

Standard Authorization Request (SAR)

Complete and submit this form, with attachment(s) to the [NERC Help Desk](#). Upon entering the Captcha, please type in your contact information, and attach the SAR to your ticket. Once submitted, you will receive a confirmation number which you can use to track your request.

The North American Electric Reliability Corporation (NERC) welcomes suggestions to improve the reliability of the bulk power system through improved Reliability Standards.

Requested information			
SAR Title:	Generator Ride-Through Standard (PRC-024-3 Replacement)		
Date Submitted:	April 28, 2022 (revised March 31, 2023)		
SAR Requester			
Name:	Mark Lauby, Senior Vice President and Chief Engineer, NERC Howard Gugel, Vice President, NERC John Moura, Director, NERC Ryan Quint, Senior Manager, NERC Rich Bauer, Principal, NERC Matt Lewis, Manager, NERC As revised by the Project 2020-02 SAR Drafting Team		
Organization:	North American Electric Reliability Corporation		
Telephone:	Mark Lauby – 404-446-9723	Email:	mark.lauby@nerc.net
SAR Type (Check as many as apply)			
<input checked="" type="checkbox"/> New Standard <input checked="" type="checkbox"/> Revision to Existing Standard <input checked="" type="checkbox"/> Add, Modify, or Retire a Glossary Term <i>(as needed)</i> <input checked="" type="checkbox"/> Withdraw/retire an Existing Standard		<input type="checkbox"/> Imminent Action/ Confidential Issue (SPM Section 10) <input type="checkbox"/> Variance development or revision <input type="checkbox"/> Other (Please specify)	
Justification for this proposed standard development project (Check all that apply to help NERC prioritize development)			
<input checked="" type="checkbox"/> Regulatory Initiation <input type="checkbox"/> Emerging Risk (Reliability Issues Steering Committee) Identified <input type="checkbox"/> Reliability Standard Development Plan		<input type="checkbox"/> NERC Standing Committee Identified <input type="checkbox"/> Enhanced Periodic Review Initiated <input checked="" type="checkbox"/> Industry Stakeholder Identified	
Industry Need (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):			
The ERO Enterprise has analyzed over 10 disturbances involving widespread loss of solar photovoltaic (PV) resources and has published multiple disturbance reports highlighting key findings and recommendations from these analyses. Across all events, a widespread loss of generating resources – solar PV, wind, synchronous generation, and battery energy storage systems (BESS) – have abnormally tripped, ceased current injection, or reduced power output with control interactions. Generator ride-through is a foundational essential reliability service. BPS-connected generating resources remaining			

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connected during normal and contingency conditions is a critical component of BPS reliability. Ensuring fault ride-through capability enables dynamic reactive power support, frequency response, and other services. The unexpected loss of widespread generating assets poses a significant risk to BPS reliability. The existing PRC-024-3 is an equipment settings standard focused solely on voltage and frequency protection. However, this standard is serving little to no value in ensuring BPS-connected inverter-based resources remain connected and support the BPS during grid disturbances. Furthermore, NERC has experienced multiple asset owners during the event analyses who have misconstrued PRC-024-3, resulting in incorrect or unnecessary protections applied to generating assets that have resulted in spurious and abnormal tripping events.

The systemic tripping and reductions of inverter-based resources, in addition to notable concurrent tripping or performance from synchronous generating resources, poses a risk to BPS reliability that must be addressed in a timely manner. This proposed standards project will address this known reliability risk with a more suitable performance-based standard that ensures generating resource ride-through performance for expected or planned BPS disturbances rather than focusing solely on a small subset of protections and controls that can trip generating resources.

Purpose or Goal (How does this proposed project provide the reliability-related benefit described above?):

The purpose of this SAR is to retire PRC-024-3 and replace it with a performance-based ride-through standard that ensures generators remain connected to the BPS during system disturbances. Specifically, this SAR focuses on the generator protection and control systems that can result in the reduction or disconnection of generating resources during these events. The SAR also ensures protection or controls that fail to ride through system events are analyzed, addressed with a corrective action plan (if possible), and reported to necessary entities for situational awareness. From a risk-based perspective, the goal of the standard is to mitigate the ongoing and systemic performance issues identified across multiple Interconnections and across many disturbances analyzed by NERC and the Regions. These issues have been identified in inverter-based resources as well as synchronous generators, with many causes of tripping entirely unrelated to voltage and frequency protection settings as dictated by the currently effective version of PRC-024.

Project Scope (Define the parameters of the proposed project):

- The scope of this project includes the following:
- Retire PRC-024-3, and create a new PRC standard or completely overhaul and replace the existing PRC-024 standard.
 - Allow for the possible modification or retirement of other relay-setting standards such as but not limited to PRC-006, PRC-019, PRC-025, and PRC-026, to prevent duplicative requirements and compliance obligations.
 - Creates a comprehensive, performance-based ride-through standard to ensure BES generating resources remain connected and providing essential reliability services during grid disturbances.

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- The scope of protections and controls involved in this ride-through standard shall include all generator protections and controls that affect the electrical output of the BES generating resource or plant. To be clear, the project should specify the protections and controls in the scope of the ride-through performance and define the term ride-through, as necessary. This should, at a minimum, include all generator (synchronous or inverter-based) protections and controls at the individual generators, at the inverters, or within the plant (i.e., plant-level controls and protections or collector system protections).
- For synchronous generators, the scope of the ride-through standard shall explicitly exclude auxiliary systems and their protection systems. These protections have not posed a systemic BES reliability risk. However, protections and controls directly focused on the generator and its prime mover impacting the ride-through performance should be addressed in the standard.
- For Inverter Based Resources (IBRs), auxiliary systems and their protection systems that can affect ride through performance shall be considered by the Standard Drafting Team.
- The new standard shall ensure that all unexpected or abnormal tripping or reductions in power output are reported by the GO to the TOP, BA, and RC.
- This team will also consider requirements for high-speed data recording relating to system events and will coordinate, as appropriate, with Project 2021-04 Modifications to PRC-002.

-Detailed Description (Describe the proposed deliverable(s) with sufficient detail for a drafting team to execute the project. If you propose a new or substantially revised Reliability Standard or definition, provide (1) a technical justification¹ that includes a discussion of the reliability-related benefits of developing a new or revised Reliability Standard or definition, and (2) a technical foundation document (e.g., research paper) to guide the development of the Standard or definition):

The following describes the proposed deliverable for this project:

- The proposed deliverable is a new NERC standard (or significant overhaul and revision of PRC-024-3) that includes the following key elements:
 - A performance-based approach to generator ride-through rather than an equipment settings standard. The new standard shall include requirements that BES resources shall ride through grid disturbances and include quantitative measures (see below) on expectations for ride-through that address all possible causes of tripping and power reductions from BES generating resources (particularly generator, turbine, inverter, and all plant-level protection and controls).
 - A reporting requirement that all trips or reductions in power output in response to grid disturbances are reported by the GO to the applicable TOP, BA, and RC
 - A requirement that abnormal reductions in active power (i.e., tripping from protections or notable reductions from controls) in response to grid disturbances are analyzed by the GO to

¹ The NERC Rules of Procedure require a technical justification for new or substantially revised Reliability Standards. Please attach pertinent information to this form before submittal to NERC.

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develop and implement a Corrective Action Plan. Situations, where corrective action plans are not able to be developed, shall be reported to the TOP, BA, and RC.

- A clear requirement that momentary cessation, or temporary ceasing of current injection during BPS fault events, is deemed unacceptable performance for BES generating resources. Inverter-based generating resources employing momentary cessation shall develop a corrective action to mitigate its use. Legacy facilities that were connected before the effective date of the standard and cannot comply due to documented inherent equipment limitations, may be considered for an exemption; however, resources with a commercial operation date after the effective date of the standard (and possibly the PRC-024-3 implementation date) shall be required to eliminate the use of momentary cessation within “ride through envelopes” (e.g., the existing PRC-024 “No Trip Zone”).
- The terms ride-through, trip, momentary cessation, and any other relevant terms should be defined in the NERC Glossary of Terms if deemed necessary.
- A clear requirement that prolonged plant controller interactions that are unnecessary to protect equipment or system and impede the ability of the resource to dynamically respond to the grid disturbance and preclude the ability to fully provide essential reliability services are deemed unacceptable and should be addressed by a corrective action plan.
- A requirement that if the TOP, BA, or RC informs the GO of a tripping occurrence, cessation event, or plant controller interactions that are not reported by the GO, then the GO shall be responsible for analyzing the facility’s performance during the event, developing a corrective action plan, and reporting this to the TOP, BA, and RC.

The technical justification regarding the reliability-related need and benefits of this project are described in extensive detail in multiple NERC disturbance reports. All widespread solar PV loss events analyzed by the ERO Enterprise have involved extensive tripping and causes of reduction that is largely not addressed by PRC-024-3, many of which are unrelated to voltage and frequency tripping entirely. Furthermore, these multiple events have also involved the loss of synchronous generators for various reasons that should be considered in the development activities of this proposed project. Key disturbance reports include:

- NERC 2021 California Disturbances Report ([2022](#))
- NERC Odessa Disturbance Report ([2021](#))
- NERC San Fernando Disturbance Report ([2020](#))
- NERC Palmdale Roost and Angeles Forest Disturbances Report ([2019](#))
- NERC Canyon 2 Fire Disturbance Report ([2018](#))
- NERC Blue Cut Fire Disturbance Report ([2017](#))

NERC Reliability Guideline: Improvements to Interconnection Requirements for BPS-Connected Inverter-Based Resources ([2019](#)), developed by the NERC Inverter-Based Resource Performance Working Group

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(IRPWG) and endorsed by the NERC Planning Committee, specifically recommends that all Transmission Owners (TOs) per FAC-001 establish or improve interconnection requirements by including quantitative requirements related to ride-through performance. Below is an excerpt from this guideline:

Quantitative requirements ensure that resources behave in a manner that supports BPS reliability and also assists the GOs and inverter manufacturers in specifying equipment to meet these requirements. These requirements may involve a performance envelope (FRT capability) that must be met by the resource, typically derived based on interconnection studies, grid codes, Reliability Standards, and other factors deemed necessary by the TO. Having these requirements ensures that the resources, particularly inverter-based resources, are unlikely to operate in a mode that has not been previously studied. Examples of these quantitative performance requirements include, but are not limited to, the following:

- *Pre- and post-fault short-circuit strength (equivalent impedance or short-circuit ratio (SCR)-based metric) for worst-case contingency conditions*
- *RMS low voltage ride-through and high voltage ride-through*
- *Instantaneous transient overvoltage*
- *Instantaneous change in phase angle*
- *Low frequency ride-through and high frequency ride-through*
- *No use of momentary cessation, by exception only*

These deliverables developed by the ERO Enterprise and its stakeholder groups serve as a strong technical basis for ensuring resources successfully ride through grid disturbances and support the BPS by providing essential reliability services moving forward.

Cost Impact Assessment, if known (Provide a paragraph describing the potential cost impacts associated with the proposed project):

Incremental costs are expected for GOs that currently do not analyze the performance of their generating assets following grid disturbances, which has been shown during the NERC disturbance analyses to be a systemic reliability issue for solar PV resources in particular. GOs will need to assess their ride-through capabilities more comprehensively than in the past, which may have some associated costs. Minimal costs are associated with reporting of tripping occurrences. Facilities with abnormal or unexpected trips that can be mitigated with corrective actions will have some incremental costs; however, these improvements will help ensure adequate levels of reliability of the BES. Otherwise, cost impacts for this project are expected to be minimal. Additionally, if high speed data recording is not available in the required locations, entities may be required to install such equipment which would have some increased cost impact.

Please describe any unique characteristics of the BES facilities that may be impacted by this proposed standard development project (e.g., Dispersed Generation Resources):

BES generating resources.

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To assist the NERC Standards Committee in appointing a drafting team with the appropriate members, please indicate to which Functional Entities the proposed standard(s) should apply (<i>e.g.</i> , Transmission Operator, Reliability Coordinator, etc. See the most recent version of the NERC Functional Model for definitions):	
Generator Owners, Generator Operators, Reliability Coordinators, Transmission Operators, Transmission Owners, Transmission Planners, Planning Coordinators	
Do you know of any consensus building activities ² in connection with this SAR? If so, please provide any recommendations or findings resulting from the consensus building activity.	
This SAR is an outcome of ongoing analyses conducted by the ERO Enterprise regarding widespread inverter-based resource tripping events. Furthermore, the NERC IRPWG has developed comprehensive recommendations for improved performance of inverter-based resources, including the recommendation to develop comprehensive ride-through requirements.	
Are there any related standards or SARs that should be assessed for impact as a result of this proposed project? If so, which standard(s) or project number(s)?	
PRC-006, PRC-019, PRC—025, PRC-026	
Are there alternatives (<i>e.g.</i> , guidelines, white paper, alerts, etc.) that have been considered or could meet the objectives? If so, please list the alternatives.	
NERC has evaluated industry progress toward adopting the recommendations outlined in NERC guidelines, white papers, its prior Alerts, and other industry efforts. NERC believes that a nationwide standard for consistent requirements for generating resource ride-through is necessary to immediately address generating resource ride-through during grid disturbances moving forward.	
Reliability Principles	
Does this proposed standard development project support at least one of the following Reliability Principles (Reliability Interface Principles)? Please check all those that apply.	
<input checked="" type="checkbox"/>	1. Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
<input checked="" type="checkbox"/>	2. The frequency and voltage of interconnected bulk power systems shall be controlled within defined limits through the balancing of real and reactive power supply and demand.
<input checked="" type="checkbox"/>	3. Information necessary for the planning and operation of interconnected bulk power systems shall be made available to those entities responsible for planning and operating the systems reliably.
<input type="checkbox"/>	4. Plans for an emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained, and implemented.
<input type="checkbox"/>	5. Facilities for communication, monitoring, and control shall be provided, used, and maintained for the reliability of interconnected bulk power systems.

² Consensus building activities are occasionally conducted by NERC and/or project review teams. They typically are conducted to obtain industry inputs prior to proposing any standard development project to revise, or develop a standard or definition.

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<input type="checkbox"/>	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, and qualified, and have the responsibility and authority to implement actions.
<input type="checkbox"/>	7. The security of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide area basis.
<input type="checkbox"/>	8. Bulk power systems shall be protected from malicious physical or cyber attacks.

Market Interface Principles	
Does the proposed standard development project comply with all of the following Market Interface Principles ?	Enter (yes/no)
1. A reliability standard shall not give any market participant an unfair competitive advantage.	Yes
2. A reliability standard shall neither mandate nor prohibit any specific market structure.	Yes
3. A reliability standard shall not preclude market solutions from achieving compliance with that standard.	Yes
4. A reliability standard shall not require the public disclosure of commercially sensitive information. All market participants shall have equal opportunity to access commercially non-sensitive information that is required for compliance with reliability standards.	Yes

Identified Existing or Potential Regional or Interconnection Variances	
Region(s)/ Interconnection	Explanation
None	None

For Use by NERC Only

SAR Status Tracking (Check off as appropriate).	
<input type="checkbox"/> Draft SAR reviewed by NERC Staff	<input type="checkbox"/> Final SAR endorsed by the SC
<input type="checkbox"/> Draft SAR presented to SC for acceptance	<input type="checkbox"/> SAR assigned a Standards Project by NERC
<input type="checkbox"/> DRAFT SAR approved for posting by the SC	<input type="checkbox"/> SAR denied or proposed as Guidance document

Version History

Version	Date	Owner	Change Tracking
1	June 3, 2013		Revised

1	August 29, 2014	Standards Information Staff	Updated template
2	January 18, 2017	Standards Information Staff	Revised
2	June 28, 2017	Standards Information Staff	Updated template
3	February 22, 2019	Standards Information Staff	Added instructions to submit via Help Desk
4	February 25, 2020	Standards Information Staff	Updated template footer