NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

September 21, 2018

Keith E. Casey, Ph.D.
Vice President, Market and Infrastructure Development
California Independent System Operator Corporation (CAISO)
kcasey@caiso.com

Re: Standard Authorization Request PRC-XXX-1 Inverter Based Resource Controls and Performance and Standard Authorization Request PRC-024-2 Generator Frequency and Voltage Protective Relay Settings

Dear Sir:

Thank you for submitting the two Standard Authorization Requests (SARs) referenced above.

Pursuant to Section 4.1 of the NERC Standard Processes Manual (SPM), Appendix 3A to the NERC Rules of Procedure, this letter is to inform you the NERC Standards Committee (SC) considered the above-referenced SARs at its September 13, 2018 meeting and voted to reject the SARs. The SC based rejection on the following:

1. One SAR indicates the Institute of Electrical and Electronic Engineers (IEEE) is addressing in IEEE Standard 1547-2018 the issues CAISO discusses in the SAR, indicating alternative methods to a mandatory Reliability Standard are being pursued. The SAR states the requested Reliability Standard is "very similar" to IEEE Standard 1547-2018. The IEEE standard sets performance standards for inverters and, as discussed at the September 13, 2018 NERC SC meeting, serves as the basis for an additional IEEE standard being developed to address inverters connected to the transmission system.

   The SAR also states the IEEE standard "…now identifies minimum requirements in the general performance specifications, reactive power capability, and voltage/power control requirements, response to abnormal grid conditions, power quality, islanding, and other aspects." This appears to address the issues CAISO discussed in the SAR requesting a mandatory Reliability Standard. The IEEE standard offers an alternative to a Reliability Standard that could be a more appropriate method to address the technology-specific issues identified in both SARs.

2. NERC technical committees recently issued guidance on the topic. The Inverter-Based Resource Performance Task Force (IRPTF) issued guidance on inverter-based resources that could address the issues identified in both SARs. The same group recommended additional studies and analysis, but did not recommend developing a new or modified Reliability Standard.

Analyzing the results of the various active initiatives – planned and already underway — would allow identification of the root causes of the reliability issues and implementation of appropriate solutions to ensure reliability rather than immediately pursuing a new or modified Reliability Standard.

For additional information on this matter, please see the background document and SAR which were included in the SC meeting packet (here).

In light of the information in this letter, if CAISO would like to submit another SAR, you are welcome to do so.

Sincerely,

A. Andrew Gallo
Chair, NERC Standards Committee

Enclosures:
PRC-024-2 SAR
Inverter Based Resource Controls SAR

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:	PRC – 024 – 2 Generator Frequency and Voltage Protective Relay Settings		
Date Submitted:	5/29/2018		
SAR Requester			
Name:	Keith E. Casey, Ph.D., Vice President, Market and Infrastructure Development		
Organization:	California Independent System Operator Corporation (CAISO)		
Telephone:	(916) 608-7125	Email:	kcasey@caiso.com

SAR Type (Check as many as apply)

- ☐ New Standard
- ☒ Revision to Existing Standard
- ☐ Add, Modify or Retire a Glossary Term
- ☐ Withdraw/retire an Existing Standard
- ☐ Imminent Action/ Confidential Issue (SPM Section 10)
- ☐ Variance development or revision
- ☐ Other (Please specify)

Justification for this proposed standard development project (Check all that apply to help NERC prioritize development)

- ☐ Regulatory Initiation
- ☐ Emerging Risk (Reliability Issues Steering Committee) Identified
- ☐ Reliability Standard Development Plan
- ☐ NERC Standing Committee Identified
- ☐ Enhanced Periodic Review Initiated
- ☒ Industry Stakeholder Identified

Industry Need (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):

NERC convened the Inverter based Resource Performance Task Force (IRPTF) shortly after it became clear that inverter based generation was dropping off line during the routine high speed clearing of transmission line faults. The purpose of this task force was to initially study the events of the Blue Cut Fire and subsequently the Canyon 2 Fire in southern California, and develop recommendations to minimize the future loss of inverter based generation. During this analysis, the task force identified a number of technical issues with PRC-024-2 that require clarification to help ensure inverter based generation contribute to the reliable operation of the bulk power system. These issues include:

a. Modifying the region outside the “No Trip” zone of the ride through curves to read “May Trip”, so that registered entities do not interpret this area as a must trip zone.

b. Clarifying the “Off Nominal Frequency Capability Curve” and the “Curve Data Point” tables on pages 8 and 9 of PRC-024-2 to reconcile the fact that the frequency capability curve starts at 0.1 sec, but the curve data point tables allows instantaneous (i.e. no deliberate time delay) operation.

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c. Clarifying the language in point #5 of the Curve Details found in the Voltage Ride-Through Curve Clarifications (page 11 of PRC-024-2) to eliminate confusion as to whether the curves pertain to RMS (Root Mean Square) or crest values. d. Making the language in point #1 of the Curve Details found in the Voltage Ride-Through Curve Clarifications (page 11 of PRC-024-2) regarding per unit voltage and nominal operating voltage as specified by the Transmission Planner internally consistent. e. Clarifying the use of cumulative time (point #3 of the Curve Details in the Voltage Ride-Through Curve Clarifications – Page 11 of PRC-024-2) beyond four seconds to clarify when cumulative values reset. This SAR proposes to address these technical issues.
Purpose or Goal (How does this proposed project provide the reliability-related benefit described above?):
This SAR proposes to revise PRC-024-2 to address technical issues within the existing standard. The goal is to add clarity, eliminate inconsistency and address ambiguity in the existing requirements. An alternative approach would be to revise PRC-024-2 to incorporate the elements the CAISO is proposing to include in a new reliability standard.
Project Scope (Define the parameters of the proposed project):
The proposed scope of this project is as follows:: a. Update the PRC-024-2 ride-through curves to specify that the area outside the “No Trip” zone is a “May Trip” zone, so that it is not erroneously interpreted as a “Must Trip” zone b. Modify reliability standard PRC-024-2 so that its applies only to synchronous machines. The CAISO is also submitting a second SAR that proposes the development of a new standard for the minimum performance and operation of inverter based generation. As an alternative, existing PRC-024 can be expanded to include a new section that addresses the minimum performance requirements of inverter based generation. c. Clarify the Curve Data Point tables and the Off Nominal Frequency Capability Curves (pages 8 & 9) d. Clarify the language in point #5 of the Curve Details section of the “Voltage Ride-Through Curve Clarifications” on page 11. e. Clarify when this time starts and stops in relation to the four second cumulative timer.

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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 justification[1]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 Standards Drafting Team should address the following technical issues within PRC-024-2: 1. The region outside the "No Trip" zone of the PRC-024-2 ride-through curves should be clearly marked as a "May Trip" zone so this region is not incorrectly interpreted as a "Must Trip" zone. Many newly interconnecting resources (including inverter based resources) on the BPS are setting voltage and protective functions based solely on these curves, since the area outside the no trip region is incorrectly interpreted as a must trip zone. The CAISO is in the process of obtaining control settings for various inverter based generators interconnected to the bulk power system, and notes that the majority of inverters were programmed to follow the curves exactly. This practice does not consider the capability of the resource to ride through transmission line faults. Clarification will help to ensure correct interpretation industry wide. This will enhance reliability since the generator owner will understand that the inverter protective settings should be based on equipment capability as opposed to following the curves in the standard, minimizing incorrect and undesired dropping of inverter based generation. 2. The "Off Nominal Frequency Capability Curve" (page 8 of PRC-024-2) is a logarithmic graph that starts at time t=0.1 seconds. However, the tables in the "Curve Data Point" section (pages 8 and 9 of PRC-024-2) allow for "instantaneous trip". Frequency cannot and should not be measured or calculated using an instantaneously sampled value. Frequency calculation methods use various types of time windows and filtering methods in order to accurately calculate grid frequency. Typically, these methods use a window on the order of 100 mSec (6 cycles). Thus, a delay of 100 mSec would occur even if the protective relay algorithm has no intentional time delay. This delay should be reflected in the standard. Also, the IRPTF identified that erroneous tripping due to frequency calculation errors was a significant factor in the Blue Cut Fire disturbance. http://www.nerc.com/pa/rrm/ea/Pages/1200-MW-Fault-Induced-Solar-Photovoltaic-Resource-Interruption-Disturbance-Report.aspx Eliminating instantaneous tripping for frequency disturbances reduces the probability of incorrect tripping due to spurious noise in the measure voltage, for example during the period of fault clearing. 3. Point #5 in the Curve Details section of the "Voltage Ride-Through Curve Clarifications" (page 11 of PRC-024-2) states, "voltages in the curve assume minimum fundamental frequency phase to ground or phase to phase voltage for the low duration curve and the greater of maximum RMS (Root Mean Square) or crest phase to phase voltage for the high voltage duration curve." There are a number of ways this can be interpreted.

[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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To minimize the probability of incorrect tripping (as noted in point 2 above), any voltage compared with the PRC-024-2 voltage ride through curves should be a well-filtered, fundamental frequency component of the voltage waveform. This will filter out spurious voltage spikes caused by switching action on the BPS. Voltage protective relays should not operate at the voltage levels specified in the voltage ride-through curve using instantaneously sampled values. The other issue is that the overvoltage component of the clarification states, "the greater of maximum RMS or crest phase to phase voltage". The crest value is greater than the RMS value of a periodic waveform, so there is ambiguity regarding which value to apply. Without clarification, inverter based resources may trip based on different criteria. Failure to address this may lead to reliability issues, as identified in the Canyon 2 Fire disturbance analysis report. https://www.nerc.com/pa/rrm/ea/October%209%202017%20Canyon%202%20Fire%20Disturbance%20Report/900%20MW%20Solar%20Photovoltaic%20Resource%20Interruption%20Disturbance%20Report.pdf

The clarification should focus on using the RMS value of the voltage, and that the voltage signal should be adequately filtered to obtain this fundamental component.

4. Point #1 of the Curve Details section of the "Voltage Ride-Through Curve Clarifications" on page 11 of PRC-024-2 states, "the per unit voltage base for these curves is the nominal operating voltage specified by the Transmission Planner in the analysis of the reliability of the Interconnected Transmission Systems at the point of interconnection to the Bulk Electric System (BES)." The Transmission Planner does not specify the nominal operating voltage. VAR-001-4 Requirement 5 requires each Transmission Operator to specify a voltage or reactive power schedule, which is either a range or a target value with an associated tolerance band, at either the high voltage side or low voltage side of the generator step up transformer at the Transmission Operator's discretion. The applicable entity should be modified to the Transmission Operator if nominal operating voltage is maintained. Transmission voltage schedules may change based on system conditions, e.g. season, time of day, etc.) and thus may not be static. Protective relay settings are not modified every time a voltage schedule changes. The per unit base for the curves should be based on the nominal voltage level to which the generator is connected at its Point of Interconnection. This is a static value and can be provided by the Transmission Planner.
5. The ride-through curves end at four seconds, and the curves use a cumulative time duration for the "No Trip" zone. Protective relays must be set to accommodate the cumulative nature of ride through curves. Under the current version of PRC-024-2, it is not clear at what point the cumulative values reset.

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

This SAR proposes to clarify some issues and correct others. The cost impact to inverter based resources is minimal because it would only entail possibly reprogramming inverter protection set points.

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However, there is a significant benefit to the bulk power system in preventing incorrect tripping of inverter based generation.
Please describe any unique characteristics of the BES facilities that may be impacted by this proposed standard development project (*e.g*. Dispersed Generation Resources):
Inverter based generation may be impacted by this proposed standard development. Inverter based generation often will use momentary cessation as a response to transient high or low voltage conditions. Inverters will momentarily cease to inject real or reactive current into the grid during momentary cessation. PRC-024 is silent on the topic of momentary cessation. It is not clear if momentary cessation for voltage excursions into the "No Trip" zone constitutes a violation of this standard. For this reason, this SAR proposes to make this standard applicable to synchronous machines. Further the CAISO is submitting a second SAR for the development of a new standard to provide minimum performance requirements for the operation of inverter based generation.
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):
Generator Owners
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.
Many of these proposals were developed by NERC's IRPTF and are outlined in the Blue Cut Fire and Canyon 2 Fire disturbance reports.
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)?
CAISO is also submitting a SAR for the development of minimum operating performance criteria for inverter based generation.
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.

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.	
☒	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.
☒	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.
☐	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.

[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.

Reliability Principles	
☐	4. Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained and implemented.
☐	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk power systems.
☐	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.
☐	7. The security of the interconnected bulk power systems shall be assessed, monitored and maintained on a wide area basis.
☐	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
None	None

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SAR Status Tracking (Check off as appropriate)	
☐ Draft SAR reviewed by NERC Staff ☐ Draft SAR presented to SC for acceptance ☐ DRAFT SAR approved for posting by the SC	☐ Final SAR endorsed by the SC ☐ SAR assigned a Standards Project by NERC ☐ 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

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:	PRC XXX-1 Inverter Based Resource Controls and Performance		
Date Submitted:	5/29/2018		
SAR Requester			
Name:	Keith E. Casey, Ph.D., Vice President, Market and Infrastructure Development		
Organization:	California Independent System Operator Corporation (CAISO)		
Telephone:	(916) 608-7125	Email:	kcasey@caiso.com

SAR Type (Check as many as apply)

- ☒ New Standard
- ☒ Revision to Existing Standard
- ☐ Add, Modify or Retire a Glossary Term
- ☐ Withdraw/retire an Existing Standard
- ☐ Imminent Action/ Confidential Issue (SPM Section 10)
- ☐ Variance development or revision
- ☐ Other (Please specify)

Justification for this proposed standard development project (Check all that apply to help NERC prioritize development)

- ☐ Regulatory Initiation
- ☒ Emerging Risk (Reliability Issues Steering Committee) Identified
- ☐ Reliability Standard Development Plan
- ☐ NERC Standing Committee Identified
- ☐ Enhanced Periodic Review Initiated
- ☒ Industry Stakeholder Identified

Industry Need (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):

This SAR proposes a new controls based standard to ensure adequate performance of Bulk Electric System (BES) inverter based resources. This effort will ensure inverter based resources support reliable operation of the BES and have controls to provide essential reliability services. The CAISO is also submitting a complementary SAR to clarify and correct existing standard PRC-024. As an alternative approach, NERC could use the information submitted in this SAR to modify existing standard PRC-024.

The North American Bulk Power System (BPS) is undergoing a rapid evolution of the generating resource mix, predominantly driven by advancements in inverter technology, market economics and renewable portfolio standards. As the grid evolves and incorporates greater amounts of inverter based resources, NERC Reliability Standards must also evolve to set minimum performance requirements for inverter based BES resources. Without this action, BPS reliability will degrade and NERC's reliability program will lack the means to ensure that inverter based BES resources are providing necessary support to the BPS. To underscore this point, the CAISO notes that between August 2016 and May 2018, there have been at least 14 instances where inverter based solar generation incorrectly tripped and/or

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ceased to operate during the routine high speed clearing of BES transmission lines. The generation dropped varied from a low of 30 MW to a high of 1178 MW.

Inverter response to grid disturbances is predominantly driven by the logic programmed into the inverter and plant level controls of these non-synchronous resources. This is very different than the dynamic response of synchronous resources, which is predominantly driven by the physical nature of the machine. This fundamental difference between technologies unlocks new capabilities and flexibility for the BPS, and also presents challenges if performance is not sufficiently responsive to support BPS essential reliability services (ERS). NERC therefore needs to establish performance based requirements for control of inverter based resources. Recent grid events have demonstrated that the existing set of NERC Reliability Standards leaves potential reliability gaps, specifically related to the dynamic response of inverter based resources.

This concept is very similar to the performance based requirements set forth in the updated IEEE Std. 1547-2018, which revamped the requirements for distributed energy resources (DERs). That standard underwent a significant revision to improve the performance of future resources connecting to the distribution system, particularly as their penetration level continues to increase. The standard now identifies minimum requirements in the general performance specifications, reactive power capability, and voltage/power control requirements, response to abnormal grid conditions, power quality, islanding, and other aspects. It is not suggested that these requirements set for DERs should be used for BPS connected resources, nor should the NERC Reliability Standards attempt to set such stringent performance requirements for BES resources. However NERC should use this general approach to ensure that the inverter based resource's steady state and dynamic response characteristics support BPS reliability.

The Blue Cut Fire (https://www.nerc.com/pa/rrm/ea/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_Interruption_Final.pdf) and Canyon 2 Fire (900 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report) disturbance reports identified a number of issues that are particular to the way inverter based resources perform when connected to the grid. Examples include the means for taking action on measured frequency and voltage waveforms, current injection during abnormal grid conditions, response times to provide current during dynamic events, fault current contribution and the use of momentary cessation.

The controls aspect of inverter based resources are very different than those used for synchronous machines. Inverter technology response is significantly faster and more flexible than synchronous generators, and most of the dynamic response of these resources is controlled by programmed logic in the inverter and plant level controls rather than the physical nature of the equipment. Statements that inverter based technology "should act like a synchronous machine" significantly underutilize the capabilities of inverter technology, and should not be the mindset moving forward. Rather, interconnections around the world have identified specific performance requirements for inverter based technology to ensure an adequate level of reliability. Controls-based performance requirements

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ensure features such as dynamic reactive power, automatic voltage control, and primary frequency response are provided in sufficient times and quantities to support the BPS. The North American grid should follow these examples in defining performance requirements for the control and dynamic performance of inverter based technology. This is not a hindrance to this technology, but rather guidance that manufacturers are seeking so they can design the equipment to reliably meet minimum performance specifications and simultaneously compete on a level playing field. NERC should review the performance requirements from other grids around the world and establish similar requirements. This SAR proposes a new NERC Standard that sets performance requirements for inverter based resources with a focus on the controls and dynamic performance of these resources. Without a continent-wide performance-based NERC Standard, regional requirements may lead to disparate interconnection requirements that may not align with each other interconnection-wide. This could potentially lead to further reliability gaps in the future. The NERC IRPTF (Inverter based Resource Performance Task Force) is developing a Reliability Guideline for Inverter Based Performance. This guideline should serve as the cornerstone for any future standard, since the recommended performance specifications in that guideline will be industry vetted across a wide group of experts including: Original Equipment Manufacturers (OEMs), Generator Owners, Generator Operators, Transmission Planners, Planning Coordinators, Balancing Authorities, Reliability Coordinators, and other industry experts. It should be noted that Guidelines are neither compulsory nor enforceable.
Purpose or Goal (How does this proposed project provide the reliability-related benefit described above?):
This SAR proposes a new controls based standard to ensure adequate performance of BES inverter based resources. Purpose: Develop a new NERC Reliability Standard that specifically addresses inverter based resource controls and performance aspects as specifically identified in recent disturbance event analyses, NERC Advisories, and the NERC IRPTF Guideline.
Project Scope (Define the parameters of the proposed project):
The scope is to develop a new NERC Reliability Standard for inverter based resources that establishes minimum performance requirements, including controls and dynamic performance, and to address recommendations in the Blue Canyon Fire and Canyon 2 event analyses, and associated NERC Advisories (NERC Alerts).

Requested information
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 justification[1]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):
A new NERC Reliability Standard to address the controls and dynamic performance aspects of inverter based resources should include, at a minimum, the elements listed below. These have been discussed thoroughly by the NERC IRPTF, and have been factors in recent grid disturbance events as well as potential future performance issues. 1. Many BES inverter based resources use a form of "ride through" where they cease injection of current into the BPS for off nominal voltages. This mode of operation is often referred to as momentary cessation. Both the Blue Cut Fire (https://www.nerc.com/pa/rrm/ea/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_Interruption_Final.pdf) and Canyon 2 Fire (900 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report) disturbances identified this control mode as a contributing factor to the loss of BPS connected inverter based resources following short circuit fault events on the grid. This performance does not support interconnection wide grid stability during low voltage transients, and should not be allowed moving forward. NERC IRPTF simulations demonstrate that this performance may lead to wide scale system instability. Existing inverter based resources may not be able to feasibly eliminate its use, and there are legitimate equipment limitations that preclude inverters from using a more grid supportive form of ride through. This should be considered by the Standard Drafting Team when crafting requirements. However, new inverter based resources are designed for current injection during "ride through" conditions and should not use momentary cessation. The topic of momentary cessation and recommendations to reduce its impact is discussed in NERC's Industry Recommendation dated May 1, 2018. https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC_Alert_Loss_of_Solar_Resources_during_Transmission_Disturbance-II_2018.pdf Again, NERC Alerts are neither compulsory nor enforceable. 2. The response of an inverter based resource is predominantly driven by the logic programmed into the controls of the overall facility, including the individual inverters and the plant level control system. Inverters are current source devices, and therefore performance should be specified as to the type of current (real or reactive component) to be injected. Performance requirements should be developed that ensure that these resources inject an adequate level of grid supportive current during abnormal grid conditions (off nominal voltage and/or frequency).

[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.

Requested information
a. Active current or frequency performance requirements should be established to ensure that the capability to provide primary frequency response is available if needed by the Balancing Authority, consistent with technical specification of FERC Order No. 842. b. Reactive current or voltage characteristics should be specified to ensure that local and wide area voltage support is provided, as expected, from generating resources. c. Response to large disturbance events such as faults should be specified to ensure that fault current is provided in a timely manner from inverter based resources. Controls are often tuned for each individual connection to the BPS; however minimum performance requirements should be set to ensure adequate fault current and a stable recovery following fault clearing. Other grid codes around the world have begun specifying these characteristics, particularly as the penetration of these resources continues to grow. d. Any performance requirements should not limit inverter technology from exploring different solution options; however they should set minimum performance characteristics that may be met in multiple ways. e. Refer to the NERC IRPTF Reliability Guideline on Inverter Based Resource Performance for more details. This guideline should be used as the cornerstone for future standard requirements. 3. Other aspects that typically are not a significant focus for synchronous machines should also be considered from a performance specification standpoint. These include automatic reconnection, ability to respond to ramp rate limits and automatic generation control signals (dispatch ability), diagnostic equipment, and other aspects that ensure grid operators have the tools and capabilities available to maintain reliability.
Cost Impact Assessment, if known (Provide a paragraph describing the potential cost impacts associated with the proposed project):
Due to a lack of any standard addressing the minimum performance of inverter based generation connected to the BES, Original Equipment Manufacturers (OEM)s often apply standards for resources connected to the distribution system to BES resources. Development of a national standard will foster robust competition which will lead to greater cost control, along with improved BPS reliability.
Please describe any unique characteristics of the BES facilities that may be impacted by this proposed standard development project (*e.g*. Dispersed Generation Resources):
This SAR proposes development of a standard applicable to *inverter based generation resources that will interconnect to the BES.*
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):
Generator Owners

Requested information
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.
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 - 024
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. The NERC IRPTF will issue a Guideline. However the Guideline is neither mandatory nor enforceable, and therefore is not adequate to maintain or promote BES reliability.

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.	
☒	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.
☒	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.
☐	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.
☐	4. Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained and implemented.
☐	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk power systems.
☐	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.
☐	7. The security of the interconnected bulk power systems shall be assessed, monitored and maintained on a wide area basis.
☐	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

[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.

Market Interface Principles	
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
None	

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SAR Status Tracking (Check off as appropriate)	
☐ Draft SAR reviewed by NERC Staff ☐ Draft SAR presented to SC for acceptance ☐ DRAFT SAR approved for posting by the SC	☐ Final SAR endorsed by the SC ☐ SAR assigned a Standards Project by NERC ☐ SAR denied or proposed as Guidance document

Version History

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2	June 28, 2017	Standards Information Staff	Updated template