

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:	Analysis and Mitigation of BES Inverter-Based Resource Performance Issues		
Date Submitted:	12/06/2022		
SAR Requester			
Name:	Julia Matevosyan, ESIG, IRPS Chair Rajat Majumder, Orsted, IRPS Vice Chair		
Organization:	NERC Inverter-based Resource Performance Subcommittee (IRPS)		
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SAR Type (Check as many as apply)			
<input checked="" type="checkbox"/>	New Standard	<input type="checkbox"/>	Imminent Action/ Confidential Issue (SPM Section 10)
<input checked="" type="checkbox"/>	Revision to Existing Standard	<input type="checkbox"/>	Variance development or revision
<input checked="" type="checkbox"/>	Add, Modify or Retire a Glossary Term	<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 checked="" type="checkbox"/>	Industry Stakeholder Identified
Industry Need (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):			
Multiple NERC disturbance reports ¹ have identified the undesired performance of bulk power system (BPS)-connected inverter-based resources (IBRs) during grid faults, and have elaborated on the systemic and significant BPS reliability risks that these pose. These are strongly highlighted in the recent disturbance reports from 2021 including the Odessa disturbance report. ² IBRs may trip for many different reasons, may cease current injection due to inverter controls, or may have unwanted plant-level controller interactions. These types of issues have been extensively documented in the NERC reports. The resulting unexpected and unwarranted loss of generation poses a significant risk to BPS reliability.			

¹ <https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx>

² <https://www.nerc.com/pa/rrm/ea/Pages/May-June-2021-Odessa-Disturbance.aspx>

Requested information

Unlike synchronous generation, IBRs can reduce power output very quickly based on the power electronic controls and protections, and the reduction does not necessarily require the operation of an ac circuit breaker or other Protection System (as defined by the NERC Glossary of Terms). The current PRC-004 is focused mainly on conventional Protection Systems and ensures that misoperations are analyzed and mitigated. However, this type of analysis and mitigation is not occurring for inverter-based resources for the reasons described above, and has led to the systemic performance issues documented in NERC disturbance reports.

Rather than complicate the existing PRC-004 focused on Protection Systems, IRPS believes that a new standard should be developed specific to IBRs to ensure that any unexpected ceasing of current injection (partial or full) is analyzed by the applicable Generator Owner and mitigated to the extent possible. NERC has also highlighted that many Generator Owners are not aware of these trips, and that the Balancing Authority or Reliability Coordinator may often identify the unexpected or unwarranted tripping issues. Therefore, it is important that the BA or RC have the authority to identify abnormal performance issues which should then initiate analysis and mitigations by the GO. To be clear, the SAR is not proposing that the BA or RC is responsible for identifying these events; rather, the SAR is proposing that the BA and RC have the ability and authority to voluntarily initiate analysis of the abnormal performance issues by the asset owner (i.e., the GO). It is important that the GO is accountable for analyzing these events, has necessary monitoring equipment installed, and cooperates with the BA/RC by providing operational data and analytical results.

Some legacy equipment may not be able to mitigate performance issues; however, these events should be analyzed with root causes of misoperation identified and possible mitigating actions (or lack thereof) should be documented for all applicable parties.

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

The purpose of this proposed project is to introduce a new standard or modify the existing PRC-004 standard³ that requires analysis and mitigation of unexpected or unwarranted protection and control operations from inverter-based resources following the identification of such a performance issue. This will ensure that IBR loss events (either through protection or control actions) such as those that have occurred numerous times as documented in the NERC disturbance reports are included in the types of events that must be analyzed and mitigated. Considerations will be given for legacy equipment; however, analysis and documentation of mitigation actions (where possible) should still occur. The project should clarify that any protections and controls within an IBR facility that causes abnormal performance of the facility should be included in this type of analysis.

These changes will prompt analysis of IBR loss events following grid disturbances to ensure that facilities are operating in a reliable manner and providing essential reliability services. Mitigating actions will reduce unnecessary IBR tripping or controls issues that result in widespread reduction of power output from these facilities, and will also reduce the possibility of systemic performance issues in the future.

³ IRPS recommends the development of a new standard; however, this is left up to the drafting team to develop an appropriate solution.

Requested information

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

The scope of this project is to either create a new NERC reliability standard or modify an existing standard⁴ that requires IBRs that respond to grid disturbances in an unexpected, unwarranted, and unreliable manner to identify, analyze, and mitigate performance issues that occur within the facility. This includes any types of protections or controls that result in abnormal performance issues within the plant, including abnormal performance resulting in anomalous behavior of active power output from the facility during events. Considerations may be needed for legacy facilities, but the root cause analysis of the abnormal performance and determination of any mitigating measures should be conducted. The IRPS also included the possibility of adding new or modifying existing NERC Glossary Terms, as the drafting team determines necessary, to ensure clarity in the standard. Battery energy storage resources, as generating resources, should also be included in the scope of this project. The SAR should be applicable to all BES inverter-based generating resources.

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 justification⁵ 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):

Rather than attempt to significantly modify PRC-004 and change the definition of Protection System, the IRPS believes the best approach is to develop a new NERC standard focused specifically on identifying, analyzing, and mitigating unexpected/abnormal performance issues at IBR facilities. The proposed standard does not intend to modify the existing Protection System definition or PRC-004 since the IRPS knows that this will be extremely complicated and could overcomplicate the matter.

The NERC reports highlight the strong need for more proactive analysis of IBR performance issues by facility owners. The past few NERC disturbance reports have highlighted limited awareness and understanding by facility owners that abnormal performance has even occurred, and therefore identification of possible performance issues should be initiated by either the IBR facility owner/operator (i.e., the GO/GOP) or by the transmission entities with a wide-area view (i.e., the TOP, RC, or BA). However, the onus of analysis and development of mitigating actions should be on the asset owner to eliminate the possible risk of repeated abnormal performance issues.

IRPS recognizes that legacy equipment may not be able to eliminate or fully mitigate performance issues at those facilities; however, analysis and determination of any possible mitigations should be explored and reported to the TOP, RC, and BA and documented by the GO/GOP. This will ensure that possible mitigating actions are fully explored and communicated to all necessary parties.

⁴ This is left up to the standard drafting team to ensure sufficient flexibility in developing an appropriate solution. IRPS recommends the creation of a new NERC Standard focused specifically on IBR-specific issues so as to avoid conflating these issues with conventional protection systems installed across transmission networks.

⁵ 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.

Requested information

IRPS believes that all BES IBR generating facilities should be applicable to this standard as these issues have been observed across generators of varying sizes (including numerous resources lower than the BES threshold). Therefore, it would not seem logical to raise the size threshold any higher than the BES definition for dispersed power producing resources.

IRPS believes that the issues requiring analysis should include any protection or controls that result in abnormal or unexpected performance of the resource for any reason. While every possible abnormal performance issue may not be picked up by the GO, GOP, or any transmission entity, any abnormal performance issue identified could result in analysis and possible mitigation. Momentary cessation and IBR tripping for external grid faults should be included in this analysis. Delayed active power recovery following fault ride-through events beyond any applicable standard or mutually agreement should be included in this analysis. Abnormal IBR unit- or plant-level control actions should be included in this analysis. These are all considered unwanted, unexpected, and abnormal and should be explored for corrective actions. The causes of abnormal changes in power output during events (e.g., faults) should include any protections and controls within the IBR, the plant-level controller, and any protection systems within the plant.

IRPS believes that the drafting team should have the flexibility to determine appropriate solutions (i.e., standards language) to codify these concepts in a new NERC Standard. The drafting team may want to explore reporting criteria that avoids unnecessary redundant reporting yet can adequately capture any new performance issues if/when they occur.

IRPS would also like to point out that the NERC reports have highlighted that the protection/controls that “operate as they are programmed” does not necessarily mean correct operation as per interconnection requirements. When a plant trips off-line for an external fault for reasons that are not expected (or allowed per interconnection requirements) nor are likely modeled appropriately in planning assessments, these types of abnormal reductions (tripping, controls, or controller interactions) should be analyzed and mitigated by the GO/GOP in a timely manner. This will likely require the engagement of equipment manufacturers and adequate monitoring data to perform root cause analysis.

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

The new standard will require Generator Owners to analyze performance issues identified at their facilities, which may require some engineering and analytical capabilities and additional coordination with equipment manufacturers to determine possible mitigating measures. This type of activity is conducted by all transmission entities, and more commonly conducted by synchronous generator owners (due to the clear operation of an ac circuit breaker tripping a large amount of power with little to no automatic reconnection). Some additional monitoring equipment and capability may be needed at the GO facilities to determine root causes of abnormal performance. Due to the systemic nature of risks posed by these issues, the reliability benefits are expected to outweigh the costs for this effort.

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

Requested information	
The proposed standard project is focused specifically on identifying, analyzing, and mitigating reliability issues for BES inverter-based resources.	
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):	
The Functional Entities that the proposed standard would apply to are the inverter-based resource Generator Owners. This standard will also give authority to the RC, TOP, or BA to initiate an analysis by a GO if abnormal performance issues are identified.	
Additional entities that may provide value to the standard drafting efforts include GOPs, RCs, BAs, TOPs, TPs, and PCs.	
Do you know of any consensus building activities ⁶ in connection with this SAR? If so, please provide any recommendations or findings resulting from the consensus building activity.	
This SAR was developed by the NERC IRPS, a consensus-based subcommittee of the NERC Reliability and Security Technical Committee (RSTC). The IRPS developed a white paper ⁷ as a follow-up to the Odessa disturbance that highlighted the need for this SAR; that white paper was also approved by the RSTC.	
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)?	
N/A	
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 disturbance reports have highlighted the need for improved analysis of systemic performance issues from inverter-based resources. NERC IRPS has published numerous guidelines and reports to support industry with recommended monitoring points, performance issues, etc. These activities have not addressed the risk that inverter-based resource owners are not identifying, analyzing, and mitigating abnormal performance issues.	

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 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.

⁶ 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.

⁷ https://www.nerc.com/comm/RSTC_Reliability_Guidelines/White_Paper_Odessa_Disturbance_Follow-Up.pdf

Reliability Principles	
<input type="checkbox"/>	4. Plans for 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.
<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
<i>e.g., NPCC</i>	

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