⁴² *Id.* at P 190.

⁴³ *Id.* at P 190.

⁴⁴ *Id.* at P 190.

⁴⁵ *Id.* at P 193.

⁴⁶ *Id.* at P 193.

⁴⁷ *Id.* at P 208.

⁴⁸ *Id.* at P 209.

⁴⁹ *Id.* at P 209.

⁵⁰ Maintaining synchronism and PLL ride-through are linked. However, synchronism is not well suited for IBR performance and was not pursued for modifications to PRC-029.

⁵¹ Order No. 901 at P 199.

⁵² *Id.* at P 209.

Milestone 3 Part 1: Data Sharing

Group 1: Model Specifications, Types, and Sharing Requirements

The following are directives pertaining to Group 1 from *Table 1: Data Sharing and Groupings*:

1. “Specifically, we direct NERC to develop new or modified Reliability Standards that require planning coordinators, transmission planners, reliability coordinators, transmission operators, and balancing authorities to establish for each interconnection a uniform framework with modeling criteria, a registered modeling designee, and necessary data exchange requirements both between themselves and with the generator owners, transmission owners, and distribution providers to coordinate the creation of transmission planning, operations, and interconnection-wide models (i.e., system models) and the validation of each respective system model.”⁵³
2. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require registered IBR generator owners and operators to provide IBR-specific modeling data and parameters (e.g., steady-state, dynamic, and short circuit modeling information, and control settings for momentary cessation and ramp rates) that accurately represent the registered IBRs to their planning coordinators, transmission planners, reliability coordinators, transmission operators, and balancing authorities that are responsible for planning and operating the Bulk-Power System.”⁵⁴
3. “Nevertheless, to support accurate modeling and performance, we direct NERC to consider during its standards development process AEU and ACP/SEIA’s suggested data sharing requirements when developing the framework, criteria, and necessary data exchange requirements to meet the registered IBR data sharing directive.”⁵⁵
4. “Regarding CAISO’s concern regarding the potential “compliance trap” where planners and operators rely on third-party data and IRC’s request that the final rule specify the data to be submitted by all IBRs (i.e., registered IBRs, unregistered IBRs, and IBR-DERs in the aggregate) and transmission devices using similar technologies, we direct NERC to determine through its standards development process the minimum categories or types of data that must be provided to transmission planners, transmission operators, transmission owners, and distribution providers necessary to predict the behavior of all IBRs and to ensure that compliance obligations are clear.”⁵⁶
5. “As discussed in more detail in section IV.C of this final rule, we are also directing NERC to develop new or modified Reliability Standards that require the use of approved industry IBR models that accurately reflect the behavior of all IBRs during steady state, short-circuit, and dynamic conditions.”⁵⁷
6. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require the use of approved industry generic library IBR models that accurately reflect the behavior of IBRs during steady state, short-circuit, and dynamic conditions when developing planning, operations, and interconnection-wide models.”⁵⁸
7. “We direct NERC to determine through its standards development process which nation-wide approved component models are needed to build IBR plant models for steady state, short-circuit, and dynamics studies.”⁵⁹
8. “Accordingly, we direct NERC to develop new or modified Reliability Standards that require the sole use of nation-wide approved component generic library models for system models to facilitate the exchange of neighboring entities’ respective planning and operation models and to build interconnection-wide models.”⁶⁰
9. “While we decline to include this level of detail in the directive to NERC, we nonetheless direct NERC to establish a standard uniform model verification process.”⁶¹

⁵³ *Id.* at P 161.

⁵⁴ *Id.* at P 76.

⁵⁵ *Id.* at P 77.

⁵⁶ *Id.* at P 108.

⁵⁷ *Id.* at P 108.

⁵⁸ *Id.* at P 122.

⁵⁹ *Id.* at P 124.

⁶⁰ *Id.* at P 125.

⁶¹ *Id.* at P 143.

10. “Accordingly, we direct NERC to develop new or modified Reliability Standards that require the use of the DER_A model or successor models to represent the behaviors of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System at a sufficient level of fidelity for Bulk-Power System planners and operators to create valid planning and operations and interconnection-wide models and to be able to perform respective system studies.”⁶²
11. “Regarding the IRC and SPP concerns about EMT model data availability and verification, as we decline to require the use of EMT models (as explained in section IV.C.1), we also decline to direct NERC to explicitly require EMT data and verified EMT models for the same reasons.”^{63, 64}

Group 2: Registered and Unregistered IBR Data Curation

The following are directives pertaining to Group 2 from [Table 1: Data Sharing and Groupings](#):

1. “Nevertheless, to support accurate modeling and performance, we direct NERC to consider during its standards development process AEU and ACP/SEIA’s suggested data sharing requirements when developing the framework, criteria, and necessary data exchange requirements to meet the registered IBR data sharing directive.”⁶⁵
2. “Specifically, as proposed in the NOPR, we direct NERC to submit to the Commission for approval one or more new or modified Reliability Standards that require: (1) transmission owners to provide to Bulk-Power System planners and operators modeling data and parameters for unregistered IBRs in their transmission owner areas that, individually or in the aggregate, materially affect the reliable operation of the Bulk-Power System and (2) distribution providers to provide to Bulk-Power System planners and operators modeling data and parameters for IBR-DERs in the aggregate in their distribution provider areas where the IBR-DERs in the aggregate materially affect the reliable operation of the Bulk-Power System.”⁶⁶
3. “Recognizing that there may be instances in which transmission owners are unable to gather adequate unregistered IBR modeling data and parameters to create and maintain unregistered IBR models in their transmission owner areas, we modify the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require each transmission owner, if unable to gather accurate unregistered IBR data or unable to gather unregistered IBR data at all, to provide instead to the Bulk-Power System planners and operators in their areas: (1) an estimate of the unregistered IBR modeling data and parameters, (2) an explanation of the limitations of the availability of data, (3) an explanation of the limitations of any data provided by unregistered IBRs, and (4) the method used for estimation.”⁶⁷
4. “To support this data collection, we further direct NERC to consider commenters suggestions to implement a process or mechanism by which transmission owners would receive modeling data and parameters.”⁶⁸
5. “Recognizing that there may be instances in which transmission owners are unable to gather accurate unregistered IBR modeling data and parameters to create and maintain accurate unregistered IBR dynamic models in their transmission owner areas, we modify the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require each transmission owner, if unable to gather accurate unregistered IBR data or unable to gather unregistered IBR data at all, to provide instead to the Bulk-Power System planners and operators in their areas, dynamic models of unregistered IBRs using estimated data in accordance with this final rule’s section IV.B.3 data sharing directives.”⁶⁹

Group 3: DER Data Curation

The following are directives pertaining to Group 3 from [Table 1: Data Sharing and Groupings](#):

⁶² *Id.* at P 146.

⁶³ *Id.* at P 150.

⁶⁴ EMT models are required in Project 2022-04. While not required for the Order, these should be considered within this Grouping for consistency.

⁶⁵ Order No. 901 at P 77.

⁶⁶ *Id.* at P 102.

⁶⁷ *Id.* at P 104.

⁶⁸ *Id.* at P 104.

⁶⁹ *Id.* at P 141.

1. “Specifically, as proposed in the NOPR, we direct NERC to submit to the Commission for approval one or more new or modified Reliability Standards that require: (1) transmission owners to provide to Bulk-Power System planners and operators modeling data and parameters for unregistered IBRs in their transmission owner areas that, individually or in the aggregate, materially affect the reliable operation of the Bulk-Power System and (2) distribution providers to provide to Bulk-Power System planners and operators modeling data and parameters for IBR-DERs in the aggregate in their distribution provider areas where the IBR-DERs in the aggregate materially affect the reliable operation of the Bulk-Power System.”⁷⁰
2. “Accordingly, to account for instances in which distribution providers are unable to gather adequate modeling data and parameters of IBR-DERs to create and maintain IBR-DER models, we modify the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require that each distribution provider, if unable to gather accurate IBR-DERs data in the aggregate or unable to gather IBR-DERs data in the aggregate at all, provide instead to the Bulk-Power System planners and operators in their areas: (1) an estimate of the modeling data and parameters of IBR-DERs in the aggregate, (2) an explanation of the limitations of the availability of data, (3) an explanation of the limitations of the data provided by IBR-DERs, and (4) the method used for estimation.”⁷¹
3. “In support of above, we further direct NERC to consider commenters’ suggestions to implement a process or mechanism by which distribution providers would receive modeling data and parameters.”⁷²
4. “For those areas with IBR-DERs that in the aggregate materially affect the reliable operation of the Bulk-Power System but do not have an associated registered distribution provider, we direct NERC to determine the appropriate registered entity responsible for providing data of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, or, when unable to gather such accurate IBR-DERs data, to provide instead to the Bulk-Power System planners and operators in their areas: (1) an estimate of the modeling data and parameters of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, (2) an explanation of the limitations of the availability of data, (3) an explanation of the limitations of any data provided by the IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, and (4) the method used for estimation.”⁷³
5. “Recognizing that there may be instances in which distribution providers are unable to gather data that accurately represents IBR-DERs in the aggregate, we modify the NOPR proposal and direct NERC to include in the proposed new or modified Reliability Standards a requirement that the distribution provider, if unable to gather data of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, provide to the Bulk-Power System planners and operators (i.e., the data recipients) a dynamic model using estimated data for IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, in accordance with this final rule’s section IV.B.3 data sharing directives.”⁷⁴
6. “Finally, NERC must ensure that the proposed new or modified Reliability Standards account for the dynamic performance of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System.”⁷⁵
7. “For those areas with IBR-DERs in the aggregate that have a material impact on the reliable operation of the Bulk-Power System but do not have an associated registered distribution provider, we modify the NOPR proposal to direct NERC to determine the appropriate registered entity responsible for the models of those IBR-DERs and to determine the registered entities responsible for updating, verifying, and coordinating models for IBR-DERs in the aggregate to meet the system models directives.”⁷⁶

Milestone 3 Part 2: Model Validation

Group 1: Planner and Operator Model Validation

The following are directives pertaining to Group 1 from [Table 2: Model Validation and Groupings](#):

⁷⁰ *Id.* at P 102.

⁷¹ *Id.* at P 105.

⁷² *Id.* at P 105.

⁷³ *Id.* at P 106.

⁷⁴ *Id.* at P 141.

⁷⁵ *Id.* at P 141.

⁷⁶ *Id.* at P 161.

1. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal to direct NERC to include in the new or modified Reliability Standards technical criteria to require registered IBR generator owners to install disturbance monitoring equipment at their buses and elements, to require registered IBR generator owners to provide disturbance monitoring data to Bulk-Power System planners and operators for analyzing disturbances on the Bulk-Power System, and to require Bulk-Power System planners and operators to validate registered IBR models using disturbance monitoring data from installed registered IBR generator owners’ disturbance monitoring equipment.”⁷⁷
2. “Therefore, we direct NERC to define the model verification process and to require consistency among the model verification processes for existing Reliability Standards (e.g., FAC-002, MOD-026, and MOD-027) and any new or modified Reliability Standards.”⁷⁸
3. “Finally, NERC must ensure that the proposed new or modified Reliability Standards account for the dynamic performance of IBR-DERs that in the aggregate have a material impact on the Bulk-Power System.”⁷⁹
4. “Moreover, although the Reliability Standards will apply to a different (albeit overlapping) set of entities than Order No. 2023, we believe consistency is needed between the complimentary proceedings and therefore direct NERC to include in the new or modified Reliability Standards a similar model verification process timeline consistent with Order No. 2023 modeling deadline requirements.”⁸⁰
5. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to submit new or modified Reliability Standards that require Bulk-Power System planners and operators to validate, coordinate, and update in a timely manner the system models by comparing all generator owner, transmission owner, and distribution provider verified IBR models (i.e., models of registered IBRs, unregistered IBRs, and IBR-DERs that in the aggregate have a material impact on the Bulk-Power System) and resulting system models against actual system operational behavior.”⁸¹
6. “Furthermore, for those areas with IBR-DERs in the aggregate that materially impact the reliable operation of the Bulk-Power System but do not have an associated registered distribution provider, we modify the NOPR proposal to direct NERC to determine the appropriate registered entity responsible for the data and parameters of IBR-DERs in the aggregate and to establish a process that requires identified registered entities to coordinate, validate, and keep up to date the system models.”⁸²

Group 2: Owner and Operator Model Validation

The following are directives pertaining to Group 2 from [Table 2: Model Validation and Groupings](#)^{Error! Reference source not found.}:

1. “NERC must also submit, by November 4, 2024, new or modified Reliability Standards that require disturbance monitoring data sharing and post-event performance validation for registered IBRs.”⁸³
2. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop new or modified Reliability Standards that require the generator owners of registered IBRs, transmission owners that have unregistered IBRs on their system, and distribution providers that have IBR-DERs on their system to provide models that represent the dynamic behavior of these IBRs at a sufficient level of fidelity to provide to Bulk-Power System planners and operators to perform valid interconnection-wide, planning, and operational studies on a basis comparable to synchronous generation resources.”⁸⁴
3. “We also direct NERC to require the generator owners of registered IBRs and the transmission owners that have unregistered IBRs on their system to provide to the Bulk-Power System planners and operators (e.g., planning coordinators, transmission planners, reliability coordinators, transmission operators, and balancing

⁷⁷ *Id.* at P 85.

⁷⁸ *Id.* at P 143.

⁷⁹ *Id.* at P 141.

⁸⁰ *Id.* at P 149.

⁸¹ *Id.* at P 156.

⁸² *Id.* at P 156.

⁸³ *Id.* at P 7.

⁸⁴ *Id.* at P 140.

- authorities) dynamic models that accurately represent the dynamic performance of registered and unregistered IBRs, including momentary cessation and/or tripping, and all ride through behavior.”⁸⁵
4. “Further, we direct NERC to require distribution providers to provide to the planning coordinators, transmission planners, reliability coordinators, transmission operators, and balancing authorities aggregated dynamic models that adequately represent the dynamic performance of IBR-DERs on their systems that in the aggregate have a material impact on the Bulk-Power System, including momentary cessation and/or tripping, and all ride through behavior (e.g., IBR-DERs in the aggregate modeled by interconnection requirements performance to represent different steady-state and dynamic behavior).”⁸⁶
 5. “Further, we direct NERC to include in the new or modified Reliability Standards a requirement for generator owners, transmission owners, and distribution providers to regularly update and communicate the verified data and models of registered IBRs, unregistered IBRs, and IBR-DERs by comparing their resulting models against actual operational behavior to achieve and maintain necessary modeling accuracy for inclusion of these resources in the system models.”⁸⁷

Milestone 4: Operations and Planning Assessments

Group 1: Operational Studies

The following are directives pertaining to Group 1 from *Table 3 : Planning And Operational Assessments*

1. “We adopt the NOPR proposal and direct NERC to submit to the Commission for approval one or more new or modified Reliability Standards that require reliability coordinators and transmission operators to include the performance and behavior of registered and unregistered IBRs individually and in the aggregate, as well as IBR-DERs in the aggregate, (e.g., IBRs tripping or entering momentary cessation individually or in the aggregate) in their operational planning analyses, real-time monitoring, and real-time assessments, including non-bulk electric system data and external power system network data identified in their data specifications.”⁸⁸
2. “Further, we agree with commenters and direct NERC to submit to the Commission for approval new or modified Reliability Standards requiring reliability coordinators and transmission operators, when performing operational studies, as well as operational planning analyses, real-time monitoring, real-time assessments, and other analyses, to include in these studies all generation resources (i.e., all generation resources including all IBRs) necessary to adequately assess the performance of the Bulk-Power System for normal and contingency conditions.”⁸⁹
3. “We adopt the NOPR proposal and direct NERC to submit to the Commission for approval one or more new or modified Reliability Standards that require balancing authorities to include the performance and behavior of registered and unregistered IBRs individually and in the aggregate, as well as IBR-DERs that in the aggregate have a material impact on the Bulk-Power System, (e.g., resources tripping or entering momentary cessation individually or in the aggregate) in their operational analysis functions and real-time monitoring to support the reliable operation of the Bulk-Power System during normal and contingency conditions.”⁹⁰

Group 2: Planning Studies

The following are directives pertaining to Group 2 from *Table 3 : Planning And Operational Assessments*

1. “Likewise, with regards to NERC’s comments related to on-peak and off-peak studies, we direct NERC to consider in the standards development process whether to require planning coordinators and transmission planners to account in planning assessments for both on-peak and off-peak conditions, normal and abnormal (contingency) conditions with high penetration levels of IBRs (i.e., registered IBRs, unregistered IBRs, and IBR-

⁸⁵ *Id.* at P 141.

⁸⁶ *Id.* at P 141.

⁸⁷ *Id.* at P 161.

⁸⁸ *Id.* at P 176.

⁸⁹ *Id.*

⁹⁰ *Id.*

DERs that in the aggregate have a material impact on the Bulk-Power System), and normal and abnormal conditions with low inertia.”⁹¹

2. “Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop and submit to the Commission for approval new or modified Reliability Standards that require planning coordinators and transmission planners to include in their planning assessments the study and evaluation of performance and behavior of registered and unregistered IBRs individually and in the aggregate, as well as IBR-DERs in the aggregate, under normal and contingency system conditions in their planning area.”⁹²
3. “These Reliability Standards should require planning coordinators and transmission planners to include in their planning assessments the study and evaluation of the ride through performance (e.g., tripping and momentary cessation conditions) of IBRs in their planning area for stability studies on a comparable basis to synchronous generation resources.”⁹³
4. “Accordingly, we direct NERC to consider in its standards development process whether to include in new or modified Reliability Standards a requirement that planning coordinators and transmission planners include a wide set of grid stress performance conditions (i.e., both typical and extreme conditions) in planning assessments.”⁹⁴
5. “The new or modified Reliability Standards should also require planning coordinators and transmission planners to study the Bulk-Power System reliability impacts of registered and unregistered IBRs individually and in the aggregate, as well as IBR-DERs in the aggregate, in their planning models of their area and in their interconnection-wide area planning models.”⁹⁵
6. “Further, the new or modified Reliability Standards should also require planning coordinators and transmission planners to study the Bulk-Power System reliability impacts of registered and unregistered IBRs individually and in the aggregate, as well as IBR-DERs in the aggregate, in adjacent and other planning areas that adversely impacts a planning coordinator’s or transmission planner’s area during a disturbance event.”⁹⁶

⁹¹ *Id.* at P 175.

⁹² *Id.* at P 174.

⁹³ *Id.*

⁹⁴ *Id.* at P 175.

⁹⁵ *Id.* at P 174.

⁹⁶ *Id.*