

Standard Authorization Request (SAR)

Complete and please email this form, with attachment(s) to: sarcomm@nerc.net

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:	Revisions to PRC-023-4		
Date Submitted:	October 19, 2020 <u>(Revised on November 16, 2021)</u>		
SAR Requester			
Name:	Jeff Iler, Chair & Bill Crossland, Vice Chair (on behalf of) <u>(Revised by Project 2021-05 SAR Drafting Team)</u>		
Organization:	NERC System Protection and Control Subcommittee Working Group		
Telephone:	Jeff: (614) 933-2373 Bill: (216) 503-0600	Email:	Jeff: jwiler@aep.com Bill: bill.crossland@rfirst.org
SAR Type (Check as many as apply)			
<input type="checkbox"/> New Standard	<input type="checkbox"/> Imminent Action/ Confidential Issue (SPM Section 10)	<input type="checkbox"/> Add, Modify or Retire a Glossary Term	<input type="checkbox"/> Variance development or revision
<input checked="" type="checkbox"/> Revision to Existing Standard	<input type="checkbox"/> Other (Please specify)	<input type="checkbox"/> Withdraw/retire an Existing Standard	
Justification for this proposed standard development project (Check all that apply to help NERC prioritize development)			
<input type="checkbox"/> Regulatory Initiation	<input checked="" type="checkbox"/> NERC Standing Committee Identified	<input type="checkbox"/> Emerging Risk (Reliability Issues Steering Committee) Identified	<input type="checkbox"/> Enhanced Periodic Review Initiated
<input type="checkbox"/> Reliability Standard Development Plan	<input type="checkbox"/> Industry Stakeholder Identified		
Industry Need (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):			
<p>Requirement R2, in PRC-023-4, requires applicable functional entities to set their Out of Step Blocking¹ (OOSB) elements to allow tripping for faults during the loading conditions prescribed by Requirement R1. A requirement to allow tripping in a Standard whose intent is to block tripping, has led to some entities disabling their OOSB-PSB relays. Disabling of these relays could lead to tripping during stable power swings causing an increased reliability risk. PSB-OOSB relays provide increased security by preventing relays from tripping for stable power swings. Preventing the tripping of transmission lines during these types of disturbances increases the reliability of the BES. Requirement R2 should be removed <u>or modified</u> because it has been interpreted to restrict the setting of PSB-OOSB elements <u>making determination of appropriate settings more difficult and</u> making compliance with PRC-026 more difficult. <u>The present inclusion of out of step tripping in Attachment A, Item 1.2 needs to be clarified.</u></p>			

¹ The term power swing blocking (PSB) is also used by industry to describe these elements. The PSB term will be used for the remainder of this SAR.

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Attachment A exclusion 2.3 should also be removed or modified. This exclusion is no longer needed and that exclusion has contributed to the confusion surrounding R2. Attachment A exclusion 2.3 has been interpreted as being in conflict with R2. Both R2 and Attachment A exclusion 2.3 are either not needed or should be modified in the Standard.

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

The purpose of the proposed project provides a reliability-related benefit by modifying or eliminating PRC-023-4 Requirement R2 to ~~This will eliminate entities disabling their OOSB elements unnecessarily~~ more effectively apply PSB when appropriate to improve BES reliability. Proper application of PSB can also be helpful in complying with PRC-026. It will modify or remove an ~~unnecessary~~ exclusion (Attachment A – 2.3) for relays that that may no longer be needed ~~an exclusion~~.

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

The scope includes:

- Retire or modify Requirement R2.
- Remove or modify Attachment A, Item 2.3 exclusion ~~with regard to the use of protection systems during stable power swings.~~
- Make ~~comporting~~ changes to the standard as needed to address modifications to Requirement R2 and Attachment A, Item 2.3 exclusion. ~~the retirement of Requirement R2 and to remove Attachment A, Item 2.3 exclusion.~~
- Ensure that removing or modifying the Item 2.3 exclusion does not overlap or create a gap with the intent of PRC-026 – Relay Performance During Stable Power Swings.
- Clarify how much time an entity has between the Requirement R6 identification and implementation of relay settings.
- Clarify the inclusion of out of step tripping in Attachment A, Item 1.2.
- Make ~~ing~~ any administrative, non-substantive modification ~~corrections~~ suggested in industry comments.
- Modify the Supplemental Technical Reference Document, “Determination and Application of Practical Relaying Loadability Ratings Version 1”, referenced in PRC-023-4, as needed to address these modifications, retirements and removal. specifically, the Out of Step Blocking [Power Swing Blocking] section.

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 justification² which 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 development of the Standard or definition):

The PRC-023 standard is about setting protective relays so they do not limit transmission loadability, meaning they do not trip unnecessarily during heavy loading conditions while still being capable of

² 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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detecting all fault conditions.³ The intent of Requirement R2 is to ensure ~~out-of-step power swing blocking (OOSB) (PSB)~~ elements allow tripping of phase protective relays for faults that occur during the loading conditions used to verify transmission line relay loadability. Requirement R2 is about ensuring ~~PSBOOSB~~ elements allow blocked relay elements to trip reliably (i.e., if a three-phase fault occurs while ~~PSBOOSB~~ is asserted) and not about ensuring protection systems do not limit transmission loadability. ~~PSBOOSB~~ elements differentiate between power swings and three-phase faults. During a power swing, a ~~PSBOOSB~~ element will typically block ~~appropriate load responsive protective elements phase distance elements (i.e., Zone 1 & Zone 2 phase distance elements)~~ from ~~operating tripping~~. According to Requirement R2, a ~~PSBOOSB~~ element must unblock the blocked ~~phase distance~~ elements for faults that occur during the loading conditions used to set the protective relay under Requirement R1. Also in the standard, Attachment A, Item 2.3 excludes protection systems intended for protection during stable power swings and ~~is seen as may~~ contradictory with Requirement R2 because these protection systems are associated with the use of ~~PSBOOSB~~ elements, whose primary purpose is to ensure ~~load responsive protective phase distance~~ elements don't ~~operate trip~~ during stable power swings.

The apparent intent of Requirement R2 is to ensure that ~~PSBOOSB~~ elements don't pick up, time out, and block ~~load responsive protective distance~~ elements from ~~tripping operating~~ for three-phase faults during the loading conditions described in Requirement R1. The protection engineer must ensure reliable fault protection and has various tools in modern microprocessor based relays to ensure the dependable unblocking of tripping elements during faults. Applying the loadability criteria while ensuring reliable fault protection is already an underpinning of Requirement R1.⁴ For example, an engineer can apply the use of ~~override-reset~~ timers⁵ that are available in modern microprocessor relays or can add such timers to existing electromechanical relay ~~schemes elements~~. An engineer can also use ~~advanced microprocessor-based continuous measurement-based PSB zero-setting OOSB~~ algorithms. Applying the loadability criteria to relay settings under Requirement R1 somewhat meets the intent of Requirement R2 because Requirement R1 mandates not limiting transmission loadability while maintaining reliable protection of the Bulk Electric System for all fault conditions. Additionally, Requirement R2 restrictively dictates the boundary setting of the ~~PSBOOSB~~ element that starts the ~~PSBOOSB~~ timer which has the overall effect of reducing the slip rate for which the ~~PSBOOSB~~ element will correctly block. This ~~can~~ results in decreasing the security of the protection scheme and increasing the chance that a misoperation of a distance element will occur for power swings that are faster than the allowable slip rate. Requirement R2 also ~~may~~ impacts the ability to comply with NERC Reliability Standard PRC-026 (Relay Performance During Stable Power Swings) ~~to the extent that in that~~ it affects the application of ~~PSBOOSB~~ relaying that is integral to

³ PRC-023-4, Purpose: "Protective relay settings shall not limit transmission loadability; not interfere with system operators' ability to take remedial action to protect system reliability and; be set to reliably detect all fault conditions and protect the electrical network from these faults."

⁴ PRC-023-4, "R1. Each Transmission Owner, Generator Owner, and Distribution Provider shall use any one of the following criteria (Requirement R1, criteria 1 through 13) for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability **while maintaining reliable protection of the BES for all fault conditions**. Each Transmission Owner, Generator Owner, and Distribution Provider shall evaluate relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees."

⁵ ~~OOSB-PSB~~ relays with ~~reset override~~ timers will allow the ~~PSBOOSB~~ blinder that starts the timer to be set beyond the loadability region prescribed by the standard. The ~~PSBOOSB~~ relay would unblock after a predetermined delay should an unlikely three-phase fault occur.

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the purpose of PRC-026, which is “[t]o ensure that load-responsive protective relays are expected to not trip in response to stable power swings during non-Fault conditions”.

~~Attachment A, 2.3 was included for protection systems that intentionally trip during power swing disturbances, such as intentional islanding schemes. Florida was cited as an example of where these schemes were employed. Research has indicated that these schemes no longer exist and there is no need for a power swing tripping exclusion.~~

Requirement R2 was added to PRC-023 in version 2 after filing version 1 with FERC.⁶ FERC observed that Attachment A item 2 in PRC-023-1 was a requirement and that it needed to be included in the requirements section of a standard with the appropriate violation risk factors and violation severity levels.

The original SDT included the “warning” in Attachment A item 2, with regards to ~~PSBOOSB~~, in reference to the ~~PSBOOSB~~ timer. Some ~~PSBOOSB~~ schemes employ an outer and an inner impedance blinder with a timer that is used to determine the rate of change of apparent impedance to differentiate between a fault (fast change) and a swing (slow change). The timer starts timing when the impedance passes ~~through into~~ (is less than) the outer blinder. If the impedance does not pass through the inner blinder (is less than), before the timer setting, the ~~PSBOOSB~~ will declare a swing and block the ~~phase distance~~ load responsive elements from tripping. The SDT wanted to inform entities that they could experience loading conditions that would result in an impedance that was between the ~~PSBOOSB~~ blinders for a long period of time that would result in the blocking of the ~~load responsive~~ phase tripping elements indefinitely. ~~This condition could exist at any time regardless of a relay loadability requirement. Therefore, this should not be a requirement associated with PRC-023.~~ It is good engineering practice to ensure ~~your~~ relays will operate properly for all conditions they are expected to experience. ~~It is questionable how a relay tripping~~ ~~should not be a requirement~~ ~~should be~~ in a relay loadability Standard. ~~PSBOOSB~~ elements are included in the Relay Performance During Stable Power Swings Standard PRC-026-1, ~~but additional coordination with PRC-023 may be appropriate.~~ PRC-026-1 already includes the language “while maintaining dependable fault detection” in regards to ~~PSBOOSB~~ supervision.

~~Attachment A, 2.3 was included for protection systems that intentionally trip during stable power swing disturbances, such as intentional islanding schemes. This exclusion is referencing “Protection systems installed specifically to separate portions of the system that are experiencing stable power swings relative to each other in order to maintain desirable performance relative to voltage, frequency, and power oscillations”⁷. Florida was cited as an example of where these schemes were employed. Research has indicated that these schemes no longer exist so there is no need for a stable power swing tripping exclusion.~~

~~Attachment A item 2.3 excludes “Protection systems intended for protection during stable power swings”. This exclusion is referencing “Protection systems installed specifically to separate portions of the system~~

⁶ See FERC Order 733 para 244 <https://www.ferc.gov/whats-new/comm-meet/2010/031810/E-5.pdf>

⁷ See Project 2010-13.1 Phase 1 of Relay Loadability: Transmission Draft 1 Relay Loadability Standard Consideration of Comments https://www.nerc.com/pa/Stand/Project%202010131%20Phase%201%20of%20Relay%20Loadability%20Trans/Consider_Comments_1st_Draft_Relay_Loadability_Std_09Jan07.pdf

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that are experiencing stable power swings relative to each other in order to maintain desirable performance relative to voltage, frequency, and power oscillations”⁸. These Out of Step Tripping (OOST) protection systems are better addressed in the standard for power swings, PRC-026.
Cost Impact Assessment, if known (Provide a paragraph describing the potential cost impacts associated with the proposed project):
Should reduce cost to Registered Entities by eliminating the compliance monitoring of a requirement that is addressed by another standard. Revising the exemption should not have a significant impact on cost. The goal is to ensure BES reliability. The SDT can't specifically identify the cost result until the final language is developed, but expects that there should be no significant impact on costs.
Please describe any unique characteristics of the BES facilities that may be impacted by this proposed standard development project (e.g. Dispersed Generation Resources):
Transmission facilities that use OOSB-PSB functionality and that experience significant oscillations (i.e., power swings) has the benefit of ensuring the system remains intact where unintended separation of portions of the transmission system could occur due to power swings.
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 (e.g. Transmission Operator, Reliability Coordinator, etc. See the most recent version of the NERC Functional Model for definitions):
Planning Coordinator , Transmission Owner, Generator Owner, and Distribution Provider
Do you know of any consensus building activities ⁹ in connection with this SAR? If so, please provide any recommendations or findings resulting from the consensus building activity.
N/A
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-026 – Relay Performance During Stable Power Swings (Note: Project 2015-09 – Establish and Communicate System Operating Limits has proposed ing modifications to PRC-026 due to revisions to the definition of System Operating Limit). This project is pending approval in FERC Docket RM21-19. Depending on the changes made to PRC-023, there could be a need to align the changes with PRC-026.
Are there alternatives (e.g. guidelines, white paper, alerts, etc.) that have been considered or could meet the objectives? If so, please list the alternatives.
N/A

⁸ See Project 2010-13.1 Phase 1 of Relay Loadability: Transmission Draft 1 Relay Loadability Standard Consideration of Comments https://www.nerc.com/pa/Stand/Project%202010131%20Phase%201%20of%20Relay%20Loadability%20Trans/Consider_Comments_1st_Draft_Relay_Loadability_Std_09Jan07.pdf

⁹ 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.

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 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 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 emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained and implemented.
<input checked="" type="checkbox"/>	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk power systems.
<input type="checkbox"/>	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, 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 to 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
N/A	

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