Comment Report

Project Name:	2020-02 Modifications to PRC-024 (Generator Ride-through) | Draft 2
Comment Period Start Date:	6/18/2024
Comment Period End Date:	7/8/2024
Associated Ballots:	2020-02 Modifications to PRC-024 (Generator Ride-through) Implementation Plan AB 2 OT 2020-02 Modifications to PRC-024 (Generator Ride-through) PRC-024-4 AB 2 ST 2020-02 Modifications to PRC-024 (Generator Ride-through) PRC-029-1 AB 2 ST

There were 63 sets of responses, including comments from approximately 138 different people from approximately 91 companies representing 7 of the Industry Segments as shown in the table on the following pages.

Questions

1. Provide any comments for the drafting team to consider, if desired.

Organization Name	Name	Segment(s)	Region	Group Name	Group Member Name	Group Member Organization	Group Member Segment(s)	Group Member Region
MRO	Anna Martinson	1,2,3,4,5,6	MRO	MRO Group	Shonda McCain	Omaha Public Power District (OPPD)	1,3,5,6	MRO
					Michael Brytowski	Great River Energy	1,3,5,6	MRO
					Jamison Cawley	Nebraska Public Power District	1,3,5	MRO
					Jay Sethi	Manitoba Hydro (MH)	1,3,5,6	MRO
					Husam Al-Hadidi	Manitoba Hydro (System Preformance)	1,3,5,6	MRO
					Kimberly Bentley	Western Area Power Adminstration	1,6	MRO
					Jaimin Patal	Saskatchewan Power Coporation (SPC)	1	MRO
					George Brown	Pattern Operators LP	5	MRO
					Larry Heckert	Alliant Energy (ALTE)	4	MRO
					Terry Harbour	MidAmerican Energy Company (MEC)	1,3	MRO
					Dane Rogers	Oklahoma Gas and Electric (OG&E)	1,3,5,6	MRO
					Seth Shoemaker	Muscatine Power & Water	1,3,5,6	MRO
					Michael Ayotte	ITC Holdings	1	MRO
					Andrew Coffelt	Board of Public Utilities-Kansas (BPU)	1,3,5,6	MRO
					Peter Brown	Invenergy	5,6	MRO
					Angela Wheat	Southwestern Power Administration	1	MRO

					Bobbi Welch	Midcontinent ISO, Inc.	2	MRO
WEC Energy Group, Inc.	Christine Kane	3		WEC Energy Group	Christine Kane	WEC Energy Group	3	RF
					Matthew Beilfuss	WEC Energy Group, Inc.	4	RF
					Clarice Zellmer	WEC Energy Group, Inc.	5	RF
					David Boeshaar	WEC Energy Group, Inc.	6	RF
California ISO	Darcy O'Connell	2	WECC	ISO/RTO Council (IRC) Standards Review Committee	Ali Miremadi	California ISO	2	WECC
					Gregory Campoli	New York Independent System Operator	2	NPCC
					John Pearson	ISO New England, Inc.	2	NPCC
					Helen Lainis	Independent Electricity System Operator	2	NPCC
					Elizabeth Davis	PJM Interconnection	2	RF
					Charles Yeung	Southwest Power Pool, Inc.	2	MRO
					Bobbi Welch	Midcontinent ISO, Inc.	2	RF
					Kennedy Meier	Electric Reliability Council of Texas, Inc.	2	Texas RE
FirstEnergy - FirstEnergy Corporation	Mark Garza	4		FE Voter	Julie Severino	FirstEnergy - FirstEnergy Corporation	1	RF
					Aaron Ghodooshim	FirstEnergy - FirstEnergy Corporation	3	RF
					Robert Loy	FirstEnergy - FirstEnergy Solutions	5	RF
					Mark Garza	FirstEnergy-FirstEnergy	1,3,4,5,6	RF
					Stacey Sheehan	FirstEnergy - FirstEnergy	6	RF

						Corporation		
Austin Energy	Michael Dillard	5		Austin Energy	Michael Dillard	Austin Energy	5	Texas RE
					Lovita Griffin	Austin Energy	3	Texas RE
					Tony Hua	Austin Energy	4	Texas RE
					Imane Mrini	Austin Energy	6	Texas RE
					Thomas Standifur	Austin Energy	1	Texas RE
Southern Company - Southern Company Services, Inc.	Pamela Hunter	1,3,5,6	SERC	Southern Company	Matt Carden	Southern Company - Southern Company Services, Inc.	1	SERC
					Joel Dembowski	Southern Company - Alabama Power Company	3	SERC
					Ron Carlsen	Southern Company - Southern Company Generation	6	SERC
					Leslie Burke	Southern Company - Southern Company Generation	5	SERC
DTE Energy	Patricia Ireland	4		DTE Energy	Patricia Ireland	DTE Energy - Detroit Edison	4	RF
					Karie Barczak	DTE Energy - Detroit Edison Company	3	RF
					Adrian Raducea	DTE Energy - Detroit Edison Company	5	RF
Black Hills Corporation	Rachel Schuldt	6		Black Hills Corporation - All Segments	Micah Runner	Black Hills Corporation	1	WECC
					Josh Combs	Black Hills Corporation	3	WECC
					Rachel Schuldt	Black Hills Corporation	6	WECC
					Carly Miller	Black Hills Corporation	5	WECC
					Sheila Suurmeier	Black Hills Corporation	5	WECC

Dominion - Dominion Resources, Inc.	Sean Bodkin	6		Dominion	Connie Lowe	Dominion - Dominion Resources, Inc.	3	NA - Not Applicable
					Lou Oberski	Dominion - Dominion Resources, Inc.	5	NA - Not Applicable
					Larry Nash	Dominion - Dominion Virginia Power	1	NA - Not Applicable
					Rachel Snead	Dominion - Dominion Resources, Inc.	5	NA - Not Applicable
Western Electricity Coordinating Council	Steven Rueckert	10		WECC	Steve Rueckert	WECC	10	WECC
					Curtis Crews	WECC	10	WECC
Tim Kelley	Tim Kelley		WECC	SMUD and BANC	Nicole Looney	Sacramento Municipal Utility District	3	WECC
					Charles Norton	Sacramento Municipal Utility District	6	WECC
					Wei Shao	Sacramento Municipal Utility District	1	WECC
					Foung Mua	Sacramento Municipal Utility District	4	WECC
					Nicole Goi	Sacramento Municipal Utility District	5	WECC
					Kevin Smith	Balancing Authority of Northern California	1	WECC
Associated Electric Cooperative, Inc.	Todd Bennett	3		AECI	Michael Bax	Central Electric Power Cooperative (Missouri)	1	SERC
					Adam Weber	Central Electric Power Cooperative (Missouri)	3	SERC
					Gary Dollins	M and A	3	SERC

	Electric Power Cooperative		
William Price	M and A Electric Power Cooperative	1	SERC
Olivia Olson	Sho-Me Power Electric Cooperative	1	SERC
Mark Ramsey	N.W. Electric Power Cooperative, Inc.	1	SERC
Heath Henry	NW Electric Power Cooperative, Inc.	3	SERC
Tony Gott	KAMO Electric Cooperative	3	SERC
Micah Breedlove	KAMO Electric Cooperative	1	SERC
Brett Douglas	Northeast Missouri Electric Power Cooperative	1	SERC
Skyler Wiegmann	Northeast Missouri Electric Power Cooperative	3	SERC
Mark Riley	Associated Electric Cooperative, Inc.	1	SERC
Brian Ackermann	Associated Electric Cooperative, Inc.	6	SERC
Chuck Booth	Associated Electric Cooperative, Inc.	5	SERC
Jarrod Murdaugh	Sho-Me Power Electric Cooperative	3	SERC

1. Provide any comments for the drafting team to consider, if desired.	
Thomas Foltz - AEP - 5	
Answer	
Document Name	
Comment	

The R1, R2, and R3 design requirement is problematic because of at least two major issues: dynamic modeling deficiencies and lack of standardized test procedures. IBR dynamic modeling is well proven to be deficient in representing performance of equipment in the field, particularly disturbance ride-through performance, and even though MOD-026-2 is addressing model verification/validation, it is still only post-interconnection (or post-commissioning). What is needed here is to expand the scope of MOD-026-2 to also encompass pre-interconnection model verification/validation so that “simulations” and “studies” on IBR plant models evaluating the plant designs are performed on verified and validated dynamic models ahead of interconnection. Secondly, without well-defined, standardized test procedures to assess ride-through capability, there is little possibility that simulations and studies on IBR designs will result in uniform across-the-board assurance that IBR equipment and plant designs adequately adhere to the PRC-029 ride-through requirements. Completion of IEEE 2800.2, which is intended to define the necessary testing and verification procedures, and selective consideration and use of its content in PRC-029 is necessary just as 2800 itself has been instrumental in formulating the mandatory ride-through requirements in PRC-029. Without dynamic model verification/validation and well-defined, standardized test procedures, the design components of R1, R2, and R3 will not achieve the desired outcome and will only result in confusion as to what evidence is actually required from GOs and TOs.

Need to indicate in association with R1 third bullet that momentary current blocking is an acceptable means of reacting to non-fault initiated phase jumps greater than 25 degrees.

There is inconsistency throughout the document in instances of both “TO and GO” and “TO or GO”. Please resolve the inconsistencies.

Please clarify what “other evidence” in M1, M2, and M3 would be acceptable to assure compliance. Please also reinsert “shall” in M1, M2, and M3 where it has been removed (to read “Each GO and TO shall have evidence…”). The sentences are not complete without it and measures in other standards (such as PRC-024-4) read that way.

Figures 1 and 2 in Attachment 1 should be better aligned. One has a log scale on the horizontal axis and the other is linear. There is no valid reason for these differences, and we recommend they be consistent in the axes used. The only difference between them should be the slight difference in the lower boundary of the must ride-through zone reflecting the slight difference between Attachment 1 tables 1 and 2.

There needs to be an exemption for system-related causes of ride-through failure. IBRs should be exempt from ride-through requirements in R1 through R3 if tripping or failure to ride through is attributable to any of the following:

1. Sub-synchronous control interaction or ferro-resonance involving series compensation confirmed by the TOP, RC, TP, or PC

2. Unstable behavior of other nearby IBRs or dynamic devices such as FACTS or HVDC confirmed by the TOP, RC, TP, or PC

3. System short circuit levels during contingencies below the level of IBR stable operation confirmed by the TOP, RC, TP, or PC

4. System-level transient or oscillatory instabilities confirmed by the TOP, RC, TP, or PC

R 2.1.3 should be .95 per unit (with a decimal point) rather than 95 per unit.

Likes 0	
Dislikes 0	

Response
Bob Cardle - Bob Cardle On Behalf of: Marco Rios, Pacific Gas and Electric Company, 3, 1, 5; Sandra Ellis, Pacific Gas and Electric Company, 3, 1, 5; Tyler Brun, Pacific Gas and Electric Company, 3, 1, 5; - Bob Cardle

Answer	
Document Name	

Comment

1) Editorial suggestions **BOLD** and ***ITALICS*** for the Measures in below

2) In PRC-029, standard as follows:

4.2 Facilities:

4.2.1. BEPS inverter-based resources(2)

(2)For the purpose of this standard, “inverter-based resources” refers to a collection of individual solar photovoltaic (PV), Type 3 and Type 4 wind turbines, battery energy storage system (BESS), or fuel cells that operate as a single plant/resource. ***In case of offshore wind plants connecting via a dedicated VSC-HVDC, the inverter-based resource includes the VSC-HVDC system.***

Question for SDT: ***Should VSC_HVDC be included even if it’s not associated with a windplant (ie Transbay Cable HVDC)?***

M1. Is very clunky, below is my attempt to making it read better.

1}· Replace *have* with *has*.

2}· Reword per the following:

o ***Has*** evidence of dynamic simulations, studies, or other evidence to demonstrate the design of each facility will adhere to Ride-through requirements, as specified in Requirement R1. ***As system conditions allow*** each Generator Owner and Transmission Owner ***retain*** evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) recorded to demonstrate that the operation of each facility did adhere to Ride-through requirements, as specified in Requirement R1. If the Generator Owner and Transmission Owner choose to utilize Ride-through exemptions that occur within the “must Ride-through zone” and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner and Transmission Owner also ***retain*** evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate that the facility failed to Ride-through during a phase jump of greater than or equal to 25 electrical degrees, and documentation from their Transmission Planner, Reliability Coordinator, Planning Coordinator, or Transmission Operator that a non-fault initiated switching event occurred.

M2 .

Each Generator Owner and Transmission Owner ***has*** evidence of dynamic simulations, studies, or other evidence to demonstrate the design of each facility will adhere to requirements, as specified in Requirement R2. Each Generator Owner and Transmission Owner also ***retain*** evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data demonstrating that the operation of each facility did adhere to performance requirements, as specified in Requirement R2, during each voltage excursion measured at the high-side of the main power transformer. ***The Generator Owner or Transmission Owner have evidence of receiving such performance requirements, (e.g. email exchange, contract information) if the Transmission Planner, Transmission Operator, Reliability Coordinator, Planning Coordinator has required the Generator Owner or Transmission Owner to follow performance requirements other than those in Requirement R2 (e.g. ramp***

rates, reactive power prioritization).

3) Question for SDT: What does this mean? **M3 Same comments as M2.**

4) Figure -1 "*Voltage ride-through requirement for AC-connected wind"* on page 20 does not match Attachment 1 Table-1 on page16 for the requirement of <1.2 and > 1.1 minimum ride-through time of 1 second.

5) For PRC-029-1, section B (Requirements and Measures)-

R2- Section 2.2:

In section 2.2, footnote 6: mentions that "*In either case and if required, the magnitude of active power and reactive current shall be as specified by the Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator*."

Question/comment for SDT: It has not been mentioned how to identify the magnitude of active power and reactive current, and it seems that Electromagnetic Transient (EMT) studies should be performed to evaluate each IBR and it will result in a significant amount of extra work for PTO to receive, evaluate and perform EMT studies.

Likes 0	
Dislikes 0	

Response

Ijad Dewan - Ijad Dewan On Behalf of: Emma Halilovic, Hydro One Networks, Inc., 1; - Ijad Dewan

Answer	
Document Name	

Comment

The Technical Rationale must include reasons for inclusion of Synchronous Condenser to the standard under the applicability section.

Likes 0	
Dislikes 0	

Response

Sean Bodkin - Dominion - Dominion Resources, Inc. - 6, Group Name Dominion

Answer	
Document Name	

Comment

Dominion Energy supports EEI's additional comments.

Likes 0	

Dislikes 0	

Response

Mark Garza - FirstEnergy - FirstEnergy Corporation - 4, Group Name FE Voter	
Answer	
Document Name	

Comment
FirstEnergy requests the DT consider changing PRC-029-1 Requirement 2 R2.5 from active power to apparent. Entities may incorporate solar sites that automatically change reactive power to attempt to control voltage similar to FirstEnergy's sites. This change will inevitably cause changes in active power post event, such that meeting this requirement as written could be difficult. Since changes in reactive power are desired for voltage control, the requirement should be changed to allow this response. Using apparent power in the requirement versus active power is one way to achieve this.

Likes 0	
Dislikes 0	

Response

Brian Lindsey - Entergy - 1	
Answer	
Document Name	

Comment

• M1: This seems more like a requirement than a measure for meeting the requirement.
• R2, M2, M3 and R4: Duplicative of Mod-026 and MOD-027. Also, seems to be dependent on PRC-028 passing and sites having DDRs installed.
• R2: is not clear. It seems to overlap significantly with VAR-002.
  ○ Should that be .95 per unit?
• R3: No provisions for exemptions for frequency limitations.
• R4.1 thru 4.2: Are we seeking approval from this large list of entities for an exemption or are we documenting the limitation that prevents from meeting requirement 1? If we have to get approval there is no requirement in this standard that require any of these entities to provide that approval.
  ○ Recommend limiting who must be notified to just the TP or TP and RC. There needs to be a single point of contact instead multiple entities.

Likes 0	

Dislikes 0	

Response

Mark Flanary - Midwest Reliability Organization - 10	
Answer	
Document Name	

Comment
The draft PRC-029-1 includes expectations in R1, R2, and R3 for entities to demonstrate ride-through adherence (R1 & R3) and performance (R2) through two separate means: 1) dynamics simulations/studies and 2) data from actual system events. These two separate expectations are combined in each requirement but are not clearly delineated within the requirement text. It is only in the measures associated with each requirement that it becomes clear that both expectations exist. This lack of clarity leads to concerns about the auditability of this standard. The Standard should clearly specify during which timeframes and under what conditions an entity is expected to show compliance using simulations/studies vs. data from actual events. For instance, upon commissioning of a new facility, no event data will be available. Should the CEA expect to see a study completed for a new facility prior to commercial operation? For existing facilities with extensive recorded event data is it still necessary to perform simulations and studies to show compliance? How much event data and how serious must the events be for this to be acceptable?

Likes 0	
Dislikes 0	

Response

Chantal Mazza - Hydro-Quebec (HQ) - 1 - NPCC	
Answer	
Document Name	

Comment
It is imperative that the standard drafting teams for this project as well as the 2021-04 (PRC-002 and PRC-028) and 2023-02 (PRC-030 vs PRC-004) assure a coherent way of addressing the inclusion and exclusion of IBRs in current and upcoming standards. The following comments are applicable to PRC-029-1 The definition for Inverter Based Resource (IBR) was approved by industry in April under Project 2020-06. We do not agree with inserting the uncapitalized version of IBR into 4.2 Facilities section because it is unbounded and insufficient to identify the Facilities applicable to this Standard, as required in the Rules of Procedure (Appendix 3a, Standard Processes Manual). Furthermore, these definitions are the foundation of several ongoing projects in response to FERC Order 901, where FERC “directs NERC to submit new or modified Reliability Standards that address specific matters pertaining to the impacts of IBRs on the reliable operation of the BPS.” Chapter A, -Section 4.2.2 What is the “IBR registration criteria”? Please add a footnote to describe it. Requirement R1: 25degrees, 1.1pu-45s and 1.18pu-2s should be moved to attachment 1 to allow for regional variance.

Requirement -R2-2.1.3 and B-R2-2.2 Can the TP ask for a mix of active/reactive power based on a predetermined ratio (currently only indicated as active OR reactive).

Requirement -R3: No exemption exists for existing equipment limitation to meet frequency and ROCOF ride-through? (like R4 for voltage) One should be added.

Requirement -R3. The 5Hz/s value should be moved to Attachment 2 to allow for a regional variance.

Requirement -R3 The 5Hz/s requirement is already indicated in R1. It should not be repeated.

Requirement -R4: Are the phase shift and V/Hz requirements described in R1 considered as being part of the “voltage ride-through criteria”? (or is it for amplitude only) An exemption should be provided for existing equipment with limitations.

Requirement -R4 and M4 What should be done when the manufacturer does not exist anymore or refuses to collaborate?

Attachment 1: Please explain (footnote) why the ride through requirement for a type-4 wind turbine needs to be different of a PV plant.

The Technical Rationale must include reasons for inclusion of Synchronous Condenser to the standard under the applicability section.

The term “active power” is not defined and appears to be used in conjunction with Real Power. Recommend consistency throughout the standards when using Real Power vs active power, such as MOD-025, BAL-001, and many others.

Recommend the DT reevaluate the implementation period of 6 months. Recommend making implementation period 18 months or greater to account for the need for working with OEMs to implement any setting changes and the need for IBR settings reviews conducted by third parties, as necessary.

Likes 0	
Dislikes 0	

Response

Donna Wood - Tri-State G and T Association, Inc. - 1

Answer	
Document Name	

Comment

Tri-State has no additional comments for PRC-024-4

Tri-State agrees with MRO NSRF Comments regarding PRC-029-1

Likes 0	
Dislikes 0	

Response

Jennifer Weber - Tennessee Valley Authority - 1,3,5,6 - SERC

Answer	

Document Name	
Comment	

- PRC-029-1 Attachment 1
  - Footnotes 10 and bullet 1 seem redundant. Consider consolidation with bullet 4.
  - Footnotes 11, 13 and bullet 5 seem redundant. Consider consolidation.
- Technical Rational for Reliability Standard PRC-029-1
  - Requirement R1, paragraph 5 – missing hyphen in “IEEE 2800-2022”.

Likes 0	
Dislikes 0	
Response	

Rachel Schuldt - Black Hills Corporation - 6, Group Name Black Hills Corporation - All Segments

Answer	
Document Name	
Comment	

PRC-024: Black Hills Corporation does not have any further comments for this revision for this standard as part of this project.

PRC-029: Black Hills Corporation agrees with the comments identified by the NAGF. They are as follows:

The NAGF believes that PRC-029 should allow for frequency ride through (“FRT”) exemptions similar to its treatment of voltage ride through (“VRT”) exemptions. The justification for allowing VRT exemptions in FERC Order 901 also apply to FRT. We believe the statement in FERC Order 901, paragraph 193 in response to ACP/SEIA’s comment in paragraph 188 does not preclude the standard drafting team from considering FRT exemptions due legacy equipment limitations. Here are a few reasons why:

1. If FERC’s intent was to exclude Frequency Ride Through exemptions while allowing Voltage ride through exemptions, there would be more of a record established to support this differential treatment.

2. FERC responded to ACP/SEIA’s comment on ride-through requirements as if they were only asking about voltage ride through requirements. FERC made no mention of frequency ride through requirements.

3. Similar to FERC’s rational for the consideration of voltage ride through exemptions, there are also older IBR technologies with hardware that would need to be physically replaced to meet frequency ride through requirements as well.

4. NERC and the NERC Standard Drafting Teams have the technical expertise to address complex technical issues such as legacy equipment limitations that FERC does not have.

Applicability Section, 4.2.2 – Recommend removing this section.

Requirement R1: The NAGF notes that R1 only addresses voltage ride through and should be revised to include frequency ride through as well. In addition, R1 should address frequency ride through limitations for legacy IBR facilities.

Measurement M1 – The proposed narrative reads more like requirements than measures; recommend to revise the narrative accordingly. In addition, the NAGF notes that the proposed narrative seems to assume that PRC-028 will be need to be approved/in place for PRC-029 to be a viable standard.

Requirement 2.1.3: The narrative is unclear as to what is expected for this proposed requirement. Request that the narrative be rewritten/restructured to address this issue. In addition, it is unclear which entity will define the preference for active or reactive power. The NAGF

suggests that the Transmission Planner (TP) should have the authority to define this preference. This recommendation also applies to Requirement 2, second bullet and Footnote 6.

Requirement R2.5: The NAGF recommends that the narrative be revised to state that active power shall be restored when" the voltage at the high-side of the main power transformer returns to the Continuous Operating Region".

Requirement R4: The draft narrative does not clearly specify who is responsible for approving the exemption. The NAGF requests the narrative be revised to address this issue.

Measure M4: Recommend replacing the word "seeking: with "submitting" in the first sentence.

Additionally, Black Hills Corporation reviewed and agrees with EEI's high level concerns for PRC-029, which are:

1. The Standard attempts to redefine the approved definition of IBR by adding VSC-HVDC systems after the IBR definition was approved by the industry.

2. The Standard adds TOs to this Standard solely to address VSC-HVDC systems, yet no technical justification has been provided. Moreover, these systems were not identified in FERC Order No. 901, or this SAR and they were not clearly identified in the Applicability Section of this proposed Reliability Standard.

3. EEI is concerned with the inclusion of requirements that are not clearly defined or set by multiple registered entities (i.e., TP, PC, RC, or TOP). This creates regulatory confusion and places IBR-GOs in a position where they may need to comply with any number of entities without clearly defining who is responsible. (See Requirement R2, subpart 2.1.3; subpart 2.2 (bullet 2); subpart 2.5) Moreover, the identification of multiple entities who could be responsible creates a situation where IBR-GOs will have reporting obligations to multiple entities because no single entity is identified as being responsible. (See requirement R4, subparts 4.2 & 4.2.1; subpart 4.3) We further note that none of the entities identified (i.e., TP, PC, RC, or TOP) are identified within the Applicability section of this proposed Reliability Standard. All of this can create confusion and places considerable burden on the IBR-GOs that needs to be resolved and clarified.

4. Throughout this Reliability Standard there is use of non-glossary terms (i.e., active power vs. Real Power) where glossary terms are available and should be used. While in other cases glossary terms are used but not capitalized. (e.g., reactive power vs. Reactive Power) Greater efforts should be made to use NERC Glossary terms where appropriate and capitalize those terms, as required.

Detailed Concerns

Ride-through Definition Comments: EEI does not support the proposed definition for "Ride-through" as proposed because it is too vague and contains no defined limits, as proposed. We recommend the following changes:

Ride-through: Ability to withstand voltage or frequency Disturbances within defined regulatory limits remaining connected, synchronized with the Transmission System, and continuing to operate**.** *(remove: **in response to System conditions through the time-frame of a System Disturbance.**)*

Applicability Section Comments:

Footnote 1: EEI does not support adding TO that own VSC-HVDC systems because this was not a scope item and is therefore not be included in the scope of this SAR. Moreover, Footnote 1 conflicts with Footnote 2 which defines VSC-HVDC as an IBR, which is again does not in alignment with the approved definition of an IBR.

Footnote 2: EEI does not support Footnote 2 because it expands the definition of IBRs beyond what was recently approved by the industry, noting the expansion of IBRs to include VSC-HVDC. Furthermore, there was no technical justification for adding VSC-HVDC and the SAR did not include adding VSC-HVDC systems to this project. For this reason, we ask that the definition of IBR not be expanded through footnotes and suggest that the DT submit a technical justification for adding VSC-HVDC systems to the applicability section of this Standard, rather than redefining an approved definition in a footnote.

To address our concerns related to Footnotes 1 & 2 we suggest that if VSC-HVDC systems are to be classified as IBRs, then the approved definition

should be pulled by NERC and resubmitted with those resources added to the definition and resubmitted to the industry for approval. Alternatively, VSC-HVDC systems could be defined separately, and that definition submitted to the industry for approval. In both cases, a technical justification should be provided to the industry that defines the issues and risks to BPS reliability that VSC-HVDC systems pose

EEI suggests that if the DT believes that certain IBR capabilities as identified under Requirement R2 need (or may need) to be specified then they should identify the entity who should be responsible among the four identified (i.e., TP, PC, RC or TOP); add them to the applicability section of this Reliability Standard; add clear requirements and adjust the reporting obligations for the IBR-GO under Requirement R4.

Requirement R1 & R2 Comments: EEI does not agree with the inclusion of Transmission Owners because they would only have an obligation under this Reliability Standard if VSC-HVDC systems were included. Given we do not support the inclusion of VSC-HVDC systems without a technical justification and modified SAR, we ask that Transmission Owners be removed from Requirement R1.

Measures M1 & M2: EEI is concerned that M1 & M2 contains measures that are overly prescriptive providing little discretion to IBR-GOs in demonstrating their compliance with Requirements R1 and R2 that seem to align more with a Requirement than a Measure. To address our concerns, we offer the following suggested changes to M1 and suggest similar changes be made to M2:

M1. Each Generator Owner (*remove:* ***and Transmission Owner***) **shall** have evidence (*remove:* ***of dynamic simulations, studies, or other evidence to demonstrate the design of each facility will adhere***) **that supports the** Ride-through **capability of each of their facilities**, as specified in Requirement R1. (e.g., simulations, studies, recorded data from disturbance monitoring equipment, etc.) (*remove:* ***Each Generator Owner and Transmission Owner have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) to demonstrate that the operation of each facility did adhere to Ride-through requirements, as specified in Requirement R1.****)* If the Generator Owner and Transmission Owner choose to utilize Ride-through exemptions that occur within the "must Ride-through zone" and are caused by non-fault-initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner (*remove:* ***and Transmission Owner***) also have evidence **supporting that exemption. (e.g., studies, simulations or supporting data from disturbance monitoring equipment)** (*remove:* ***of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate that the facility failed to Ride-through during a phase jump of greater than or equal to 25 electrical degrees, and documentation from their Transmission Planner, Reliability Coordinator, Planning Coordinator, or Transmission Operator that a non-fault initiated switching event occurred***).

Requirement R3 & R4: EEI does not support the inclusion of Transmission Owners within Requirements R3 & R4 for the same reasons identified above.

Likes 0	
Dislikes 0	

Response

Duane Franke - Manitoba Hydro - 1,3,5,6 - MRO

Answer	
Document Name	

Comment

PRC-024-4

No Comments, MH is generally supportive of this proposed standard.

PRC-029-1

Applicability:

The standard switches between BPS (bulk power system) and BES (bulk electric system). For consistency, one term should be used throughout the standard.

R1: bullet # 3:

MH recommends adding a footnote stating that the facility may operate in current block mode if necessary to avoid tripping for non-fault initiated phase jumps greater than 25 degrees.

R2:

MH recommends that the defined terms, Real Power and Reactive Power be used throughout the document instead of active power and reactive power.

R 2.1.3

To SDT: “The voltage is below 95 per unit” should be replaced by “The voltage is below 0.95 per unit”

R 2.1.3 & 2.2

Allowing multiple entities to place potentially conflicting requirements upon an applicable functional entity is unacceptable. Either a single entity be tasked with the obligation, or a hierarchy be provided so that an entity is not placed in a multibed conflicted request situation.

M1, M2, M3, and R4

To SDT: Consistently replace “Each Generator Owner and Transmission Owner” with “Each Generator Owner or Transmission Owner”

R3

This requirement requires that Each Generator Owner or Transmission Owner shall ensure the design and operation are such that each facility adheres to Ride-through requirements during a frequency excursion but does not require any governor response action or capability. The inverter-based resources that “adhere to Ride-through requirements” but are not based on frequency deviation, would comply with the standard requirements, which is not ideal. The TP/PC is expected to specify inverter-based resources performance during abnormal system frequency.

MH recommends:

Each Generator Owner or Transmission Owner shall ensure the design and operation is such that each facility adheres to Ride-through requirements **and response as specified by TP, RC, TOP, or PC** during a frequency excursion.

Implementation plan:

The standard is event-based compliance that requires installing recorded equipment data with higher sampling rates at all applicable legacy IBR Facilities. Therefore, we suggest that the implementation plan for PRC-029 should be aligned with Project 2021-04 (PRC-028-1) for the legacy IBRs. Also, MH recommends that the implementation plan of legacy IBR (a facility that is in service by the effective date of PRC-029-1) be longer than any new interconnected IBR (a facility that is in service after the effective date of PRC-029-1/ PRC-028-1)

Likes 0	
Dislikes 0	

Response

Kimberly Turco - Constellation - 6	
Answer	
Document Name	
Comment	

Constellation feels that the draft 2 added significant technical requirements that would require OEM collaboration and input on their equipment. Operating at Max capability requires additional analysis from GOs and OEMs to ensure subcomponents in the BOP and WTG side will be able to operate at these limits.

Further, the added language for the high side transformer volts per hz (Hz) settings to exceed 1.1 per unit longer than 45 seconds or exceed 1.18 for longer than 2 seconds will require GO/GOPs to work with the transformer manufacturer to see if these new limits can be met. The volt/hz settings are set to protect the transformer during over excitation conditions and they are above the provided transformer excitation curve from the manufacturer.

Also, the new ride through voltage limits is set so high that the current WTGs will not be able to ride through without tripping due to equipment operating conditions. OEMs are still unsure and not incentivized to collaborate in a timely manner to understand capabilities and limitations.

Finally, Constellation asks the DT to address scheduling and implementation plan. The current plan is not reasonable to implement.

Kimberly Turco on behalf of Constellation Segments 5 and 6

Likes 0	
Dislikes 0	
Response	

Alison MacKellar - Constellation - 5	
Answer	
Document Name	
Comment	

Constellation feels that the draft 2 added significant technical requirements that would require OEM collaboration and input on their equipment. Operating at Max capability requires additional analysis from GOs and OEMs to ensure subcomponents in the BOP and WTG side will be able to operate at these limits.

Further, the added language for the high side transformer volts per hz (Hz) settings to exceed 1.1 per unit longer than 45 seconds or exceed 1.18 for longer than 2 seconds will require GO/GOPs to work with the transformer manufacturer to see if these new limits can be met. The volt/hz settings are set to protect the transformer during over excitation conditions and they are above the provided transformer excitation curve from the manufacturer.

Also, the new ride through voltage limits is set so high that the current WTGs will not be able to ride through without tripping due to equipment operating conditions. OEMs are still unsure and not incentivized to collaborate in a timely manner to understand capabilities and limitations.

Finally, Constellation asks the DT to address scheduling and implementation plan. The current plan is not reasonable to implement.

Alison Mackellar on behalf of Constellation Segments 5 and 6

Likes 0	

Dislikes 0	
Response	
Marcus Bortman - APS - Arizona Public Service Co. - 6	
Answer	
Document Name	
Comment	

AZPS supports the following comments that were submitted by EEI on behalf of its members:

PRC-029-1 Comments:

While EEI appreciates that changes made to address our previous comments for the 1st draft of PRC-029-1, we have some new concerns that need to be addressed.

Our high level concerns are described in our comments below:

1. The Standard attempts to redefine the approved definition of IBR by adding VSC-HVDC systems after the IBR definition was approved by the industry.

2. The Standard adds TOs to this Standard solely to address VSC-HVDC systems, yet no technical justification has been provided. Moreover, these systems were not identified in FERC Order No. 901, or this SAR and they were not clearly identified in the Applicability Section of this proposed Reliability Standard.

3. EEI is concerned with the inclusion of requirements that are not clearly defined or set by multiple registered entities (i.e., TP, PC, RC, or TOP). This creates regulatory confusion and places IBR-GOs in a position where they may need to comply with any number of entities without clearly defining who is responsible. (See Requirement R2, subpart 2.1.3; subpart 2.2 (bullet 2); subpart 2.5) Moreover, the identification of multiple entities who could be responsible creates a situation where IBR-GOs will have reporting obligations to multiple entities because no single entity is identified as being responsible. (See requirement R4, subparts 4.2 & 4.2.1; subpart 4.3) We further note that none of the entities identified (i.e., TP, PC, RC, or TOP) are identified within the Applicability section of this proposed Reliability Standard. All of this can create confusion and places considerable burden on the IBR-GOs that needs to be resolved and clarified.

4. Throughout this Reliability Standard there is use of non-glossary terms (i.e., active power vs. Real Power) where glossary terms are available and should be used. While in other cases glossary terms are used but not capitalized. (e.g., reactive power vs. Reactive Power) Greater efforts should be made to use NERC Glossary terms where appropriate and capitalize those terms, as required.

Detailed Concerns

Ride-through Definition Comments:

EEI does not support the proposed definition for “Ride-through” as proposed because it is too vague and contains no defined limits, as proposed. We recommend the following changes:

Ride-through: Ability to withstand voltage or frequency Disturbances within defined regulatory limits remaining connected, synchronized with the Transmission System, and continuing to operate***. in response to System conditions through the time-frame of a System Disturbance(remove).***

Applicability Section Comments:

Footnote 1: EEI does not support adding TO that own VSC-HVDC systems because this was not a scope item and is therefore not be included in the

scope of this SAR. Moreover, Footnote 1 conflicts with Footnote 2 which defines VSC-HVDC as an IBR, which is again does not in alignment with the approved definition of an IBR.

Footnote 2: EEI does not support Footnote 2 because it expands the definition of IBRs beyond what was recently approved by the industry, noting the expansion of IBRs to include VSC-HVDC. Furthermore, there was no technical justification for adding VSC-HVDC and the SAR did not include adding VSC-HVDC systems to this project. For this reason, we ask that the definition of IBR not be expanded through footnotes and suggest that the DT submit a technical justification for adding VSC-HVDC systems to the applicability section of this Standard, rather than redefining an approved definition in a footnote.

To address our concerns related to Footnotes 1 & 2 we suggest that if VSC-HVDC systems are to be classified as IBRs, then the approved definition should be pulled by NERC and resubmitted with those resources added to the definition and resubmitted to the industry for approval. Alternatively, VSC-HVDC systems could be defined separately, and that definition submitted to the industry for approval. In both cases, a technical justification should be provided to the industry that defines the issues and risks to BPS reliability that VSC-HVDC systems pose

EEI suggests that if the DT believes that certain IBR capabilities as identified under Requirement R2 need (or may need) to be specified then they should identify the entity who should be responsible among the four identified (i.e., TP, PC, RC or TOP); add them to the applicability section of this Reliability Standard; add clear requirements and adjust the reporting obligations for the IBR-GO under Requirement R4.

Requirement R1 & R2 Comments: EEI does not agree with the inclusion of Transmission Owners because they would only have an obligation under this Reliability Standard if VSC-HVDC systems were included. Given we do not support the inclusion of VSC-HVDC systems without a technical justification and modified SAR, we ask that Transmission Owners be removed from Requirement R1.

Measures M1 & M2: EEI is concerned that M1 & M2 contains measures that are overly prescriptive providing little discretion to IBR-GOs in demonstrating their compliance with Requirements R1 and R2 that seem to align more with a Requirement than a Measure. To address our concerns, we offer the following suggested changes to M1 and suggest similar changes be made to M2:

M1. Each Generator Owner shall have evidence that supports the Ride-through capability of each of their facilities, as specified in Requirement R1. (e.g., simulations, studies, recorded data from disturbance monitoring equipment, etc.) If the Generator Owner and Transmission Owner choose to utilize Ride-through exemptions that occur within the “must Ride-through zone” and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner also have evidence supporting that exemption. (e.g., studies, simulations or supporting data from disturbance monitoring equipment)

Requirement R3 & R4: EEI does not support the inclusion of Transmission Owners within Requirements R3 & R4 for the same reasons identified above.

Likes 0	
Dislikes 0	

Response

David Vickers - David Vickers On Behalf of: Daniel Roethemeyer, Vistra Energy, 5; - David Vickers

Answer	
Document Name	

Comment

Vistra supports comments made by EEI and Entergy.

Likes 0	

Dislikes 0	
Response	
Hayden Maples - Hayden Maples On Behalf of: Jeremy Harris, Evergy, 3, 5, 1, 6; Kevin Frick, Evergy, 3, 5, 1, 6; Marcus Moor, Evergy, 3, 5, 1, 6; Tiffany Lake, Evergy, 3, 5, 1, 6; - Hayden Maples	
Answer	
Document Name	
Comment	
Evergy supports and incorporates by reference the comments of the Edison Electric Institute (EEI) and Midwest Reliability Organization's NERC Standards Review Forum (MRO NSRF) on question 1	
Likes 0	
Dislikes 0	
Response	
Todd Bennett - Associated Electric Cooperative, Inc. - 3, Group Name AECI	
Answer	
Document Name	
Comment	
AECI supports comments provided by the NAGF.	
Likes 0	
Dislikes 0	
Response	
Wayne Sipperly - North American Generator Forum - 5 - MRO,WECC,Texas RE,NPCC,SERC,RF	
Answer	
Document Name	
Comment	
PRC-029: *General Comment: The NAGF believes that PRC-029 should allow for frequency ride through ("FRT") exemptions similar to its treatment of voltage ride through ("VRT") exemptions. The justification for allowing VRT exemptions in FERC Order 901 also apply to FRT. We believe the statement in FERC Order 901, paragraph 193 in response to ACP/SEIA's comment in paragraph 188 does not preclude the standard drafting team from considering FRT*	

exemptions due legacy equipment limitations. Here are a few reasons why:

1. If FERC's intent was to exclude Frequency Ride Through exemptions while allowing Voltage ride through exemptions, there would be more of a record established to support this differential treatment.

2. FERC responded to ACP/SEIA's comment on ride-through requirements as if they were only asking about voltage ride through requirements. FERC made no mention of frequency ride through requirements.

3. Similar to FERC's rational for the consideration of voltage ride through exemptions, there are also older IBR technologies with hardware that would need to be physically replaced to meet frequency ride through requirements as well.

4. NERC and the NERC Standard Drafting Teams have the technical expertise to address complex technical issues such as legacy equipment limitations that FERC does not have.

Applicability Section, 4.2.2 – Recommend removing this section.

Requirement R1: The NAGF notes that R1 only addresses voltage ride through and should be revised to include frequency ride through as well. In addition, R1 should address frequency ride through limitations for legacy IBR facilities.

Measurement M1 – The proposed narrative reads more like requirements than measures; recommend to revise the narrative accordingly. In addition, the NAGF notes that the proposed narrative seems to assume that PRC-028 will be need to be approved/in place for PRC-029 to be a viable standard.

Requirement 2.1.3: The narrative is unclear as to what is expected for this proposed requirement. Request that the narrative be rewritten/restructured to address this issue. In addition, it is unclear which entity will define the preference for active or reactive power. The NAGF suggests that the Transmission Planner (TP) should have the authority to define this preference. This recommendation also applies to Requirement 2, second bullet and Footnote 6.

Requirement R2.5: The NAGF recommends that the narrative be revised to state that active power shall be restored when" the voltage at the high-side of the main power transformer returns to the Continuous Operating Region".

Requirement R4: The draft narrative does not clearly specify who is responsible for approving the exemption. The NAGF requests the narrative be revised to address this issue.

Measure M4: Recommend replacing the word "seeking: with "submitting" in the first sentence.

Likes 1	Scott Brame, N/A, Brame Scott
Dislikes 0	

Response

Karen Demos - NextEra Energy - Florida Power and Light Co. - 1,3,6

Answer	
Document Name	

Comment

Support NEE comments submitted

Likes 0	

Dislikes 0	

Response

Anna Martinson - MRO - 1,2,3,4,5,6 - MRO, Group Name MRO Group	
Answer	
Document Name	

Comment

PRC-024-4

No Comments, MRO NSRF is generally supportive of this proposed standard.

PRC-029-1

MRO NSRF recommends that the defined terms, Real Power and Reactive Power be used throughout the document instead of active power and reactive power.

Section 4, footnote 2 – MRO NSRF does not support using a definition for “inverter based resources” that differs from the what is currently being proposed by the standard drafting team responsible for developing the Glossary of Terms definition for this term. There must be alignment between standards prior to any of them being able to move forward.

Measure 1 – This measure is overly prescriptive and does not allow the applicable functional entity sufficient flexibility to demonstrate compliance with Requirement 1. MRO NSRF would recommend the standard drafting team review measures from PRC-024 and align with the approach taken there.

Measure 2 – This measure is overly prescriptive and does not allow the applicable functional entity sufficient flexibility to demonstrate compliance with Requirement 2. MRO NSRF would recommend the standard drafting team review measures from PRC-024 and align with the approach taken there.

Requirement 2.1.3 – This requirement is unclear in its intent. Additionally, allowing multiple entities to place potentially conflicting requirements upon an applicable functional entity is unacceptable. Either a single entity be tasked with the obligation, or a hierarchy be provided so that an entity is not placed in a “catch-22” situation.

Requirement 4 – MRO NSRF Recommends the following modifications to improve clarity:

Each Generator Owner and Transmission Owner identifying a facility that is in-service by the effective date of PRC-029-1, that has known hardware limitations which prevent the facility from meeting voltage Ride-through criteria as detailed in Requirements R1 and R2, and requires an exemption from specific voltage Ride-through criteria shall:

Measure 4 – MRO NSRF recommends changing “seeking” to “documenting” or “submitting”.

Additional comments:

1. The standard switches between BPS (bulk power system) and BES (bulk electric system). For consistency, one term should be used throughout the standard.

2. R1 bullet # 3: MRO NSRF recommends adding a footnote stating that the facility may operate in current block mode if necessary to avoid tripping for non-fault initiated phase jumps greater than 25 degrees

3. M1, M2, M3, and R4: consistent replace “Each Generator Owner and Transmission Owner” with “Each Generator Owner or Transmission Owner”

4. R2, 2.1.3: “The voltage is below 95 per unit” should be replaced by “The voltage is below 0.95 per unit”	
Likes 1	Lincoln Electric System, 3, Christensen Sam
Dislikes 0	

Response

Richard Vendetti - NextEra Energy - 5

Answer	
Document Name	

Comment

R1 “The instantaneous positive sequence voltage phase angle change is more than 25 electrical degrees at the high-side of the main power transformer and is initiated by a non-fault switching event on the transmission system” - *How is the GO of IBR going to identify the cause of the fault?*

R1 “The Volts per Hz (V/Hz) at the high-side of the main power transformer exceed 1.1 per unit for longer than 45 seconds or exceed 1.18 per unit for longer than 2 seconds.” – *What is the technical rationale behind the 45 second and 2 seconds? This is a very specific scenario as described in the “Technical Rationale”. Requests incorporating language that suggests where it applies.*

M1 *M1 requires multiple data requirements. It is not clear in language. Interpretation is that GO / TO should have evidence that design can meet as well as performance based evidence that it does or does not perform. The amount and time frame to collect evidence is not provided. Is the expectation that this data is only required for a specific event upon the data request?*

The language in R2 requirements does not explicitly state that changes in resource availability (i.e wind or sun) will also affect the active and reactive current or recovery of the IBR.

R2.5 “Each facility shall restore active power output to the pre-disturbance or available level (whichever is lesser) within 1.0 second when the voltage at the high-side of the main power transformer returns from the mandatory operation region or permissive operation region (including operating in current block mode)” *Recommend language updated to “continuous operating region”. IBR units will be limited in capabilities until transient has ended and IBR equipment is no longer sitting at its equipment limiters”*

It is not understood why requirement R1 exists when R2 has all the details. The standard appears to be first written as the test criteria for model validation. Secondly, as a standard to provide data that plant performance matches model. A standard practice guide on the method to demonstrate compliance through dynamic simulations, studies or other evidence is necessary before full adoption of new standard.

Attachment 1

Overall there are concerns with the PRC-029 implementation timeline for any requirement where the OEM has not had time to fully assess the new requirement and utilize the new IEEE2800 testing standard. New standard implementation needs to give GO/TO time to fully assess new requirements; in particular with the multiple disturbance criteria or method OEMs calculate values.

There is no R6

R3/M3 – All Measurement requirements should be confirmed as inclusion into the PRC-028 standard (RoCoF, V/Hz, Phase Angle, etc)

There is no instruction regarding requirement if IBR cannot meet R3 due to Equipment Limitation

R4 Implementation timeline is too short to assess all facilities with additional requirements in PRC-029. There is also not enough time to allow for OEM responses. Recommend tracking an implementation guideline similar to PRC-028 and PRC-030 to meet FERC deadline.

There is no instruction on process to report a new limitation after the full implementation of R4 when a piece of equipment within the IBR may temporarily limit the capability

R4.3 Each Generator Owner and Transmission Owner with a previously submitted request for exemption that replace the equipment causing the limitation shall document and communicate such an equipment change to the associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), and Reliability Coordinator(s) within 90 days of the equipment change

The language should be clear to state "full replacement". Should not be misinterpreted to include subcomponent replacement.

There is no R5

The Implementation timeline of this standard is the most concerning given the additional requirements generating new review of all facilities and the need to receive additional feedback from OEMs without new testing standard.

The performance data collection requirements will need to align with implementation timeline of PRC-028 at each facility.

A practice guide is highly recommended to demonstrate method and expectation for compliance.

Likes 0	
Dislikes 0	

Response

Robert Follini - Avista - Avista Corporation - 3

Answer	
Document Name	

Comment

Avista supports the development of a new Reliability Standard to address gaps in Inverter-Based Resource Performance but has concerns with numerous definitions/verbiage.

Likes 0	
Dislikes 0	

Response

Christine Kane - WEC Energy Group, Inc. - 3, Group Name WEC Energy Group

Answer	
Document Name	

Comment

R1*: Revise text as follows: "…each facility adheres to voltage Ride-through requirements…"*
WEC also disagrees with M1 and agrees with the comments made by NAGF and EEI.

R2: *WEC disagrees with text "…shall ensure the design and operation is such…". The requirement must state what TO and GO must do. Otherwise,*

this requirement is open-ended without a measurable statement. The "…shall ensure" has no quantitative meaning and it does not benefit the BES stability.

2.1: *The proposed "continuous operating region" range conflicts with acceptable continuous operating ranges by Transmission Operators. Many Transmission Operators classify continuous operating range from 0.95 and 1.05 pu, and consider voltage ranges from 0.9 to 0.95 pu and 1.05 to 1.1 pu as abnormal voltage ranges.*

2.1.1: *Continue to deliver the pre-disturbance level of active power or available active power, whichever is less.* ***Please explain and list what entity must do to ensure this requirement is met.***

2.1.2: *Continue to deliver reactive power up to its reactive power limit and according to its controller settings.* ***Please explain and list what entity must do to ensure this requirement is met.***

2.1.3: *What document governs a TP, PC, RC or TO to specify active/reactive power prioritization.*

2.3: *Term "current block mode" may not be understood and its meaning could be misinterpreted. Does it mean mandatory cessation? Please explain and at least define it in footnotes. Assuming this means momentary cessation, it looks like this requirement will allow momentary cessation if necessary to avoid tripping, OR, per 2.3.1 entity can enter current cessation for 5 cycles. It seems the statement contradicts itself.*

2.5: *WEC owns and operates multiple IBR sites and it is in our experience that the limitation to the one second requirement will come from the power plant controller. The ramp rate capabilities of the power plant controllers are far slower than inverter ramp rates and are typically in minutes range. WEC also had an instance where the power plant controller ramp rate increase was denied by the Transmission Operator/Planner. Applying one second requirement will simply be impractical and most entities will take equipment limitation exception that will not benefit the BES.* ***Unless stated in quantitative way (what and when) the requirement R2 provides no benefit to BES.***

M2: *The current version of M2 calls for dynamic simulations, studies, or other evidence* ***plus*** *having ACTUAL disturbance monitoring data proving the Requirement was met. The dynamic simulations/studies can be performed by third-party engineering contractors specializing in these activities to prove each site meets the first part. However, two questions must be addressed regarding actual data: (1) "How" actual data is acquired if SER, DDR and/or Fault Recording does not become mandated. NAGF made a similar point in their response.*
(2) "When" actual data must be submitted as evidence if we as GOs are not specifically asked for it by some other entity. Without some mandate for data, we as GOs are not going to know when every voltage disturbance that would have (should have) triggered a ride-through has occurred on the transmission system.

Attachment 1: *Are items 1 thru 10 requirements or they are notes supplementing Tables 1 and 2? Please define.*
More description needs to be provided on how to apply items 8, 9, and 10.

Attachment 2: *Are items 1 thru 5 requirements or they are notes supplementing Table 3? Please define.*
More description needs to be provided on how to apply item 5.

Likes 0	
Dislikes 0	

Response

Russell Ferrell - Luminant - Luminant Energy - 6	
Answer	
Document Name	
Comment	

. I support EEI's and Entergy's comments	
Likes 0	
Dislikes 0	
Response	
Dave Krueger - SERC Reliability Corporation - 10	
Answer	
Document Name	
Comment	
For the applicability section, suggest adding "that owns equipment as identified in section 4.2" after "generator owner" similarly to the proposed PRC-030-1	
Likes 1	Scott Brame, N/A, Brame Scott
Dislikes 0	
Response	
Selene Willis - Edison International - Southern California Edison Company - 5	
Answer	
Document Name	
Comment	
“See comments submitted by the Edison Electric Institute”	
Likes 0	
Dislikes 0	
Response	
Israel Perez - Israel Perez On Behalf of: Laura Somak, Salt River Project, 3, 6, 5, 1; Mathew Weber, Salt River Project, 3, 6, 5, 1; Thomas Johnson, Salt River Project, 3, 6, 5, 1; Timothy Singh, Salt River Project, 3, 6, 5, 1; - Israel Perez	
Answer	
Document Name	
Comment	

none.

Likes 0	
Dislikes 0	

Response

Robert Blackney - Edison International - Southern California Edison Company - 1

Answer	
Document Name	

Comment

See comments submitted by Edison Electric Institute.

Likes 0	
Dislikes 0	

Response

Patricia Ireland - DTE Energy - 4, Group Name DTE Energy

Answer	
Document Name	

Comment

No comments at this time

Likes 0	
Dislikes 0	

Response

David Jendras Sr - Ameren - Ameren Services - 1,3,6

Answer	
Document Name	

Comment

Ameren agrees with and supports EEI's comments.

Likes 0	
Dislikes 0	
Response	
Dwanique Spiller - Berkshire Hathaway - NV Energy - 5	
Answer	
Document Name	
Comment	

PRC-024-4:

· We support creation of new standard PRC-029 to address IBR specific ride through issues, as both the different natures of synchronous and inverter-based generation and several recent events exhibiting significant IBR ride-through deficiencies and failures the causes of which are not relevant to synchronous generators. The approach to address IBR issues should be different to that of PRC-024 because there are too many other factors and causes of IBR ride-through failure not directly related to voltage and frequency protection settings that may and have caused ride-through deficiencies and failures.

· PRC-028 was voted out due to issues around definition of IBR criteria and implementation plan. Separate PRC-029 would allow PRC-024 to pass through the ballot process without many issues.

PRC-029-1:

· Support inclusion of Ride through requirement in the TERM section, which will get included into NERC Glossary of Terms.

· In all the requirements **IBR** is replaced with **Facility**, except the requirement R2.2 as **IBR**. In attachment 1 it is mentioned as **inverter-based resource facility.** That is not consistent.

Likes 0	
Dislikes 0	
Response	
Michael Dillard - Austin Energy - 5, Group Name Austin Energy	
Answer	
Document Name	
Comment	

Austin Energy supports comments posted by NAGF:

PRC-029:

General Comment: The NAGF believes that PRC-029 should allow for frequency ride through ("FRT") exemptions similar to its treatment of voltage ride through ("VRT") exemptions. The justification for allowing VRT exemptions in FERC Order 901 also apply to FRT. We believe the statement in FERC Order 901, paragraph 193 in response to ACP/SEIA's comment in paragraph 188 does not preclude the standard drafting team from considering FRT

exemptions due legacy equipment limitations. Here are a few reasons why:

1. If FERC's intent was to exclude Frequency Ride Through exemptions while allowing Voltage ride through exemptions, there would be more of a record established to support this differential treatment.

2. FERC responded to ACP/SEIA's comment on ride-through requirements as if they were only asking about voltage ride through requirements. FERC made no mention of frequency ride through requirements.

3. Similar to FERC's rational for the consideration of voltage ride through exemptions, there are also older IBR technologies with hardware that would need to be physically replaced to meet frequency ride through requirements as well.

4. NERC and the NERC Standard Drafting Teams have the technical expertise to address complex technical issues such as legacy equipment limitations that FERC does not have.

Applicability Section, 4.2.2 – Recommend removing this section.

Requirement R1: The NAGF notes that R1 only addresses voltage ride through and should be revised to include frequency ride through as well. In addition, R1 should address frequency ride through limitations for legacy IBR facilities.

Measurement M1 – The proposed narrative reads more like requirements than measures; recommend to revise the narrative accordingly. In addition, the NAGF notes that the proposed narrative seems to assume that PRC-028 will be need to be approved/in place for PRC-029 to be a viable standard.

Requirement 2.1.3: The narrative is unclear as to what is expected for this proposed requirement. Request that the narrative be rewritten/restructured to address this issue. In addition, it is unclear which entity will define the preference for active or reactive power. The NAGF suggests that the Transmission Planner (TP) should have the authority to define this preference. This recommendation also applies to Requirement 2, second bullet and Footnote 6.

Requirement R2.5: The NAGF recommends that the narrative be revised to state that active power shall be restored when" the voltage at the high-side of the main power transformer returns to the Continuous Operating Region".

Requirement R4: The draft narrative does not clearly specify who is responsible for approving the exemption. The NAGF requests the narrative be revised to address this issue.

Measure M4: Recommend replacing the word "seeking: with "submitting" in the first sentence.

Likes 0	
Dislikes 0	

Response

Steven Rueckert - Western Electricity Coordinating Council - 10, Group Name WECC

Answer	
Document Name	

Comment

WECC suggests the DT should ensure that the labeling on the Project page of the Standard is accurate in terms of what is being considered. The "redline" version is not a true redline from PRC-024-3 it is a redline from a failed version of PRC-024-4 with the language that was voted down shown as "approved" (i.e., text appearing as not being changed.) This could be misleading. There is no mention of Attachment 2A or Attachment 2C in any of the Requirements. It is noted that there is a reference to Attachment 2B in the Quebec variance. Consider changing Requirement R2 language to

reference Attachment 2A and incorporate current Attachment 2A language into Attachment 2. And incorporate Attachment 2C language into Attachment 2B. That provides clarity with a minimal change in Requirement R2 language. In theory, this is a set it and forget it Standard unless something changes. The data retention should reflect that condition and not be limited. GOs and TOs will have to be able to demonstrate settings when requested and can not simply say "the settings were done 6 years ago so no evidence is retained". There have been cases where a GO has indicated retrieval of settings required a third party because the GO did not have documentation. Absence of a failure (i.e., unit trip that would need to be reviewed to see if voltage/frequency was the root cause and if the associated relay responded within the "no-trip" zone) is not necessarily a successful reliability indicator and would require quite a bit of data to demonstrate reliable operation resulting in compliance.

Overall for PRC-024-4 WECC is supportive of the efforts and end results.

PRC-029-1

It is unclear why lower cased "facility" is used. In Footnote 2 "facility" is not used but "plant/resource" is used. In the Technical Rationale "plant/facility" is used. Please provide consistency in language within the Standard, the Requirements, and Technical Rationale.

Facilities Section 4.2 is extremely unclear in that it simply says "IBR Registration Criteria" for 4.2.2. Additionally, Footnote 2 does not consider any hybrid resource types (or Facility types or plant types).

R1 indicates "design and operation" which is a valid approach but "design" can be assessed reviewing settings (and simulations, etc.) but "operation" can only be assessed through a review of time periods where applicable voltage (or frequency) demonstrates a change that calls for operation per the Tables. The VSL for R1 is written in a manner that requires that level of assessment (e.g., entities would have to find a point in time where .89 Voltage existed and show they exceeded the minimum Ride-through time.) The VSL is written where a design issue is a lower VSL but the wrong setting would indicate that the operation could not adhere to Attachment 1. Measurement M1 mentions SER/FR/DDR which are covered in PRC-028-1 (Project 2021-04). Are those enough to demonstrate operation to Attachment 1 under the criteria set in the Tables? With PRC-028-1 setting data retention levels so short, the evidence suggested by Measurement M1 will require retention per Evidence Retention requirements in PRC-029-1 to be able to clearly demonstrate compliance.

If using capitalized "Transmission System" in the definition of "Ride-through" use it capitalized in Requirement 1 bullet 3. PRC-024 had MPT and GSU used and "defined". Consistency in use here in PRC-029 (with appropriate changes) to correlate with PRC-024 is appropriate but should be footnoted in Requirement R1 bullets 3 and 4 first prior to being called out in Requirement R2.1.

Measurement M1 is expansive and some of the details should be in the Technical Rationale rather than in a measure. As is, appears to be not consistent and should, at a minimum, include the word "shall" where needed as others Standards (including PRC-024) are written in this manner (e.g.",….shall have evidence…"). M1 does not mention bullet 2.

Requirement 2 will require a voltage excursion to demonstrate operation adhering to Attachment 1. What criteria constitutes a "voltage excursion"?
Requirement 2.1- Consider adding a comma after "region" to be consistent with similar language in other parts of Requirement R2.

Requirement 2.1.1 The phrase "or available active power, whichever is less" appears to be supportive of the footnote regarding a frequency excursion but what if the "available active power" is lower than the pre-disturbance level of active power. "Less" could be zero output as the voltage at the MPT high-side could remain within the continuous operation range with the IBR disconnected.

Requirement 2.1.3 Please verify if that should be ".95" per unit versus "95" per unit. Since this Requirement is within the Operations Horizon timeline, the reference to Transmission Planner and Planning Coordinator should be dropped. Furthermore, it is not clear what a GO would operate to if given conflicting orders by the RC and TOP. Consider limiting the "preference" to the TOP who is to set the system voltage expectations per VAR-001.

Requirement 2.2.- Consider "sub Part" formatting used in other Requirements versus bullets for consistency. Since this Requirement is within the Operations Horizon timeline, the reference to Transmission Planner and Planning Coordinator should be dropped. Furthermore, it is not clear what a GO would operate to if given conflicting orders by the RC and TOP. Consider limiting the "requirement" to the TOP who is to set the system voltage expectations per VAR-001. In this bullet the language says "each IBR" versus "each facility" as called out in other parts of Requirement R2. Is that correct?

Requirement R4 is a grandfathering clause and assumes each unit after the effective date will meet Requirements 1, 2, and 3. There should not be any additional implementation timeline built into a Requirement language as this Standard will take time to be approved and there is a proposed 6 month

Implementation Plan. If there is a hardware limitation, it should be known Day 1 of the effective date of Standard and gathering of the limited information should have already been don ein the 6 months leading to the effective date. There is no requirement for an entity to replace the hardware limitation. The entire Requirement will result in documentation with no expectation of mitigation. What data does the DT have to support this exemption language? At a minimum, notification of an issue needs to be provided to the TOP and RC. Suggest a Corrective Action Plan with definitive time requirements to mitigate the issue (or explain why it can not be mitigated) be instituted here.

Footnote 9 may not be necessary as non-US Jurisdictional applicable government authorities have mechanisms in place to implement any Standard.

Within Requirement R4.1- 4.1.1- Call out specifics for consistency. Leaving as “other” invites inconsistency. Use “Ride-through” as that is a proposed defined term (versus “ride-through”) in 4.1.2. Be consistent in using “hardware” or “equipment” to avoid confusion throughout Requirement R4. Suggest removing the phrase “or that the limitation cannot be removed by software updates or setting changes” as this is limited to a hardware limitation exemption. Requirement R4.1.5 is ambiguous and clarity should be provided. Requirement 4.2 It is not clear why the Planning Coordinator and Transmission Planner is included here. Model data demonstrating the limitation should be provided through another mechanism. Including the Regional Entity here is not needed or recommended as Regional Entities are NOT subject to Standards. If the DT wants to include providing information to the Regional Entity place it in “Additional Compliance” section (similar to FAC-003) and recognize it as a data submittal. Recommend removal of Regional Entity from the Requirement language.

Measure M4 does not support Requirement R4 with regards to notification timeline in Requirement R4.3, sentence regarding submission of information in 4.1 should not be limited to the Regional Entity (alternatively that sentence could be removed as Regional Entity is covered in next sentence), and there is no information regarding the response timeline in 4.2.1. Furthermore, “experience from an actual event” indicates that the GO/TO could not adhere to the design and operation criteria set—equating to a possible noncompliance. If there is a hardware (or “equipment” depending on where consistency efforts lead) limitation that should be known in the design phase and addressed at that point

There is no corresponding frequency “hardware” limitation language if a facility can not adhere to Attachment 2.

Evidence Retention Section- Requirement R4 has no obligatory requirement to mitigate the hardware(equipment) limitation. As such, entities should be obligated to maintain information demonstrating compliance until the issues are mitigated. There should be language within the Requirement to correct the issue within a certain timeframe. As is, data demonstrating compliance for R4 would not be retained after 5 years and the entity would be held to performing per R1, R2, and R3 in subsequent compliance monitoring efforts unless tracking (and verification of compliance to R4) existed.

Attachment 1- Consider lowercasing “Through” in Table titles as it is part of the proposed defined single word “Ride-through”. Consider lowercasing “Continuous Operating Region” as it is not a defined term nor is it capitalized in the Requirement language. Table 1 cannot have “1.1” and “1.10” be in the Mandatory Operation Region and Continuous Operation Region at the same time (e.g., the mathematical operator shows inclusion.) “1.1” should be shown a “1.10” for consistency. Footnote 10 is unclear as Type 3 and Type 4 wind turbines are IBRs and the use of “directly” in the footnote could leave some entities with Type 3 and Type 4 wind turbines to use Table 2. Simply say it is for Type 3 and Type 4 and leave the AC-Connected and directly connected verbiage out to avoid confusion. Note- Anytime a DT says it is clear the issue gets pushed into the compliance environment where suddenly no clarity exists. IBR is a definitive example of clear technical understanding but extremely unclear understanding when applying a compliance lens.

“Voltage Source Converter High Voltage Direct Current” is not defined nor explained. There are inconsistencies in how “Voltage Source Converter High Voltage Direct Current” is displayed—Footnote 1 is lower cased “v” and contains a hyphen after “High”; Bullet 3 does not have a hyphen in “VSC HVDC but bullet 2, Footnote 1, and Footnote 2 does.

Need to be consistent with the depiction of the Figures (in Attachment 2) in terms of what the boundary line depicts (inclusion or exclusion within the “Regions”) as entities have struggled in the past versions of PRC-024 (and others). Figure 1 does not depict the 1.1 Voltage point and therefore appears to not support the Table (consider moving the 1.05 down to the boundary between the “1800 second” section and “no time requirement” section depiction while adding 1.1 to the upper boundary of the “1800 second” section.

Figure 2 does not reflect 1.05 Voltage point so the “1800 second" section appears to not be depicted appropriately. Consider adding the 1.05 Voltage point to the y-axis and redraw boundaries for “1800 second” section and “no time requirement” section. 1.05 should be the upper boundary of the “no time requirement” section. To provide consistency and clarity, Table 2 X-axis values should reflect the table values as Figure 1 reflected those (for Table 1) (i.e., show .32 and 1.2).

Since this is an Operating Horizon based Standard why would Bullet 5 depend upon the PC or TP? Bullet 5 and Bullet 6 do not use the same language (use of hyphens, use of neutral, use of ground). Is the intent of Bullet 10 to supersede Bullet 8 (i.e., does not matter is the time associated with the 4

deviations is below the time associated with the voltage?)

Attachment 2- Consider lowercasing “Through” in Table titles as it is part of the proposed defined single word “Ride-through”. Table 3 should reflect consistency in the System Frequency column. The frequency slot between 58.5 and 58.8 is not covered (suspect the 6th row needs adjustment as it is referencing the same frequency point—58.8). Additionally, it appears that there may be inconsistency in mathematical operators inclusion or exclusion of certain ranges. DT needs to confirm where 58.8 resides in terms of allowed time. Consider the Table below with bolded changes. For consistency with Voltage tables “N/A” versus “may trip” is suggested and for consistency the DT may consider a footnote as Tables 1 and 2 did in Attachment 1 regarding voltage.

System Frequency (Hz)

Minimum Ride-Through Time (sec)

≥64

N/A

< 64 and ≥61.8

6

< 61.8 and ≥ 61.5

299

< 61.5 and > 61.2

660

≤ 61.2 and **>** 58.8

Continuous

≤ 58.8 and **≥ 58.5**

660

< 58.5 and ≥ 57

299

< 57.0 and ≥ 56

6

< 56

N/A

PRC-024 had “MPT” and “GSU” used and “defined”. Consistency in use here in PRC-029 (with appropriate changes) to correlate with PRC-024 is appropriate.

VSLs- Requirement R1--DT should consider a different method to assign levels. While the Requirement language may say “each” perhaps a consideration for the VSL should be fleet-based. As written, the DT has created a “zero” tolerance Requirement. If the design is wrong the operation would be incorrect. Proving that should not take an event to demonstrate (as the compliance argument this will set up is that “there has not been a

period where operation would have occurred").

Requirement R2 and Requirement R3- Essentially same comments as VSLs for Requirement R1

Requirement R4- The notification timeframe appears to be initially set at 30 calendar days for all the VSLs (with adjustments considering the 30 calendar day foundation) but the Requirement R4 language indicates a foundation of "90 days" (also an issue noted in Measurement M4). With the timeframes associated

Implementation Plan—The last sentence regarding Requirement R4 needs to be struck or incorporated within the Requirement language. Requirement R4 says "hardware limitations" and does not specify the "coordinated protection and control settings". To be clearer the DT should consider changing Requirement R4 language to "inability to modify coordinated protection and control functions". There is a gap between the language regarding provision of a "copy to applicable entities" in the Lower VSL and what is in the Severe VSL. Effectively the Severe VSL covers 15 month plus 1 day to beyond 24 months. Is that the intent of the DT?

Likes 0	
Dislikes 0	

Response

Gail Elliott - Gail Elliott On Behalf of: Michael Moltane, International Transmission Company Holdings Corporation, 1; - Gail Elliott

Answer	
Document Name	

Comment

Response from ITC Holdings:

"IBR Registration Criteria" is not an applicable Facility.

The applicabilities of PRC-028, PRC-029, and PRC-030 need to be aligned. E.g. A TO that owns the VSC-HVDC connection for offshore wind is subject to PRC-029 but not PRC-028 or PRC-030.

R1 has no value as a standalone requirement and should be incorporated into R2. In other words, you can't violate R1 without also violating R2, so eliminate R1 or incorporate its subtle value into R2.

Likes 0	
Dislikes 0	

Response

Hillary Creurer - Allete - Minnesota Power, Inc. - 1

Answer	
Document Name	

Comment

Minnesota Power supports EEI's comments.

Likes 0	
Dislikes 0	

Response

Rachel Coyne - Texas Reliability Entity, Inc. - 10

Answer	
Document Name	

Comment

Texas RE has the following comments on the PRC-024-4 draft:

- Requirements R1, R2, and R4 use the term 'Facility' when referencing synchronous generator, type 1 or type 2 wind resource, or synchronous condenser. Requirement R3, however, uses a description of the Facility. Texas RE recommends using the term Facility to be consistent with the other requirements. Texas RE recommends the following revision (in bold):

R3. Each Generator Owner and Transmission Owner shall document each known regulatory or equipment limitation that prevents **an** its **synchronous generator, type 1 or type 2 wind resource, or synchronous condenser Facility**, with applicable frequency or voltage protection from meeting the protection setting criteria in Requirements R1 or R2, including (but not limited to) study results, **technical incapability identified after** experience from an actual event, or manufacturer's advice.

'Technical incapability identified after' language is added to clarify that the Facility Owner must conduct detailed analysis to ensure that the Facility is technically incapable of providing the required system support and the specific technical limitations should be documented.

- Please update footnote 4 (Requirement 2.1) on page 5 of 22 (clean version) - changes in bold font:

Frequency, voltage, and volts per hertz protection (whether provided by relaying or functions within associated control systems) that respond to electrical signals and: (i) directly trip the synchronous generator(s), type 1 or type 2 wind resource(s), or synchronous condenser(s); or (ii) provide signals **to same** to trip **the same Facilities**.

- In Requirement R4, Texas RE recommends that each Generator Owner and Transmission Owner shall provide its applicable protection settings to Planning Coordinator *and* Transmission Planner. The applicable data should be provided to both the Planning Coordinator and Transmission Planner so the study model(s) used by Planning Coordinator and Transmission Planner can be updated concurrently. Texas RE recommends the following revision (in bold):

R4. Each Generator Owner and Transmission Owner shall provide its applicable protection settings associated with Requirements R1 and R2 to the Planning Coordinator **or and** Transmission Planner that models the associated Facility within 60 calendar days of receipt of a written request for the data and within 60 calendar days of any change to those previously requested settings unless directed by the requesting Planning Coordinator or Transmission Planner that the reporting of protection setting changes is not required. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

It is important that the applicable data is provided to the Planning Coordinator and Transmission Planner so that the study model(s) used by PC and TP can be updated concurrently.

- Technical Rationale document - Texas RE recommends the Facilities section include the Frequency and Voltage Protection Settings for Type 1 and Type 2 Wind Resources in addition to the Synchronous Generators and Synchronous Condensers in the title document since they were

added to section A 4.2.1.4 of the standard. Texas RE recommends the following revision (in bold):

Facilities (4.2)

Applicability Facilities subparts in Section 4.1**2**.1 were modified to restrict PRC-024-4 to synchronous generators **and Type 1 and Type 2 Wind Resources**. Section 4.2.2 was added as new subparts to identify which synchronous condensers and equipment.

PRC-029-1 Comments

- Ride-through definition: Ride-through capability is the ability of the resource to continuously deliver power during a disturbance event. It appears the phrase 'continuing to operate' used in the Ride-through definition is intended to state that the Facility needs to deliver power in response to system conditions. Texas RE recommends the following revision (in bold):

Ride-through: Remaining connected, synchronized with the Transmission System, and continuing to operate **by delivering power** in response to System conditions through the time-frame of a System Disturbance.

Applicability Section 4.2.1: Footnote 2 refers to 'offshore wind plants connecting via dedicated VSC-HVDC". Texas RE recommends revising this footnote to include offshore and on-land VSC-HVDC. Texas RE recommends the following revision (in bold):

For the purpose of this standard, "inverter-based resources" refers to a collection of individual solar photovoltaic (PV), Type 3 and Type 4 wind turbines, battery energy storage system (BESS), or fuel cells that operate as a single plant/resource. In case of **offshore any** wind plants connecting via a dedicated VSC-HVDC, the inverter-based resource includes the VSC-HVDC system.

- Applicability Section 4.2.2: Texas RE recommends revising the verbiage to "**Resource which meets** IBR Registration Criteria".

- Requirement R1: Texas RE recommends clarifying the first bullet to state that the facility is electrically disconnected in order to clear a fault within its protection zone as designed. Texas RE recommends the following revision (in bold):

The facility needed to electrically disconnect in order to clear a fault **within its zone of protection as designed**;

- Measures: Texas RE noticed the Measures for IBRs in PRC-029-1 are more burdensome than the Measures for synchronous generators in PRC-024-4. Though Measures are not enforceable, they are instructive in which activities could be used to demonstrate compliance with a Requirement. For synchronous generators in PRC-024-4, the Measures indicate that a Generator Owner or Transmission Owner can demonstrate compliance by providing a settings sheet or supporting calculations, or the synchronous generator can instead rely on dynamic simulation studies. In contrast, the Measures in PRC-029-1 indicate that the IBR shall have dynamic simulations, studies, or other evidence to demonstrate the design of each Facility, and the Measures also indicate that the IBR shall have evidence of actual disturbance monitoring to demonstrate performance of the Facility in actual historical Ride-through events. These Measures appear to be more burdensome for IBRs than for synchronous generators and also appear to suggest obligations exist beyond what is stated in the enforceable Requirement text.

- Measures: Since the measures are not enforceable, Texas RE encourages the SDT to consider removing shall statements from the measures. Texas RE recommends using similar verbiage to the measures in the CIP standards, which say "Examples of evidence may include, but are not limited to…"

- Measure M1: The first sentence in Measure M1 shows the word "shall" removed, but nothing was put in its place. Is that the intent of the SDT?

- Requirement Part R2.1.3: Texas RE recommends revising Requirement Part 2.1.3 from passive to active voice so it is clear that the Generator Owner or Transmission Owner is the entity giving preference. Texas RE recommends the following revision (in bold):

If the facility cannot deliver both active and reactive power due to a current or apparent power limit or reactive power limit, when the applicable voltage is below 95% per unit and still within the continuous operation region, **then the Generator Owner or Transmission Owner shall give preference to active or reactive power as** required by the Transmission Planner, Planning Coordinator Reliability Coordinator, or Transmission Operator.

- Requirement Part 2.5: If a small number of the inverters or turbines trip offline at a facility during a fault while the voltage remains in the mandatory operation region, will that facility be in violation of Requirement R 2.5?

- Requirement R4: Texas RE noticed Requirement R4 does not provide an opportunity for legacy Facilities to identify an equipment limitation after 12 months from the effective date of PRC-029-1. PRC-029-1 R1 provides an exception for IBRs that document equipment limitations in accordance with R4. In PRC-029-1 R4, a Facility that existed before the effective date of PRC-029-1 shall identify and document information supporting identified hardware limitations no later than 12 months from the effective date of PRC-029-1. Is the intention that equipment limitations identified after this 12-month window will not be eligible for the exception in PRC-029-1 R1? For a Facility that identifies an equipment limitation in the 13th month or beyond, does the SDT intend for that IBR to still be able to document the equipment limitation and qualify for the exception in R1, albeit with the obligation to submit a Self-Report for failing to meet the 12-month deadline in R4? Alternatively, does the SDT intend that an IBR that does not identify an equipment limitation within the 12-month window should never be able to qualify for the exception in R1?

- Requirement R4: Texas RE recommends the measures include evidence that the Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), Reliability Coordinator(s), and to the Regional Entity the documented information supporting the identified hardware limitation.

- Attachment 1: Figure 1: Voltage Ride-Through Requirements for AC-Connected Wind Facilities graphical representation should be corrected to match Tables 1 and 2. The continuous operating region is between 1.05-0.9 and Continuous Operating Region (1800 seconds) time delay is greater than 1.05-1.1 voltage level. In Figure 1, Texas RE recommends adding 1.1 above 1.05 in the Continuous Operating Region (1800 seconds). In Figure 2, Texas RE recommends replacing 1 with 1.05.

- Attachment 2: Frequency Ride – Through Criteria table 3 should be updated to reflect the correct low frequency levels for 660 seconds time delay.

≤ 58.8 and < 58.8 58.5

- Page 16 onward: The Mandatory Operation Region and Continuous Operation Region phrases should be lowercase to match changes made to rest of the standard.

Texas RE noticed the word “facility” is lowercase throughout (redline shows it replaces IBR, e.g. in R1). If the intent is to be consistent the applicability, Texas RE recommends using the term “applicable facility” to refer back to 4.2 Applicability section.

Likes 0	
Dislikes 0	

Response

John Pearson - ISO New England, Inc. - 2

Answer	
Document Name	

Comment

ISO New England signs onto comments of the Standard Review Committee of the ISO/RTO Council.

Likes 0	

Dislikes 0	

Response

Richard Jackson - U.S. Bureau of Reclamation - 1	
Answer	
Document Name	

Comment
• Bureau of Reclamation (BOR) notes that PRC-024-4 draft 2 is redlined to the draft 1 (clean version). Draft 2 has accepted all of the redlines from Draft 1, yet the ballot for Draft 1 was below the two-thirds majority of the weighted Segment votes requirement for approval per Appendix 3A of NERC's standard process manual V5 dated 11-28-2023. • Recommend SDT provide a separate comment form for each Standard under development. • PRC-029-1 is not applicable to BOR. • BOR recommends an 18-month implementation timeline for both standards.

Likes 0	
Dislikes 0	

Response

Ruchi Shah - AES - AES Corporation - 5	
Answer	
Document Name	

Comment
• AES CE fully supports the SEIA working group and other industry comments on allowing exceptions for frequency ride through. • AES CE is concerned by the updated language in several Measures reading "Each Generator Owner and Transmission Owner have evidence of actual disturbance monitoring…" and believe that the simulations and studies used to demonstrate compliant design should be sufficient, similar to PRC-024. There will be many plants that do not experience an applicable disturbance before this Standard becomes effective and therefore cannot demonstrate adherence to ride-through requirements as prescribed. We are also concerned about expectations for this Measure as time goes on, are we expected to document and record every applicable disturbance and the asset's performance? Additional clarification is required if the Drafting Team believes that actual disturbance monitoring language should remain in the Measures. • The required protection is not currently modeled in basic models and will require substantial effort to ensure we can perform as required. AES CE requests that the Implementation Plan be modified to use a phased-in approach for existing sites to allow adequate time to prepare for these performance requirements. We suggest that the Implementation Plan for PRC-029 should align or lag the Implementation Plan for PRC-028.

Likes 0	
Dislikes 0	

Response

Scott Thompson - PNM Resources - Public Service Company of New Mexico - 1,3,5 - WECC	
Answer	

Document Name	
Comment	
PNM agrees with the comments made by EEI.	
Likes 0	
Dislikes 0	
Response	
Carver Powers - Utility Services, Inc. - 4	
Answer	
Document Name	
Comment	
The term “active power” is not defined and appears to be used in conjunction with Real Power. Recommend consistency throughout the standards when using Real Power vs active power, such as MOD-025, BAL-001, and many others. Recommend the DT reevaluate the implementation period of 6 months. Recommend making implementation period 18 months or greater to account for the need for working with OEMs to implement any setting changes and the need for IBR settings reviews conducted by third parties, as necessary.	
Likes 0	
Dislikes 0	
Response	
Daniel Gacek - Exelon - 1	
Answer	
Document Name	
Comment	
Exelon supports the comments submitted by the EEI.	
Likes 0	
Dislikes 0	
Response	
Constantin Chitescu - Ontario Power Generation Inc. - 5	
Answer	

Document Name	

Comment

OPG supports NPCC Regional Standards Committee's comments.

Likes 0	
Dislikes 0	

Response

Mark Gray - Edison Electric Institute - NA - Not Applicable - NA - Not Applicable

Answer	
Document Name	

Comment

EEI offers the following Comment to Draft 2 for PRC-024 and PRC-029.

PRC-024-4 Comments:

EEI has no substantive concerns with any of the proposed changes to PRC-024-4 but point out a minor typo in Requirement R2 (below).

R2. Each Generator Owner and Transmission Owner shall set applicable voltage protection in accordance with PRC-024-4 Attachment 2, such that the applicable protection does not cause the Facility to which it is applied **to** trip within the "no trip zone" during a voltage excursion at the high-side of the GSU or MPT, subject to the following exceptions: [Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]

PRC-029-1 Comments:

While EEI appreciates that changes made to address our previous comments for the 1st draft of PRC-029-1, we have some new concerns that need to be addressed.

Our high level concerns are described in our comments below:

1. The Standard attempts to redefine the approved definition of IBR by adding VSC-HVDC systems after the IBR definition was approved by the industry.
2. The Standard adds TOs to this Standard solely to address VSC-HVDC systems, yet no technical justification has been provided. Moreover, these systems were not identified in FERC Order No. 901, or this SAR and they were not clearly identified in the Applicability Section of this proposed Reliability Standard.
3. EEI is concerned with the inclusion of requirements that are not clearly defined or set by multiple registered entities (i.e., TP, PC, RC, or TOP). This creates regulatory confusion and places IBR-GOs in a position where they may need to comply with any number of entities without clearly defining who is responsible. (See Requirement R2, subpart 2.1.3; subpart 2.2 (bullet 2); subpart 2.5) Moreover, the identification of multiple entities who could be responsible creates a situation where IBR-GOs will have reporting obligations to multiple entities because no single entity is identified as being responsible. (See requirement R4, subparts 4.2 & 4.2.1; subpart 4.3) We further note that none of the entities identified (i.e., TP, PC, RC, or TOP) are identified within the Applicability section of this proposed Reliability Standard. All of this can create confusion and places a considerable burden on the IBR-GOs that needs to be resolved and clarified.
4. Throughout this Reliability Standard there is use of non-glossary terms (i.e., active power vs. Real Power) where glossary terms are available and should be used. While in other cases glossary terms are used but not capitalized. (e.g., reactive power vs. Reactive Power) Greater efforts should be made to use NERC Glossary terms where appropriate and capitalize those terms, as required.

Detailed Concerns

Ride-through Definition Comments:

EEI does not support the proposed definition for “Ride-through” as proposed because it is too vague and contains no defined limits, as proposed. We recommend the following changes:

Ride-through: Ability to withstand voltage or frequency Disturbances within defined regulatory limits remaining connected, synchronized with the Transmission System, and continuing to operate**.**

Applicability Section Comments:

Footnote 1: EEI does not support adding TO that own VSC-HVDC systems because this was not a scope item and is therefore not be included in the scope of this SAR. Moreover, Footnote 1 conflicts with Footnote 2 which defines VSC-HVDC as an IBR, which is again does not in alignment with the approved definition of an IBR.

Footnote 2: EEI does not support Footnote 2 because it expands the definition of IBRs beyond what was recently approved by the industry, noting the expansion of IBRs to include VSC-HVDC. Furthermore, there was no technical justification for adding VSC-HVDC and the SAR did not include adding VSC-HVDC systems to this project. For this reason, we ask that the definition of IBR not be expanded through footnotes and suggest that the DT submit a technical justification for adding VSC-HVDC systems to the applicability section of this Standard, rather than redefining an approved definition in a footnote.

To address our concerns related to Footnotes 1 & 2 we suggest that if VSC-HVDC systems are to be classified as IBRs, then the approved definition should be pulled by NERC and resubmitted with those resources added to the definition and resubmitted to the industry for approval. Alternatively, VSC-HVDC systems could be defined separately, and that definition submitted to the industry for approval. In both cases, a technical justification should be provided to the industry that defines the issues and risks to BPS reliability that VSC-HVDC systems pose.

EEI suggests that if the DT believes that certain IBR capabilities as identified under Requirement R2 need (or may need) to be specified then they should identify the entity who should be responsible among the four identified (i.e., TP, PC, RC or TOP); add them to the applicability section of this Reliability Standard; add clear requirements and adjust the reporting obligations for the IBR-GO under Requirement R4.

Requirement R1 & R2 Comments: EEI does not agree with the inclusion of Transmission Owners because they would only have an obligation under this Reliability Standard if VSC-HVDC systems were included. Given we do not support the inclusion of VSC-HVDC systems without a technical justification and modified SAR, we ask that Transmission Owners be removed from Requirement R1.

Additional Requirement R2 Comment: EEI suggests that there should be clearer linkage between Requirement R1 and R2. We are also concerned that R2 only exempts documented equipment limitations but does not also include the exemptions provided within R1. To address these concerns, we offer the following edits to Requirement R2:

R2. Each Generator Owner shall ensure the design and operation **of** the voltage performance **of its IBR Facilities** adheres to the following **conditions** in accordance with Requirement **R1**. [Violation Risk Factor: High] [Time Horizon: Operations Assessment]

EEI also suggests that the “each facility” be replaced with “IBR Facilities” because the use of the uncapitalized version of facility is too broad, making compliance requirement unclear.

Measures M1 & M2: EEI is concerned that M1 & M2 contains measures that are overly prescriptive providing little discretion to IBR-GOs in demonstrating their compliance with Requirements R1 and R2 that seem to align more with a Requirement than a Measure. To address our concerns, we offer the following suggested changes to M1 and suggest similar changes be made to M2:

M1. Each Generator Owner **shall** have evidence **that supports the** Ride-through **capability of each of their facilities**, as specified in Requirement R1. (e.g., simulations, studies, recorded data from disturbance monitoring equipment, etc.) If the Generator Owner choose to utilize Ride-through exemptions that occur within the “must Ride-through zone” and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner **shall** also have evidence **supporting that exemption. (e.g., studies, simulations or supporting data from disturbance**

monitoring equipment)

Requirement R3 & R4: EEI does not support the inclusion of Transmission Owners within Requirements R3 & R4 for the same reasons identified above.

Likes 0	
Dislikes 0	

Response

Tim Kelley - Tim Kelley On Behalf of: Charles Norton, Sacramento Municipal Utility District, 3, 6, 4, 1, 5; Foung Mua, Sacramento Municipal Utility District, 3, 6, 4, 1, 5; Kevin Smith, Balancing Authority of Northern California, 1; Nicole Looney, Sacramento Municipal Utility District, 3, 6, 4, 1, 5; Ryder Couch, Sacramento Municipal Utility District, 3, 6, 4, 1, 5; Wei Shao, Sacramento Municipal Utility District, 3, 6, 4, 1, 5; - Tim Kelley, Group Name SMUD and BANC

Answer	
Document Name	

Comment

Regarding PRC-024-4, SMUD has no comments and supports the Standard Drafting Team (SDT) in this latest version of the Standard.

Regarding PRC-029-1, SMUD has the following comments:

1) The voters in Project 2020-06, Inverter-based Resource Glossary Terms draft #2, approved the definition of IBR on April 8, 2024, which is different than the definition proposed in Footnote 2 of PRC-029-1. Using the term “inverter-based resources” and defining it with Footnote 2 is inefficient and would create two definitions for the same resource.

The SDT of PRC-029-1 should coordinate with the SDT of Project 2020-06, and NERC staff, to ensure the definition of IBR and new PRC-029-1 are submitted to FERC simultaneously thereby eliminating another ballot for PRC-029-1 to add the NERC Glossary Term for IBR into the standard and eliminate confusion between IBR and “inverter based resources.”

2) Requirement R2.2, the term “IBR” should be replaced with “facility” to be consistent with the rest of the Standard. As currently written, Requirement R2.2 states “While voltage at the high-side of the main power transformer is within the mandatory operation region as specified in Attachment 1, each ***IBR*** [emphasis added] shall…”

3) Requirement R2.1.3 should specify only one entity. As currently written, this sub-requirement gives Transmission Planners, Planning Coordinators, Reliability Coordinators, or Transmission Operators the ability to require the facility to deliver active or reactive power. The SDT should make it clear which single entity can set the requirement to avoid any conflicts.

4) Measure 1 and Measure 2 contain the language “Each Generator Owner and Transmission Owner also have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data ***to demonstrating that the operation of each facility did adhere to performance requirements*** [emphasis added]…”

Some facilities may not have sufficient data from actual system disturbances by the time this Standard becomes mandatory and enforceable. The SDT should allow for the use of simulations and studies to demonstrate compliant design, similar to PRC-024, in such cases where the facility does not have evidence of an actual disturbance.

Likes 0	
Dislikes 0	

Response	
Kyle Thomas - Elevate Energy Consulting - NA - Not Applicable - NA - Not Applicable	
Answer	
Document Name	
Comment	

Elevate appreciates the opportunity to comment on the draft NERC standards, particularly those pertaining to future IBR NERC Reliability Standards and FERC Order No. 901 directives.

Adoption of, or Alignment with, IEEE 2800-2022

Elevate continues to strongly encourage NERC to reconsider adoption of IEEE 2800-2022. The unwillingness to adopt IEEE 2800-2022 by NERC is leading to entirely duplicative efforts that are not serving any additional value as compared to the work conducted in the IEEE 2800-2022 developments. It does not appear that a holistic approach and strategy is being taken to meet the FERC Order No. 901 directives, which is leading to very low ballot scores, significant rework, and misalignment with industry recommended practices.

The draft NERC PRC-029 is duplicative with IEEE 2800-2022 Clause 7 yet only covers a small fraction of the IBR-specific capability and performance requirements outlined in that clause. Therefore, there is no clear reliability benefit versus the cost of implementation PRC-029 as compared with IEEE 2800-2022 and the recommendations set forth in the NERC disturbance reports and guidelines.

Elevate strongly recommends a single NERC standard that adopts IEEE 2800-2022 in a uniform and consistent manner. NERC can also issue a reliability guideline or implementation guidance that supports industry implementation of the standard. Rather than recreate parts of IEEE 2800-2022 inconsistently over multiple different standards, Elevate recommends a singular standard for BPS-connected IBR capability and performance requirements related to IEEE 2800-2022. Additional NERC standards can be developed where needed in situations where they are not covered directly with IEEE 2800-2022 (e.g., NERC PRC-030).

Concerns with Draft PRC-029

If the draft PRC-029 standard is to be pursued as currently structured, Elevate would like to highlight the following concerns:

Inconsistencies with PRC-029 and IEEE 2800-2022: There are numerous inconsistencies in the draft standard language and attachment 1 and 2 when compared to IEEE 2800-2022. These should be considered and reviewed for clarity and completeness in the standard. The option to cite IEEE 2800-2022 and use the requirements in the IEEE 2800-2022 directly should be allowed over just the use of Attachment 1/2 (i.e. give each GO/TO the ability to use either of these guides to base their performance off on).

IEEE 2800 identifies the following items, but the standard does not support. Clarification/review should occur for each of these items:

IEEE 2800 recognizes FRT requirement limitations, but the standard does not.

IEEE 2800 recognizes exceptions for Negative-sequence voltage exceeding thresholds

IEEE 2800 recognizes Volts/Hz limitations, but the standard does not.

IEEE 2800 recognizes 500kV system voltages are actually operated in the range of 525kV and therefore has equipment rated to 550kV. These 500kV operating conditions should be considered in the standard.

In IEEE 2800 the frequency ride-through criteria defines 10-minute time periods whereas the standard defines them in a 15 minute time period (Table 3 of Attachment 2). This should be clarified and identified.

Attachment 1: Voltage Ride-through criteria has issues that should be corrected. Row 2, voltage (per unit) has an error, the mathematical operand should be “greater than” for the 1.10 value; this entry should read “=< 1.20 and > 1.10”.

Attachment 1: frequency ride-through criteria should be updated to fully match with IEEE 2800. Creating a different FRT ride-through curve without adequate technical justification will continue to challenge the industry.

The SDT should consider allowing for FRT and V/Hz exemptions, similar to what is already in place for VRT exemptions. Legacy equipment limitations apply to FRT, V/Hz, and VRT ride-through requirements, so exemptions should be allowed for both.

The standard should be updated to explicitly state that the voltage ride-through curves are to be interpreted as voltage vs time duration as is stated in IEEE 2800. This is to ensure that there is no incorrect interpretation that these curves are “envelope” curves. This could be done by adding a new note to explicitly call out the voltage vs time duration interpretation of the curves.

Alignment with FERC Directive for IBR Registration: BPS-connected/non-BES IBRs should be applicable to this standard, as it aligns with the FERC order activities and the on-going NERC Registration effort to incorporate the non-registered BPS-connected IBRs that are owned/operated by the new proposed Category 2 GO and GOP entities. Exclusion of these BPS-connected resources would significantly limit the ability to ensure that all BPS-connected IBRs have adequate voltage and frequency ride-through requirements during BPS/BES disturbances.

Alignment with NERC Glossary Definitions for IBRs: Creating a new definition for “inverter-based resources” is not aligned with the on-going IBR standard related work throughout NERC. By creating a new definition, it seems counter-productive to have a unique definition of IBRs and IBR units under the different NERC standards. Having all standards aligned to the new core NERC Glossary definition for IBRs will make all this standard development work, execution of the standards, and compliance activities more efficient for all entities involved.

Likes 0	
Dislikes 0	

Response

Colin Chilcoat - Invenergy LLC - 6

Answer	
Document Name	

Comment

Thank you for the opportunity to provide comments and for your work on this project. Invenergy provides the below comments for the Drafting Team to consider:

R1: In response to industry comments, the SDT indicated that Requirement R5 from Draft 1 was removed, but it appears the phase-angle jump requirements have simply been reinserted under Requirement R1 in this second draft. As drafted, a facility is expected to ride-through fault-initiated switching events regardless of the magnitude of voltage phase angle change. Consider that positive sequence phase angle change cannot be accurately measured during a fault occurrence and clearance. We propose the assessment of ride-through performance during fault occurrence, clearance, and recovery be based only on the voltage ride-through criteria in Attachment 1 Table 1 and Table 2.

We recommend reverting the “Voltage (per unit)” columns of Table 1 and Table 2 back to their first draft state to remain consistent with Tables 11 and 12 of IEEE 2800.

R2.1.3: The decimal place is missing from “95 per unit.”

R2.2: Consider more clearly defining “maximum capability.” As an alternative, R2.2 could state, “…each IBR shall exchange current, up to the total sum

of the nameplate current rating of online IBR units in the plant to provide voltage support…"

R2.3.1: Consider removal of this requirement. The time it should take a facility to restart current exchange following blocking seems irrelevant if the other ride-through performance requirements are being met.

Attachment 1: Note 11 from Attachment 1 should be removed. There are many equipment protection settings that are near instantaneous to protect against current or voltage surges that far exceed the equipment's maximum rating. A power electronic switch could burn out in a matter of micro-seconds due to such a surge, before any tripping decision could be made if the filtering length must be at least 16.6 milliseconds.

R3: We recommend reverting the "System Frequency (Hz)" columns of Table 3 back to its first draft state to remain consistent with Tables 15 of IEEE 2800.

The Consideration of Comments document seemed to indicate that the drafting team intended to respond to our previous comment regarding the expansion of the frequency ride-through range, but none was provided. The proposed 6-second frequency ride-through capability requirement for the ranges of 61.8Hz to 64Hz and 57Hz to 56Hz does not align with the requirements on the rest of the BES and would expose synchronous generators to dangerous variations in frequency. Can the drafting team cite more specific reasoning or data to support the expansion of the frequency ride-through capability requirement to the range of 64Hz to 56Hz, well beyond the IEEE 2800-2022 standard frequency ride-through requirement and the capabilities of many legacy IBRs?

R4: We recommend the following revision to R4.

R4. Each Generator Owner and Transmission Owner identifying a facility with a signed interconnection agreement by the effective date of PRC-029-1 with known hardware limitations that prevent the facility from meeting ride-through criteria as detailed in Requirements R1, R2, and R3, and requires an exemption from specific ride-through criteria shall:

Exemptions in R4 should be based on the execution of the interconnection agreement rather than the in-service date of the facility. As drafted, facilities with executed interconnection agreements, but not yet in-service by the effective date of the standard may need to make significant equipment modifications and perform interconnection restudies to comply with requirements that did not become effective until after the interconnection agreement was executed.

Regarding the lack of frequency ride-through exemptions, the limited exception language in FERC Order 901 is not supported by any comments or other evidence in the record in the original NOPR proceeding, and therefore we believe this to be an inadvertent omission and unjustified application of Order 901 in the draft language of PRC-029-1. In fact, in the NOPR, FERC proposed to direct NERC "to develop new or modified Reliability Standards that would require Generator Owners and Generator Operators to ensure that their registered IBR facilities ride through system frequency and voltage disturbances **where technologically feasible**." The drafted frequency ride-through performance requirements are not technologically feasible for many legacy IBRs.

Further, in Order 901, FERC "encourage[s] NERC's standard drafting team to consider currently effective Reliability Standard PRC-024-3, Requirement R3 as an example for establishing registered IBR technology exemptions." Requirement R3 of PRC-024-3, and the currently drafted version of PRC-024-4, allows for exemptions from both the frequency and voltage ride-through requirements due to equipment limitations.

Given the lack of a clear evidentiary record on this point, the drafting team should rely on the discretion FERC has always granted NERC when it comes to drafting and implementing practical Reliability Standards. Invenergy recommends Requirement R4 be amended to allow limited exemptions from specific voltage and frequency ride-through criteria for facilities with known hardware limitations that prevent the facility from meeting the ride-through criteria detailed in Requirements R1, R2, and R3.

Finally, Invenergy has concerns regarding the deviation of this project from its original goal of developing a standard that will require ride-through performance from *all* generating resources. As currently drafted, PRC-024-4 imposes fewer ride-through performance responsibilities on synchronous generators while allowing broader exemptions from its requirements than PRC-029-1. This undue discrimination permits scenarios in which both a synchronous generator and an IBR could trip offline due to the same system disturbance and only the IBR would be subject to a potential noncompliance, assuming the synchronous generator did not trip due to its protection system settings.

Implementation Plan: In its Consideration of Comments, the drafting team indicated that the Implementation Plan has been modified such that PRC-029-1 shall become effective on the first day of the first calendar quarter that is 12 months after the effective date of the applicable governmental

authority's order approving PRC-028-1, however the Implementation Plan still lists an implementation timeframe of six months.

Likes 0	
Dislikes 0	

Response

Maozhong Gong - GE - GE Wind - NA - Not Applicable - NA - Not Applicable

Answer	
Document Name	

Comment

-In R1, suggest the phase jump measurement to align to 2800 definition i.e.,Sub-cycle-to-cycle

-In Attachment 2, frequency ride through table is different with 2800. Suggest to align to 2800, otherwise the OEMs need to design for different specs.

-For R4.1, 12 months is not sufficient for documenting the supporting information for hardware limitation. Recommend a 2-year period for the exception documentation.

Likes 0	
Dislikes 0	

Response

Steven Taddeucci - NiSource - Northern Indiana Public Service Co. - 3

Answer	
Document Name	

Comment

PRC-029 R 2.1.3 should be 0.95 per unit not 95 per unit.

Figures 1 and 2 in Attachment 1 of PRC-029 should use the same scale on the horizontal axis, either log or linear.

Please clarify point 10 of attachment 1 of PRC-029: "The facility may trip for more than four deviations of the applicable voltage at the high-side of the main power transformer outside of the continuous operation region within any 10 second time period."

The Implementation Plan should be extended to 36 months to allow for monitoring equipment to be installed at sites completed before PRC-029 becomes enforceable, to demonstrate performance and compliance with the standard.

Likes 0	
Dislikes 0	

Response

Kinte Whitehead - Exelon - 3	
Answer	
Document Name	
Comment	
Exelon supports the comments submitted by the EEI.	
Likes 0	
Dislikes 0	
Response	
Chance Back - Muscatine Power and Water - 5	
Answer	
Document Name	
Comment	
I support NSRF comments.	
Likes 0	
Dislikes 0	
Response	
Jennifer Bray - Arizona Electric Power Cooperative, Inc. - 1	
Answer	
Document Name	
Comment	
AEPC only has minor concerns with PRC-024-4; however, in our opinion, PRC-029-1 still needs some work before we can recommend approval. Thank you for the opportunity to comment.	
Likes 0	
Dislikes 0	
Response	

Junji Yamaguchi - Hydro-Quebec (HQ) - 1,5	
Answer	
Document Name	

Comment

It is imperative that the standard drafting teams for this project as well as the 2021-04 (PRC-002 and PRC-028) and 2023-02 (PRC-030 vs PRC-004) assure a coherent way of addressing the inclusion and exclusion of IBRs in current and upcoming standards.

The following comments are applicable to PRC-029-1

The definition for Inverter Based Resource (IBR) was approved by industry in April under Project 2020-06. We do not agree with inserting the uncapitalized version of IBR into 4.2 Facilities section because it is unbounded and insufficient to identify the Facilities applicable to this Standard, as required in the Rules of Procedure (Appendix 3a, Standard Processes Manual). Furthermore, these definitions are the foundation of several ongoing projects in response to FERC Order 901, where FERC "directs NERC to submit new or modified Reliability Standards that address specific matters pertaining to the impacts of IBRs on the reliable operation of the BPS."

The purpose section of PRC-029-1 refers to Inverter-Based Resources (IBRs) (capitalized, defined term) whereas the facilities section uses the uncapitalized version.

Section 4.2.2: What IBR Registration Criteria are we referring to? Are we referring to the Category 2 GO/GOP facilities that are still awaiting a FERC decision? This section is not consistent with project 2021-04.

For requirements R1 through R4, it is unclear which facilities are being referred to. Suggest rewording to "facilities identified in Section 4.2" or adding a sentence to 4.2 to indicate "For the purpose of this standard, the term "Applicable facilities" refers to the following:". However, as stated above, it is unclear what facilities are included in the IBR Registration Criteria.

Likes 0	
Dislikes 0	

Response

Andy Thomas - Duke Energy - 1,3,5,6 - SERC,RF	
Answer	
Document Name	

Comment

Duke Energy offers the following Comments for Draft 2 of PRC-024 and PRC-029 - see Duke Energy, EEI and NAGF comments below.

PRC-024-4 Comments

1-Duke Energy recommends the following R2 word omission be rectified:

R2. Each Generator Owner and Transmission Owner shall…which it is applied "to" trip within…

PRC-029-1 Comments

EEI COMMENTS

Duke Energy agrees with and supports EEI filed comments as summarized below - see official EEI filed comments for additional detailed comments and proposed resolution(s):

1-The Standard attempts to redefine the approved definition of IBR by adding VSC-HVDC systems after the IBR definition was approved by the industry. EEI does not support: (a) expansion of the definition of IBRs beyond what was recently approved by the industry, since there is no technical justification for adding VSC-HVDC and, (b) the SAR did not include adding VSC-HVDC systems to this project. For these reasons, we ask that the definition of IBR not be expanded, and that the DT submit a technical justification for adding VSC-HVDC systems to the applicability section of this Standard, rather than redefining an approved definition in a footnote.

2-The Standard adds TOs to this Standard solely to address VSC-HVDC systems although: (a) no technical justification has been provided, and (b) these systems were not identified in FERC Order No. 901, the SAR, or in the Applicability Section of this proposed Reliability Standard.

3-EEI is concerned with the inclusion of requirements that are not clearly defined or set by multiple registered entities (i.e., TP, PC, RC, or TOP). This situation creates: (a) regulatory confusion and places IBR-GOs in a position where they may need to comply with any number of entities without clearly defining who is responsible, (b) IBR-GOs will have reporting obligations to multiple entities because no single entity is identified as being responsible, and (c) none of the entities identified (i.e., TP, PC, RC, or TOP) are identified within the Applicability section of this proposed Reliability Standard. This situation will likely create confusion and places considerable regulatory burden on the IBR-GOs and requires resolution and additional clarification.

4-Throughout this Reliability Standard there is use of: (a) non-glossary terms (i.e., active power vs. Real Power) where glossary terms are available and should be used and (b) glossary terms are used but not capitalized (e.g., reactive power vs. Reactive Power). Greater efforts should be made to use NERC Glossary terms where appropriate and capitalize those terms, as required.

5-Ride-through Definition:

EEI does not support the proposed definition for “Ride-through” as proposed because it is too vague and contains no defined limits, as proposed. We recommend the following changes: Reference EEI filed comments for this item.

6-Applicability Section:

(a) Footnote 1: EEI does not support adding TOs that own VSC-HVDC systems because it was not a scope item and is therefore not included in the scope of this SAR.

(b) Footnote 1 conflicts with Footnote 2 which defines VSC-HVDC as an IBR, which is not in alignment with the approved definition of an IBR.

(c) Footnote 2: EEI does not support Footnote 2 because it expands the definition of IBRs beyond what was recently approved by the industry, noting the expansion of IBRs to include VSC-HVDC.

(d) There was no technical justification for adding VSC-HVDC and the SAR did not include adding VSC-HVDC systems to this project.

For these reasons, we ask that the definition of IBR not be expanded through footnotes and suggest that the DT submit a technical justification for adding VSC-HVDC systems to the applicability section of this Standard, rather than redefining an approved definition in a footnote.

To address our concerns related to Footnotes 1 & 2, we suggest that if VSC-HVDC systems are to be classified as IBRs, then the approved definition should be pulled by NERC and resubmitted with those resources added to the definition and subsequently resubmitted to the industry for approval. Alternatively, VSC-HVDC systems could be defined separately, and that definition submitted to the industry for approval. In both cases, a technical justification should be provided to the industry that defines the issues and risks to BPS reliability that VSC-HVDC systems pose.

EEI suggests that if the DT believes certain IBR capabilities as identified under Requirement R2 need (or may need) to be specified then the DT should identify the entity who should be responsible among the four identified (i.e., TP, PC, RC or TOP); add them to the applicability section of this Reliability Standard; and add clear requirements and adjust the reporting obligations for the IBR-GO under Requirement R4.

7-Requirement R1 & R2:

EEI does not agree with the inclusion of Transmission Owners because they would only have an obligation under this Reliability Standard if VSC-HVDC systems were included. Given we do not support the inclusion of VSC-HVDC systems without a technical justification and modified SAR, we ask Transmission Owners be removed from Requirement R1.

8-Measures M1 & M2:

EEI is concerned that M1 & M2 contains measures that are overly prescriptive and provide little discretion to IBR-GOs in demonstrating their compliance with Requirements R1 and R2. As written, M1 and M2 appear to align more with a Requirement than a Measure (see official EEI filed comments for additional detailed comments and proposed resolution(s)).

9-Requirement R3 & R4: EEI does not support the inclusion of Transmission Owners within Requirements R3 & R4 for the same reasons identified above.

DUKE ENERGY COMMENTS

Additionally, Duke Energy provides the following additional comments:

10-Amend Standard to include GO specific and comprehensive responsibilities and identify functional entity required to approve exemption(s).

11-R3 does not provide specific Measure information in the Requirement – amend; as stated above, this action must provide definitive compliance guidance for GOs.

12-R4: Language does not allow for frequency exemptions (voltage exemptions allowed) – amend Requirement to allow for frequency exemptions.

13-R4.2.1 Amend language to require Regional Entity to respond within X calendar days.

14-R3: Amend language as follows: …“and suggest similar changes be made to M2” and M3.

15-R2.1.3: Requirement is duplicative with VAR-002 Reactive/Voltage support – consider removing.

16-Duke Energy recommends the word “ensure” be removed from all Requirements and specific Requirement language obligations be inserted to identify compliance. Use of the word “ensure” results in global compliance guidance that is not auditable unlike specific compliance Requirement(s).

17-Measurement M1: Consider including a standard Prerequisite Section in Standard that validates design and operation is such that each facility adheres to Ride-through requirements

18-M4/R4.3 – Resolve 30 calendar days vs. 90 calendar days conflict or clarify differences. Also, add “calendar” days to R4.3.

NAGF COMMENTS

Finally, Duke Energy agrees with and supports NAGF filed comments summarized below - see official NAGF filed comments for additional detailed comments and proposed resolution(s):

19-Consider removing Applicability 4.2.2 section, IBR Registration Criteria.

20-R2.5 requires clarity – revise narrative to state that active power shall be restored when ”the voltage at the high-side of the main power transformer returns to the Continuous Operating Region”.

Likes 0	
Dislikes 0	

Response

Michael Goggin - Grid Strategies LLC - 5	
Answer	
Document Name	

Comment

In the draft of PRC-029, R4 should be modified to allow existing resources with equipment limitations to obtain an exemption from the frequency ride-through requirements in R3, instead of only allowing an exemption from the voltage ride-through requirements in R1 and R2. This is necessary because some existing IBR generators cannot meet the stringent frequency ride-through requirements proposed in R3 without deploying significant hardware modifications or replacement, which goes against the intent of FERC Order 901.

The frequency ride-through requirements are particularly problematic for some existing wind generators. In the Technical Rationale document accompanying the PRC-029 draft, the drafting team notes that some wind generators are more sensitive to frequency deviations, writing that "All IBR resources (except for type 3 wind turbines) interface to the grid through fast switching of power electronics devices. These power electronic devices are much less sensitive to the transmission system frequency excursion than non-hydraulic turbine synchronous resources."{C}[1] However, the drafting team then incorrectly concludes that "Therefore, IBR should be capable of riding through the increased proposed 6-second frequency ride-through requirement without risk of equipment damage or need for frequency protection to operate." The Technical Rationale document does not offer any justification for its assumption that Type III wind turbines can meet the frequency ride-through requirements, despite noting that those turbines more directly interface with the grid and thus are more affected by frequency deviations than other IBRs.

In fact, many existing Type III wind turbines cannot meet the frequency ride-through requirements proposed in this draft of PRC-029. Those resources were designed to meet the reliability Standards and interconnection requirements that were in effect when they were placed in service, and were not designed to ride through frequency excursions of the magnitude and duration proposed in the draft Standard. Other types of existing IBR resources were also not designed to meet the proposed frequency ride-through requirements, and may similarly require extensive equipment modification or replacement to comply with R3.

Imposing a retroactive requirement on wind generators is particularly problematic as it is not typically feasible to retrofit existing wind turbines to increase their ability to ride through and withstand mechanical stresses due to frequency changes. In such cases, making existing equipment better able to withstand frequency changes would require full replacement or extensive modification of hardware, which would come at a significant, and sometimes prohibitive, cost. Frequency changes can impose mechanical stresses on highly sensitive elements in the wind turbine's rotating equipment, including the generator, gearbox, the main shaft, and bearings associated with all of that equipment, and requiring such resources to ride through frequency changes they were not designed to operate through can damage that equipment. Subjecting Type III wind turbines to this damage may lead to increased outages or premature failure of these generators, potentially increasing reliability risks.

The easiest solution is to modify R4 to allow existing resources with equipment limitations toobtain an exemption from the frequency ride-through requirements in R3, which would make PRC-029 consistent with a long precedent of FERC interconnection requirements and NERC Standards only applying prospectively, including PRC-024. Retroactive requirements impose a much greater financial burden on the generator than prospective Standards, and set a bad precedent by unfairly penalizing generators that met all requirements that were in effect at the time they were installed. Retrofit or replacement costs are typically much greater than if the capability were installed at the plant to begin with. In some cases equipment needed for retrofits may not be available, particularly for models that have been discontinued or manufacturers that are no longer in business, potentially requiring the replacement of the entire wind turbine. Moreover, existing IBR generators typically sell their output at a fixed price under a long-term power purchase agreement, and unexpected retrofit or replacement costs cannot typically be recovered once a power purchase agreement has been signed. These unexpected and unrecoverable costs are far more concerning to lenders and other generation project financiers as they were not accounted for during the project's financing. As a result, retroactive requirements set a bad precedent by introducing regulatory uncertainty that makes future generation investment more uncertain and riskier, and likely more costly by forcing financiers to charge higher risk premiums.

Fortunately, these problems can be fixed by inserting "R3" into the list of permissible exemptions in R4, which would allow existing resources with equipment limitations to obtain an exemption from the frequency ride-through requirements in R3.

In the Technical Rationale document, the drafting team points to FERC's directive in Order No. 901 to justify not allowing existing resources to obtain an exemption from the frequency ride-through requirements in R3: "FERC Order No. 901 states that this provision would be limited to exempting 'certain registered IBRs from voltage ride-through performance requirements.' This is the reason that no similar provisions are included for exemptions for

frequency or rate-of-change-of-frequency (ROCOF) ride-through requirements per R3."[2]

However, a contextual reading of Order No. 901 indicates FERC was focused on targeting equipment limitation exemptions at existing generators that would have to physically replace or modify hardware to comply with the Standard, and not focused on limiting such exemptions to voltage ride-through requirements. Paragraph 193 in its entirety, and particularly the first sentence, explain that FERC's intent was exempting existing resources that would have to physically replace or modify hardware: "we agree that a subset of existing registered IBRs –typically older IBR technology with hardware that needs to be physically replaced and whose settings and configurations cannot be modified using software updates – may be unable to implement the voltage ride though performance requirements directed herein." As a result, FERC continued by directing that "Any such exemption should be only for voltage ride-through performance for those existing IBRs that are **unable to modify their coordinated protection and control settings to meet the requirements without physical modification of the IBRs' equipment**."[3]

Allowing existing plants to apply for an equipment limitation exemption for the frequency ride-through requirements in R3 is necessary to ensure some existing generators do not have to physically replace or modify hardware. As a result, such an exemption is consistent with FERC's directive and intent in Order No. 901. As documented in the following footnote, there is ample precedent for NERC and standards drafting teams to exercise their technical expertise to craft Standards to align content and requirements with technical realities.[4]

Additional context in Order 901 further demonstrates that FERC intended for NERC to include an exemption for existing IBRs that cannot meet frequency ride-through requirements. At paragraph 190 in Order No. 901, FERC directed NERC to develop Standards that ensure resources "ride through frequency and voltage system disturbances and that permit IBR tripping only to protect the IBR equipment in scenarios similar to when synchronous generation resources use tripping as protection from internal faults." For many existing IBRs that cannot meet the proposed frequency ride-through requirements, tripping is necessary to protect the IBR equipment, similar to when synchronous generation resources use tripping as protection from internal faults. As a result, an exemption from R3 for existing resources is consistent with FERC's intent. Order No. 901 also directed NERC to consider the "PRC-024-3, Requirement R3 as an example for establishing registered IBR technology exemptions," and that exemption applies equally to voltage ride-through and frequency ride-through settings, further suggesting that FERC will allow certain IBRs an exemption from the frequency ride-through requirements.[5] Finally, Order No. 901 notes that in the notice of proposed rulemaking that led to the order, FERC "proposed to direct NERC to develop new or modified Reliability Standards that would require registered IBR facilities to ride through system frequency and voltage disturbances where technologically feasible."[6] FERC then adopted that very proposal,{C}[7] further demonstrating that FERC sought to direct NERC to only require frequency and voltage ride-through where technologically feasible.

It is likely that FERC Order No. 901 did not explicitly direct NERC to include frequency ride-through exemptions because FERC did not anticipate that NERC would adopt such an aggressive frequency ride-through requirement that some existing plants cannot meet. The drafting team even notes at page 7 in the Technical Rationale document that "The proposed 6-second time frame of the frequency ride-through capability requirement is beyond the IEEE 2800 standard frequency ride-through requirement and beyond frequency ride-through requirements for synchronous machines under proposed PRC-024-4." There is nothing in Order No. 901 that suggests that FERC was opposed to existing equipment exemptions for a frequency ride-through standard that was drafted after FERC issued Order No. 901 and is more stringent than FERC anticipated. A much more reasonable interpretation is that the logic FERC provided in paragraph 193 of Order No. 901 also applies to a frequency ride-through requirement that some existing resources cannot meet without physical modification or replacement of equipment. In fact, paragraph 193 makes clear that FERC's language focuses on an exemption from voltage ride-through requirements because "a subset of existing registered IBRs… may be unable to implement the voltage ride though performance requirements directed herein."

At the end of paragraph 193, FERC also explained that an exemption for existing resources would not harm reliability because "The concern that there are existing registered IBRs unable to meet voltage ride through requirements should diminish over time as legacy IBRs are replaced with or upgraded to newer IBR technology that does not require such accommodation." FERC's reasoning in paragraph 193 also applies to an exemption from frequency ride-through requirements, but particularly the conclusion that exempting existing plants does not cause reliability concerns and therefore should be allowed. The NERC drafting team's technical justification document explicitly explains that the frequency ride-through requirement is "to ensure the reliability of future grids with high IBR penetration,"{C}[8] based on concerns about declining inertia due to IBRs replacing synchronous resources. NERC and others have demonstrated that inertia and frequency response will remain more than adequate for the foreseeable future even following disturbances that are several times larger than current credible contingencies, and that higher IBR penetrations can actually significantly improve frequency stabilization following disturbances.[9]

As a result, there is no reliability concern from an exemption for the small number of existing resources that cannot meet the requirements without physical modification or replacement of equipment. Moreover, as FERC notes, these plants will replace that equipment anyway over time as legacy inverters fail or are replaced with more modern equipment for other reasons, and the draft standard requires replacement equipment to comply with the

Standard. Utility-scale inverters installed at solar and battery installations typically come with warranties of 10 years or less,{C}[10] and those inverters are typically replaced at least once during the plant's lifetime. Many existing wind plants are also being repowered with newer turbines, often to allow the project to receive another 10 years of production tax credits after the initial 10 years of credits have been received. As a result, by the time the drafting team's concerns about inertia in a high IBR penetration future might materialize, the vast majority of IBRs that cannot meet the frequency ride-through requirements will have been replaced with new equipment that is not exempt.

Moreover, the drafting team's assumption that frequency deviations will be larger on a future low inertia power system is flawed. IBRs can provide fast frequency response, which stabilizes frequency in the initial seconds following a grid disturbance, before synchronous generators begin to provide their slower primary frequency response.[11] Thus fast frequency response provides a similar service to inertia in helping to arrest the change in frequency before primary frequency response is fully deployed, reducing the need for inertia.[12] Fast frequency response is easily provided by batteries due to their available energy, but can also be provided by curtailed wind or solar resources. Power systems with high IBR penetrations will tend to have some wind or solar curtailment in a significant share of hours. If allowed to do so, solar an battery resources with spare DC capacity behind the inverter can also temporarily exceed their interconnection agreement's AC injection limit to provide fast frequency response.

The replacement of inflexible synchronous resources with more flexible IBRs could also significantly improve primary frequency response, as NERC's modeling has demonstrated.{C}[13] NERC has also documented that only about 30% of synchronous generators provide primary frequency response, and only about 10% provide sustained primary frequency response.[14] Even with less inertia, the fast and accurate frequency response provided by IBRs will keep frequency more tightly controlled than the slow to nonexistent primary frequency response from synchronous generators. The replacement of large synchronous generators with smaller IBRs should also reduce the magnitude of frequency deviations following the loss of generators. If frequency response does begin to emerge as a concern, the more effective solution would be to enforce requirements on synchronous generators that are supposed to provide it but do not. If necessary, operators would alter real-time dispatch, as ERCOT and some island power systems occasionally do today, to ensure that inertia and fast frequency response are adequate to ensure under-frequency load shedding or generator tripping thresholds are not reached. Finally, grid-forming inverters are increasingly being deployed with battery storage and other IBR installations, further increasing the contributions of IBRs to stabilizing frequency.

At page 8 in the Technical Rationale document, the drafting team argues that "To compensate for the lack of inertia and short circuit contributions, [IBRs] should have wider tolerances for frequency and voltage excursions to meet the needs of future power systems with a higher percentage of IBR." The drafting team also argues that IBRs should have to ride-through much larger frequency deviations than synchronous resources because "Synchronous resources are more sensitive to frequency deviations than IBR resources." This logic is flawed for many reasons. Grid operators need all resources to ride through disturbances, and the contribution of a resource to inertia or short circuit needs is irrelevant to that need. Any concerns about resources' inertia and short circuit contributions are outside the drafting team's scope and authority, and should be addressed by other means (such as by increasing the deployment of grid-forming IBRs in the localized areas that have short circuit or stability concerns). It is also perverse for the drafting team to penalize IBRs for being less sensitive to frequency deviations than synchronous generators. As noted below, there are already grounds for FERC to reject this proposed standard due to undue discrimination against IBRs relative to the far more lenient requirements on synchronous generators under PRC-024, including an equipment limitation exemption for synchronous generators from the frequency relay setting requirement in PRC-024, and this only adds to those concerns.

In short, the drafting team's unfounded concerns about a future power system do not justify withholding an exemption to frequency ride-through requirements for existing IBR resources that will have been largely replaced by the time any concerns might materialize.

Finally, R4 equipment limitation exemptions should be allowed for resources with signed interconnection agreements as of the effective date of the Standard, instead of resources that are in-service as of that date. Resource equipment decisions are typically locked down at the time the interconnection agreement is signed, and a change in requirements after that point can require a costly change in equipment or settings that may also trigger a material modification and resulting interconnection restudies. The implementation plan for PRC-029 indicates that the effective date for the Standard will be the first day of the first quarter six months after FERC approval. Many resources take significantly longer than that to move from a signed interconnection agreement to being placed in service, so it makes more sense to allow R4 equipment limitation exemptions for resources that have a signed interconnection agreement as of the effective date of the Standard.

The current draft of the PRC-029 Standard is unworkable and will impose massive costs on some existing generators with no benefit for reliability. As explained above, the drafting team incorrectly ventures that "IBR should be capable of riding through the increased proposed 6-second frequency ride-through requirement without risk of equipment damage or need for frequency protection to operate," even after noting that some wind turbines use very different technology. NERC's rigorous standard development process exists to ensure that errors like this do not make it into final Standards, and the exceedingly low level of support for the initial draft and the major revisions in the current draft indicate that further revisions will likely be necessary.

It takes time to fine tune highly technical requirements and vet them across the industry to avoid unnecessary and exorbitant costs for existing resources that cannot meet the standard. If the drafting team and NERC believe Order No. 901's deadlines do not provide enough time for further standard revisions and balloting periods to make the frequency ride-through requirement workable for existing resources, adding the letters "R3" to R4 to create an exemption for existing resources is the fastest and easiest way to address those concerns. For the reasons explained above, such an exemption does not pose any risk to reliability and is consistent with FERC's directive in Order 901.

Undue discrimination

A major concern with the Standards, as drafted, is that ride through performance is not required for synchronous generators under PRC-024-4, but it is for IBRs under PRC-029. PRC-024 simply requires protective relays to be set so they do not trip the generator within specified bounds, but it allows a resource to trip offline for other reasons. PRC-024-4 also allows a plant to trip if protection systems trip auxiliary plant equipment, per section 4.2.3. In contrast, PRC-029 requires IBRs to remain electrically connected and to continue to exchange current within the specified voltage and frequency bounds. Said another way, an IBR and a synchronous resource could both trip during the same disturbance, and the IBR would be in violation of PRC-029 but the synchronous generator would not be in violation of PRC-024-4, as long as the synchronous generator did not trip due to the settings of its protection system.

To ensure grid reliability and resilience, all resources including IBRs and synchronous resources should ride through grid disturbances. The failure of synchronous generators to ride through grid disturbances threatens grid reliability as much or more than the failure of IBRs, as synchronous resources are often producing at a higher level of output, are more typically relied on as capacity resources, and often take longer to come back online and ramp up to full output if they trip due to a disturbance.

FERC Order No. 901 directed NERC to treat IBR resources similarly to how NERC Standards treat synchronous generators, writing that the IBR Standard should "permit IBR tripping only to protect the IBR equipment in scenarios similar to when synchronous generation resources use tripping as protection from internal faults."{C}[15] Allowing synchronous generators to trip but requiring IBRs to ride through the same or similar disturbance will be challenged at FERC as undue discrimination. Providing synchronous generators with an equipment limitation exemption from PRC-024's relay-setting requirements but not offering existing IBR resources an exemption from the far more stringent frequency ride-through requirements in PRC-029 is also undue discrimination.

This disparate treatment of IBRs versus synchronous generators is also at odds with the intent for this project that NERC stated in its February 2023 comments on the FERC proposed rulemaking that led to Order No. 901: "A comprehensive, performance-based ride-through standard is needed to assure future grid reliability. To that end, NERC re-scoped an existing project, Project 2020-02 Modifications to PRC-024 (Generator Ride-through), to revise or replace current Reliability Standard PRC-024-3 with a standard that will require ride-through performance from all generating resources."[16] FERC's Order No. 901 also noted NERC's statement that this project would require ride-through performance from all generating resources,[17] so a failure to require ride-through performance from synchronous generators is contrary to both NERC's and FERC's intent.

Providing an exemption in PRC-029 R4 for existing IBRs that cannot meet the frequency ride-through requirement in R3 will result in less disparity with the treatment of synchronous resources under PRC-024, and is therefore an essential step if NERC wants to reduce the risk of FERC rejecting the proposed standard due to undue discrimination against IBRs.

{C}[1]{C} Technical Rationale, PRC-029-1 – Frequency and Voltage Ride-Through Requirements for Inverter-Based Generating Resources, at 8, https://www.nerc.com/pa/Stand/202002_Transmissionconnected_Resources_DL/2020-02_PRC-029-1_Technical_Rationale_Redline_to_Last_Posted_06182024.pdf ("Technical Rationale").

{C}[2]{C} *Id.*, at 10

{C}[3]{C} *Reliability Standards to Address Inverter-Based Resources*, Order No. 901, 185 FERC ¶ 61,042, P 193 (2023).

{C}[4]{C} For example, **Section 215(d)(2) of the FPA** requires FERC to give "due weight" to the technical expertise of the ERO when evaluating the content of a proposed Reliability Standard or modification to a Standard.

Order No. 733-A, P 11: "In this order, we emphasize and affirm that we do not intend to prohibit NERC from exercising its technical expertise to develop a solution to an identified reliability concern that is equally effective and efficient as the one proposed in Order No. 733."

Order No. 748, P 43: "In consideration of these ongoing efforts, we will not direct specific modifications to these Reliability Standards and, rather,

accept NERC's commitment to exercise its technical expertise to study these issues and develop appropriate revisions to applicable Standards as may be necessary."

Order No. 896, P 36: "NERC may also consider other approaches that achieve the objectives outlined in this final rule. Further, as recommended by PJM, we believe there is value in engaging with national labs, RTOs, NOAA, and other agencies and organizations in developing benchmark events. Considering NERC's key role, technical expertise, and experience assessing the reliability impacts of various events and conditions, we encourage NERC to engage with national labs, RTOs, NOAA, and other agencies and organizations as needed."

Order No. 901, P 192: "We believe that, through its standard development process, NERC is best positioned, with input from stakeholders to determine specific IBRs performance requirements during ride through conditions, such as type (e.g., real current and/or reactive current) and magnitude of current. NERC should use its discretion to determine the appropriate technical requirements needed to ensure frequency and voltage ride through by registered IBRs during its standards development process."

{C}[5]{C} Order 901, P 193

{C}[6]{C} *Id.* at P 178.

{C}[7]{C} *Id.* at P 190.

{C}[8]{C} Technical Rationale at 7.

{C}[9]{C} East Interconnection Frequency Response Assessment with Inverter Based Resources, at 7 https://www.energy.gov/sites/prod/files/2018/07/f53/2.1.4%20Frequency%20Response%20Panel%20-%20Velummylum%2C%20NERC.pdf.

{C}[10]{C} Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems, at 55, https://www.nrel.gov/docs/fy19osti/73822.pdf.

{C}[11]{C}Fast Frequency Response Concepts and Bulk Power System Reliability Needs, https://www.nerc.com/comm/PC/InverterBased%20Resource%20Performance%20Task%20Force%20IRPT/Fast_Frequency_Response_Concepts_and_BPS_Reliability_Needs_White_Paper.pdf.

{C}[12]{C} Inertia and the Power Grid: A Guide Without the Spin, https://www.nrel.gov/docs/fy20osti/73856.pdf.

{C}[13]{C} East Interconnection Frequency Response Assessment with Inverter Based Resources, at 7 https://www.energy.gov/sites/prod/files/2018/07/f53/2.1.4%20Frequency%20Response%20Panel%20-%20Velummylum%2C%20NERC.pdf.

{C}[14]{C} https://www.nerc.com/pa/Stand/Project%20200712%20Frequency%20Response%20DL/FRI_Report_10-30-12_Master_w-appendices.pdf

{C}[15]{C} Order No. 901, at P190

[16]{C}https://www.nerc.com/FilingsOrders/us/NERC%20Filings%20to%20FERC%20DL/Comments_IBR%20Standards%20NOPR.pdf, at 21-22.

[17]{C} Order No. 901, at P 185

Likes 0	
Dislikes 0	

Response

Rhonda Jones - Invenergy LLC - 5

Answer

Document Name	

Comment

Thank you for the opportunity to provide comments and for your work on this project. Invenergy provides the below comments for the Drafting Team to consider:

R1: In response to industry comments, the SDT indicated that Requirement R5 from Draft 1 was removed, but it appears the phase-angle jump requirements have simply been reinserted under Requirement R1 in this second draft. As drafted, a facility is expected to ride-through fault-initiated switching events regardless of the magnitude of voltage phase angle change. Consider that positive sequence phase angle change cannot be accurately measured during a fault occurrence and clearance. We propose the assessment of ride-through performance during fault occurrence, clearance, and recovery be based only on the voltage ride-through criteria in Attachment 1 Table 1 and Table 2.

We recommend reverting the "Voltage (per unit)" columns of Table 1 and Table 2 back to their first draft state to remain consistent with Tables 11 and 12 of IEEE 2800.

R2.1.3: The decimal place is missing from "95 per unit."

R2.2: Consider more clearly defining "maximum capability." As an alternative, R2.2 could state, "…each IBR shall exchange current, up to the total sum of the nameplate current rating of online IBR units in the plant to provide voltage support…"

R2.3.1: Consider removal of this requirement. The time it should take a facility to restart current exchange following blocking seems irrelevant if the other ride-through performance requirements are being met.

Attachment 1: Note 11 from Attachment 1 should be removed. There are many equipment protection settings that are near instantaneous to protect against current or voltage surges that far exceed the equipment's maximum rating. A power electronic switch could burn out in a matter of micro-seconds due to such a surge, before any tripping decision could be made if the filtering length must be at least 16.6 milliseconds.

R3: We recommend reverting the "System Frequency (Hz)" columns of Table 3 back to its first draft state to remain consistent with Tables 15 of IEEE 2800.

The Consideration of Comments document seemed to indicate that the drafting team intended to respond to our previous comment regarding the expansion of the frequency ride-through range, but none was provided. The proposed 6-second frequency ride-through capability requirement for the ranges of 61.8Hz to 64Hz and 57Hz to 56Hz does not align with the requirements on the rest of the BES and would expose synchronous generators to dangerous variations in frequency. Can the drafting team cite more specific reasoning or data to support the expansion of the frequency ride-through capability requirement to the range of 64Hz to 56Hz, well beyond the IEEE 2800-2022 standard frequency ride-through requirement and the capabilities of many legacy IBRs?

R4: We recommend the following revision to R4.

R4. Each Generator Owner and Transmission Owner identifying a facility with a signed interconnection agreement by the effective date of PRC-029-1 with known hardware limitations that prevent the facility from meeting ride-through criteria as detailed in Requirements R1, R2, and R3, and requires an exemption from specific ride-through criteria shall:

Exemptions in R4 should be based on the execution of the interconnection agreement rather than the in-service date of the facility. As drafted, facilities with executed interconnection agreements, but not yet in-service by the effective date of the standard may need to make significant equipment modifications and perform interconnection restudies to comply with requirements that did not become effective until after the interconnection agreement was executed.

Regarding the lack of frequency ride-through exemptions, the limited exception language in FERC Order 901 is not supported by any comments or other evidence in the record in the original NOPR proceeding, and therefore we believe this to be an inadvertent omission and unjustified application of Order 901 in the draft language of PRC-029-1. In fact, in the NOPR, FERC proposed to direct NERC "to develop new or modified Reliability Standards that would require Generator Owners and Generator Operators to ensure that their registered IBR facilities ride through system frequency and voltage disturbances **where technologically feasible**." The drafted frequency ride-through performance requirements are not technologically feasible for many

legacy IBRs.

Further, in Order 901, FERC “encourage[s] NERC’s standard drafting team to consider currently effective Reliability Standard PRC-024-3, Requirement R3 as an example for establishing registered IBR technology exemptions.” Requirement R3 of PRC-024-3, and the currently drafted version of PRC-024-4, allows for exemptions from both the frequency and voltage ride-through requirements due to equipment limitations.

Given the lack of a clear evidentiary record on this point, the drafting team should rely on the discretion FERC has always granted NERC when it comes to drafting and implementing practical Reliability Standards. Invenergy recommends Requirement R4 be amended to allow limited exemptions from specific voltage and frequency ride-through criteria for facilities with known hardware limitations that prevent the facility from meeting the ride-through criteria detailed in Requirements R1, R2, and R3.

Finally, Invenergy has concerns regarding the deviation of this project from its original goal of developing a standard that will require ride-through performance from all generating resources. As currently drafted, PRC-024-4 imposes fewer ride-through performance responsibilities on synchronous generators while allowing broader exemptions from its requirements than PRC-029-1. This undue discrimination permits scenarios in which both a synchronous generator and an IBR could trip offline due to the same system disturbance and only the IBR would be subject to a potential noncompliance, assuming the synchronous generator did not trip due to its protection system settings.

Implementation Plan: In its Consideration of Comments, the drafting team indicated that the Implementation Plan has been modified such that PRC-029-1 shall become effective on the first day of the first calendar quarter that is 12 months after the effective date of the applicable governmental authority’s order approving PRC-028-1, however the Implementation Plan still lists an implementation timeframe of six months.

Likes 0	
Dislikes 0	

Response

Pamela Hunter - Southern Company - Southern Company Services, Inc. - 1,3,5,6 - SERC, Group Name Southern Company

Answer	
Document Name	

Comment

Southern Company supports NAGF comments.

Southern Company suggests that M1 be divided out to be clearer such as:

M1. Each Generator Owner and Transmission Owner shall have evidence of dynamic simulations, studies, or other evidence to demonstrate the design of each facility will adhere to Ride-through requirements, as specified in Requirement R1.

M1.1 Each Generator Owner and Transmission Owner shall have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) to demonstrate that the operation of each facility did adhere to Ride through requirements, as specified in Requirement R1.

M1.2 If the Generator Owner and Transmission Owner choose to utilize Ride-through exemptions that occur within the “must Ride-through zone” and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner and Transmission Owner shall also have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate that the facility failed to Ride-through during a phase jump of greater than or equal to 25 electrical degrees, and documentation from their Transmission Planner, Reliability Coordinator, Planning Coordinator, or Transmission Operator that a non-fault initiated switching event occurred.

Southern Company suggests adding an exemption for V/Hz to R3 like bullet 4 in R1.

R3 - Frequency Ride-Through Criteria

Southern Company recommends PRC-029-1 adopt Frequency Ride-Through Criteria (Attachment 2, Table 3 in draft 2) consistent with the IEEE2800 standard. Individual Regions should be allowed to adopt more stringent frequency ride-through standards based on their respective system needs and resource capabilities.

R4 – Exemptions

Any ultimate decision to disallow exemptions for requirements other than voltage, must be grounded in a thorough technical analysis of IBR OEM capabilities. NERC staff and standard drafting team participants have the necessary technical expertise to make these determinations. Additionally, there is ample precedent from prior Standard processes for FERC to defer to NERC on such technical issues. Finally, if the more stringent Frequency Ride-Through criteria in the current draft is preserved, this amplifies the need for consideration of existing equipment frequency ride-through exemptions. GOs and OEMs have not had adequate time to assess resource capabilities against requirements more stringent than IEEE2800.

Southern Company suggests that Requirement R4.3 be reworded to "...that replace the equipment causing the limitation, such that the limitation no longer exists, shall document and communicate..." The current wording is being interpreted that the only equipment that can be put back in place of a failed piece of equipment with a limitation is one without a limitation. Furthermore, R4.3.1 alludes that replacement of equipment with a limitation must be made with equipment without limitation. This may not be possible due to uniqueness and limits associated with an existing facility design. There is no allowance for in-kind replacements. If one inverter burns down, there is no provision to replace it with an in-kind spare replacement unit.

Note 7 on page 15 states that you only have to ride-through the voltage deviations if the frequency remains within the "must ride through zone". Doesn't there need to be a corresponding statement made on page 19? In other words, the standard should allow you to trip even if the frequency remained at a constant 60Hz if the voltage does not remain within the values in Attachment 1.

Southern Company suggests that Requirement R4 also include identified "software limitations" in addition to hardware limitations.

Likes 0	
Dislikes 0	

Response

Jessica Cordero - Unisource - Tucson Electric Power Co. - 1

Answer	
Document Name	

Comment

TEPC does not have any comments for PRC-024-4.

TEPC agrees with EEI's comments regarding PRC-019-1.

Likes 0	
Dislikes 0	

Response

Darcy O'Connell - California ISO - 2, Group Name ISO/RTO Council (IRC) Standards Review Committee	
Answer	
Document Name	
Comment	

Ride-through Definition:

The ISO RTO Council Standards Review Committee (SRC) recommends that the drafting team provide a rationale for the proposed “Ride-through” definition, as it is not clear what benefits result from creating a formal definition for this term, and the definition that has been proposed contains ambiguous language.

First, use of the term “synchronized” in a definition intended to apply to IBRs could result in confusion because IBRs are generally considered to be asynchronous resources (though no mention of IBRs is made in the proposed definition). As a stand-alone term in the NERC glossary, the proposed definition could reasonably be interpreted to apply only to synchronous machines.

Second, the phrase “continuing to operate” is an inadequate description of desired performance – ride-through should include a concept of performance that is beneficial (or at the very least not detrimental) to overall grid reliability.

Third, the use of “Transmission System” potentially limits the applicability of the definition to only transmission-connected resources – the SDT may want to consider instead using a more general term such as “electric system” as was used in the proposed IBR definition.

Finally, defining the term “ride-through” may not be necessary at all. Meeting all of the requirements in PRC-029 essentially constitutes ride-through. Creating a separate defined term may just cause confusion, as the proposed definition does not clarify the desired (or required) performance associated with ride-through. The best option may be to leave the term undefined. If the SDT determines that a definition for Ride-though is an absolute necessity, the SRC proposes the following definition:

“Facilities, including all individual dispersed power producing resources, remaining connected to the electric system and continuing to operate in a manner that supports grid reliability throughout a System Disturbance, including the period of recovery back to a normal operating condition.”

Comments on Proposed Requirements:

The language in PRC-029-1 Requirement R2, Part 2.1.3 that reads “…according to requirements if required by the [TP, PC, RC, or TOP]” seems awkward and redundant, as it seems that any requirements that exist will always be required. The SRC recommends that this language be changed to: “…according to TP, PC, RC, and TOP requirements, if any.” Additionally, if the SDT continues to use a per unit metric for Part 2.1.3, the proposed “95 per unit” should be replaced with “.95 per unit . . . .”

Regarding PRC-029-1 Requirement R2, Part 2.2, it can be problematic to simply specify reactive/active power priority because not all priority implementations perform the same way. Part 2.2 does not really prohibit dropping active current to zero even for shallow voltage dips (e.g. 0.7-0.9pu), but seems to allow the TP, PC, RC, or TOP to specify the desired performance. The SRC requests that the SDT clarify whether this is the intended meaning, and revise Part 2.2 as necessary to clarify the intended meaning.

PRC-029-1 Requirement R2, Part 2.5 reads “…when the voltage at the high-side of the main power transformer returns from the mandatory operation region….” The SRC requests that the SDT clarify whether this was intended to read: “when the voltage at the high-side of the main power transformer returns **to the continuous operation region** from the mandatory operation region….”

In R2, Part 2.5 “available level (whichever is less)” should be revised to clarify whether “a lower post-disturbance active power level requirement” means lower than the pre-disturbance level or lower than the available level.

The SRC also notes that the phrase “…pre-disturbance or available level (whichever is lesser)…” in PRC-029-1 Requirement R2, Part 2.5 may be interpreted as allowing partial tripping/idling for an IBR facility. If the SDT’s intent is that no individual wind turbines/inverters should be allowed to trip/idle, SRC recommends that this phrase be clarified with a footnote such as: “Reduction in available active power shall only be allowed due to a

reduction in available source power (e.g. wind or solar irradiance). Reduction in available active power shall not occur due to tripping or idling of individual turbines or inverters within the IBR."

The SRC requests that the SDT clarify whether Requirement R1 should include an absolute rate of change of voltage criteria similar to the RoCoF criteria in PRC-029-1 Requirement R3. The SRC also requests clarification of whether the other bulleted exceptions listed in Requirement R1 apply during frequency excursions (in other words, the SRC requests clarification of whether ride through is required for frequency excursions even if the thresholds for V/Hz or phase angle jump specified in Requirement R1 are exceeded).

The SRC is concerned that the word "replaced" in PRC-029-1 Requirement R4, Part 4.3.1 may provide a pathway to circumvent the spirit of the standard (e.g., an entity could refurbish equipment and claim that its exemption should be maintained because equipment wasn't "replaced"). The SRC recommends that "replaced, refurbished, or updated" be used instead. At the very least, the Technical Rationale should explain that documented limitations are expected to be eliminated whenever an IBR is re-powered, upgraded, or updated with significant re-investment.

In PRC-029-1, Attachment 1, Tables 1 and 2 use the term "operation region" while Figures 1 and 2 use the term "operating regions." If the two terms are intended to have the same meaning, the SRC recommends that the same term be used in both locations (and throughout the standard). If the two terms are intended to have different meanings, the SRC recommends that the intended meanings be clarified.

In PRC-029-1, Attachment 1, item 7 references a "must ride-through zone" in Table 3 of Attachment 2. However, Table 3 of Attachment 2 does not explicitly specify a "must ride-through zone." The SRC recommends that the SDT clarify whether Attachment 1, item 7 was intended to reference Figure 3 of Attachment 2, or otherwise clarify the intended meaning. The SRC also requests that the SDT clarify why Attachment 2 does not have a corollary item specifying that Table 3 is only applicable when voltage is within the "must ride-through zone" specified in Attachment 1. The SDT should update the Technical Rationale to clarify the intent: whether there is a need to verify or not to verify voltage status for the Table 3 Attachment 2.

The SRC notes that the Technical Rationale for PRC-029-1 contains what appears to be an extraneous "Must Ride-through" heading between the rational for R2.5 and the rationale for R3. The SRC recommends removal of this extraneous heading.

The SRC notes that the Technical Rationale for PRC-024-4 makes no explicit mention of the addition of type 1 and type 2 wind resources to PRC-024-4 and refers to restricting the applicability of PRC-024-4 to synchronous generators and synchronous condensers, which does not appear to be consistent with the posted redlines for PRC-024-4. The SRC recommends that PRC-024-4 and the Technical Rationale be harmonized to remove this discrepancy.

The applicability section for PRC-029-1 references "IBR Registration Criteria," which presumably is intended to include IBRs connected to the BPS that are not considered BES Elements (consistent with the pending revisions to the registration criteria for IBRs). The SRC notes that the Technical Rationale is not very clear on the intent of this structure and requests that a more detailed explanation be included in the Technical Rationale.

Finally, the SRC notes that the addition of type 1 and type 2 wind resources to PRC-024-4 appears to be limited to facilities that meet the BES definition. The SRC requests that the SDT clarify whether this difference is intentional and, if it is, provide the rationale for the difference (such as if the revisions to NERC's registration criteria are not intended to apply to non-BES type 1 or type 2 wind resources) and an explanation of whether the difference constitutes a potential gap that should be addressed.

Comments on Attachment 1: Voltage Ride-Through Criteria

Attachment 1 lists a minimum ride-through time of 1800 seconds for the continuous operation voltage region between 1.05 pu and 1.1 pu (<= 1.1 and >1.05) in Tables 1 and 2. The SRC requests that, consistent with IEEE 2800, an exception for 500 kV systems be allowed such that the minimum ride-through time for 1.05 pu < voltage <= 1.1 pu for 500 kV systems is "Continuous," because the 1.05 pu < voltage <= 1.1 pu voltage range is within the normal operation range for some systems, such as PJM's system.

In addition, in Figures 1 and 2, the SRC requests that the voltage pu values on Y-axis for the "Continuous Operating Region (1800 seconds)" be revised to be consistent with the values listed in Tables 1 and 2 (1.05 < and <= 1.1).

Finally, the SRC generally supports incorporating as much of the IEEE 2800 language and parameters into PRC-029-1 as possible, and the SRC encourages the drafting team to lean on IEEE 2800 as much as is feasible.

Likes 0	
Dislikes 0	

Response

Kennedy Meier - Electric Reliability Council of Texas, Inc. - 2

Answer	
Document Name	

Comment

Electric Reliability Council of Texas, Inc. (ERCOT) joins the comments submitted by the ISO/RTO Council Standards Review Committee (SRC) and adopts them as its own. In addition, ERCOT submits the following comments.

ERCOT notes that the proposed Ride-through definition is unclear as to whether ride-through applies to partial trips (individual inverter or turbine trips). ERCOT believes ride-through should apply both to the IBR facility and to the individual IBR units and requests that this be made clear in any definition that may be adopted. If a defined term for ride-through is implemented, ERCOT recommends the use of a clarification modeled after the I4 inclusion ("dispersed power producing resources") in the BES definition, as detailed in the SRC's proposed definition:

"Facilities, including all individual dispersed power producing resources, remaining connected to the electric system and continuing to operate in a manner that supports grid reliability throughout a System Disturbance, including the period of recovery back to a normal operating condition."

Additionally, ERCOT has identified the following concerns with Requirement R1 as it is currently proposed:

1.) R1 does not clarify whether partial trips (individual IBR unit trips) would be allowed. ERCOT believes individual turbine/inverter trips should not be permissible under R1 and that R1 should clearly indicate that ride-through does not occur when individual turbines or inverters trip offline.

2.) Requirement R1's reference to "adhering" to requirements may create the mistaken impression that exceeding the minimum ride-through requirements is not allowed.

3.) Allowing an exclusion from Requirement R1 for equipment limitations should not result in a unit being exempt from complying with requirements that are not impacted by the limitation.

4.) The process for obtaining a documented limitation should be reviewed to ensure it is consistent with the directives that FERC included in its recent Order on EOP-011-2 in Docket No. RD24-5-000.

To address these issues, ERCOT recommends that Requirement R1 be revised to read as follows:

R1. Each Generator Owner or Transmission Owner shall ensure the design and operation is such that each facility ***meets or exceeds*** the Ride-through requirements, in accordance with the "must Ride-through3 zone" as specified in Attachment 1, except for the following: [Violation Risk Factor: High] [Time Horizon: Operations Assessment]

• The facility needed to electrically disconnect in order to clear a fault;

• ***The electrical system at the high-side of the main power transformer demonstrated characteristics that exceeded a*** documented ***and confirmed*** equipment limitation identified and communicated in accordance with Requirement R4; or

• The instantaneous positive sequence voltage phase angle change is more than 25 electrical degrees at the high-side of the main power transformer and is initiated by a non-fault switching event on the transmission system; or

• The Volts per Hz (V/Hz) at the high-side of the main power transformer exceed 1.1 per unit for longer than 45 seconds or exceed 1.18 per unit for

longer than 2 seconds.

3 Includes no tripping associated with phase lock loop loss of synchronism; additionally, individual inverter or turbine tripping is not allowed.

ERCOT also recommends that Requirement R2, Part 2.1 and the surrounding language be reviewed and revised to clarify that the facility should continue to deliver the pre-disturbance level of current as appropriate, since power depends on voltage. In principle, during a disturbance active power should only reduce proportionally to voltage such that active current is consistent unless needed for frequency response. Reactive current should adjust as needed to support voltage (lead or lag as appropriate) up to its current limits. In general, the Requirement should neither incentivize entities to undersize inverters/converters nor impose onerous requirements to oversize this equipment. This lack of clarity may cause issues in enforcing this requirement and miss the reliability objective.

In addition, requiring a facility to deliver reactive power "according to its controller settings" is impractical and misses the objective. The requirement should be to ensure the proper response performance, as each facility operates according to its controller settings, even if those settings happen to be incorrect.

To address these issues, ERCOT recommends that the following portions of Requirement R2 be revised to read as follows:

R2. Each Generator Owner or Transmission Owner shall ensure the design and operation is such that the voltage performance for each facility adheres to the following during a voltage excursion, unless a documented equipment limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment]

2.1.1 Continue to deliver the pre-disturbance level of active ***current***, unless a different level of current is needed for frequency response.

2.1.2 Continue to deliver reactive ***current*** up to its reactive ***current*** limit, as appropriate to control voltage to within normal System Voltage Limits.

2.1.3 If the facility cannot meet 2.1.1 and 2.1.2 due to an apparent, active, or reactive current limit, when the applicable voltage is below .95 per unit and still within the continuous operation region, then preference shall be given to active or reactive current ***as well as allowed levels of reduction***, according to the Transmission Planner, Planning Coordinator, Reliability Coordinator, and Transmission Operator requirements.

2.6 Individual dispersed power producing resources must Ride-Through.

ERCOT appreciates the SDT's work on the purpose statement and believes that the purpose statement can be further clarified and simplified if it is revised to place the focus on PRC-029-1's intended effect of ensuring the units and facilities ride-through and perform as expected instead of focusing on "adhering" to requirements.

To achieve this objective, ERCOT recommends that the purpose statement be revised to read as follows: "To ensure that Inverter-Based Resources (IBRs) ride-through, during and after, defined frequency and voltage excursions while performing operationally as expected to support the Bulk-Power System (BPS)."

ERCOT is aware of an overarching concern that the RoCoF and phase angle jump requirements may be difficult to enforce for partial IBR tripping. Addressing this concern may be a matter of coordination of DFRs. If individual IBR units trip but the plant does not, DFRs may not trigger. PMUs would most likely not be fast enough to record the frequency or angle changes to validate performance. The appropriate NERC standard development teams should coordinate with each other to ensure that individual IBR unit trips trigger DFR recording.

ERCOT requests that the drafting team remove or provide additional explanation regarding the six-month gap between the PRC-028 effective date and the PRC-029 effective date in the Implementation Plan.

ERCOT also requests that the Implementation Plan be revised to clarify what constitutes being "in operation" (unit synchronization, full commercial operations, or some other milestone) for purposes of determining whether an IBR may be considered for a potential exemption under the Implementation Plan.

ERCOT encourages the SDT to review Requirement R4 and the Implementation Plan in their entirety and revise them as necessary to ensure they align with the directives regarding constraints and exemptions that FERC included in its recent Order on EOP-012-2 in Docket No. RD24-5-000. Each limitation should be confirmed before it is allowed to go into effect. ERCOT opposes the SDT's broad approach of allowing exemptions without some

level of confirmation of the impact of the exemption, such as an evaluation of the reliability impact of the exemption by a PC, RC, TP, or TOP. ERCOT believes that it is important for reliability to specifically require that limitations be modeled and provided to the PC/RC/TP/TOP. This is important enough that it should be explicitly referenced in the standard and should be required if a limitation is to be allowed/confirmed. Otherwise, the PC/RC/TP/TOP will receive limitations that cannot be modeled. A description of a limitation may not allow assessments and may limit determination studies that can be performed, resulting in a gap that reliability entities are expected to address, when the burden should be on generator owners to remove the limitation or improve the model fidelity. ERCOT believes the SDT's proposed approach misses the objective of FERC's directive that the RC/PC/TP/TOP should ensure that reliability is maintained while any allowed exemptions are in effect. PRC-029-1 should incentivize facility owners to explore whether less expensive upgrades can remove limitations rather than passing the burden of unmodeled limitations onto reliability entities that do not have the means to secure the system against limitations they cannot model properly.

Likes 0	
Dislikes 0	

Response

Jens Boemer - Electric Power Research Institute - NA - Not Applicable - NA - Not Applicable

Answer	
Document Name	

Comment

Introduction

The Electric Power Research Institute (EPRI)[1] respectfully submits these comments (This Response) in response to North American Electric Reliability Corporation (NERC)'s request for formal comment on Project 2020-02 Modifications to PRC-024 (Generator Ride-through), issued on June 18, 2024.

EPRI closely collaborates with its members inclusive of electric power utilities, Independent System Operators (ISOs), and Regional Transmission Organizations (RTOs), as well as numerous other stakeholders, domestically and internationally. In its role, EPRI conducts independent research and development relating to the generation, delivery, and use of electricity for public benefit by working to help make electricity more reliable, affordable and environmentally safe. EPRI's comments on this topic are technical in nature based upon EPRI's research, development, and demonstration experience over the last 50 years in planning, analyzing, and developing technologies for electric power.

EPRI research and technology transfer deliverables are generally accessible on its website to the public, either for free or for purchase, and occasionally subject to licensing, export control, and other requirements.[2] The publicly available and free-of-charge milestone reports from a U.S. Department of Energy (DOE)- and EPRI member-funded research project, Adaptive Protection and Validated Models to Enable Deployment of High Penetrations of Solar PV ("PV-MOD"), substantiate many of the comments made in This Response.[3]

While not a standards development organization (SDO) itself, EPRI conducts research and demonstration projects in relevant areas as well as facilitates knowledge transfer and collaboration that SDOs may, at times, use to inform technical and regulatory standards development, such as in Institute of Electrical and Electronics Engineers (IEEE), International Electrotechnical Commission (IEC), International Council on Large Electric Systems (CIGRE), and NERC.[4]

EPRI's comments in This Response address reliability and NERC's draft PRC-029 Reliability Standards for IBRs ride-through requirements developed under project 2020-02. All comments are aimed at providing independent technical information to respond to the draft published by NERC based on EPRI's research and development results and associated staff expertise and do not necessarily reflect the opinions of those supporting and working with EPRI to conduct collaborative research and development. Where appropriate, EPRI's comments do not only address the specific questions of the NOPR but also related scope that may help to inform a final order. Some of EPRI's comments presented in This Response have also been

submitted in response to the previous Federal Energy Regulatory Commission's (FERC) Notice of Proposed Rulemaking (NOPR) to direct North American Electric Reliability Corporation (NERC) to develop Reliability Standards for inverter-based resources (IBRs) that cover data sharing, model validation, planning and operational studies, and performance requirements (RM22-12), issued on November 17, 2022.

EPRI also submitted comments on the initial draft of PRC-029 which was issued on March 27, 2024. This 2nd set of EPRI comments supports the same direction as the previously submitted comments and offers a technical analysis based on the latest "Draft 2".[5]

Conclusion

EPRI appreciates the opportunity to provide NERC with its technical recommendations and comments on these important topics related to Reliability Standards for IBRs. EPRI looks forward to working with its members, NERC, and other stakeholders on providing further independent technical information on these important questions.

[1] EPRI is a nonprofit corporation organized under the laws of the District of Columbia Nonprofit Corporation Act and recognized as a tax-exempt organization under Section 501(c)(3) of the U.S. Internal Revenue Code of 1996, as amended, and acts in furtherance of its public benefit mission. EPRI was established in 1972 and has principal offices and laboratories located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass. EPRI conducts research and development relating to the generation, delivery, and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety, and the environment. EPRI also provides technology, policy and economic analyses to inform long-range research and development planning, as well as supports research in emerging technologies.

[2] https://www.epri.com (last accessed, April 22, 2024)

[3] PV-MOD Project Website. EPRI. Palo Alto, CA: 2024. [Online] https://www.epri.com/pvmod (last accessed, April 22, 2024)

[4] For transparency, we would like to disclose that EPRI collaborates with other organizations such as IEEE, IEC, CIGRE, and NERC; however, EPRI is not a regulatory- or standard-setting organization. EPRI research is often considered in the development of recommendations, guidelines, and best practices that are not determinative.

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

Likes 0	
Dislikes 0	

Response

Wes Baker - Silicon Ranch - NA - Not Applicable - NA - Not Applicable

Answer	
Document Name	

Comment

General

The SDT should consider specifying the grid conditions to which the ride-through requirements apply. The conditions should be bounded to some degree as the GO does not know the details of the transmission system and the range of operating conditions over the entire life of the plant.

R1

PRC-029 does not have an exception for transient overvoltage. This implies that the plant must ride through an unbounded transient voltage magnitude, which is unreasonable. Power electronic devices are sensitive to voltage and current. Equipment vendors and plant designers need to have clear performance requirements to design their equipment and plants to meet and be able to protect their equipment from damage when conditions are outside of these performance requirements. The SDT should consider adding an exception for transient overvoltage similar to IEEE

2800-2022 Clause 7.2.

R2
R2.1
Requirements for operating within the continuous operating range do not seem to be in scope with a ride-through standard. Additionally, these requirements are incomplete if the SDT intends to specify how the plant shall perform when voltage and frequency are within the continuous operating range. The SDT should consider removing R2.1.

R2.2

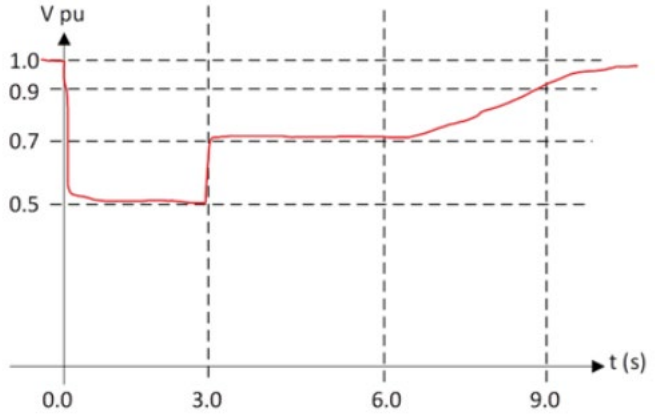
- Given that this requirement is at the IBR plant level, it is unclear how 'maximum capability' is defined. The SDT should consider clarifying in the standard what the IBR plant's 'maximum capability'technically refers to.
- During a mandatory operating range, it is more appropriate to use 'current' rather than 'power' since power is a function of voltage. The SDT should replace all references to 'power' with 'current' for voltage outside the continuous operating range.
- The response of the IBR during HVRT and LVRT is typically dictated by the inverterlevel control based on inverter terminal voltage. The inverter does not have information about the high side of the main power transformer voltage at the required time scale. Additionally, there are multiple transformers with different winding configurations (e.g., delta, wye, wye-grounded) between the POI/POM where the PRC-029 requirement applies and the inverter terminal where the control is implemented. Using positive and negative sequence reactive current consistent with IEEE 2800-2022 Clause 7.2 is more practical than the 'affected phases.' The key is that the IBR should regulate the positive sequence and negative sequence voltage. This is the resulting effect of the IBR injecting positive and negative sequence reactive current based on positive and negative sequence voltage, /';'[‘respectively, and is consistent with how a synchronous machine naturally responds to asymmetrical disturbance. The SDT should consider making the current injection requirements applicable at the inverter terminal and based on sequence components consistent with IEEE 2800-2022 Clause 7.2.

R2.3.1
The use of 'positive sequence voltage' with respect to the continuous and mandatory operating range is not consistent with the rest of the standard which uses max/min of phase-phase or phase-ground fundamental frequency RMS voltage. For consistency, the SDT should change positive sequence voltage to max/min of phase-phase or phase-ground fundamental frequency RMS voltage.

R2.4
The requirement, as written, may not be practical for assessing compliance/noncompliance for the GO. The voltage at the IBR plant would also depend on the grid, including neighboring plants. Therefore, the IBR plant itself is unlikely to cause the plant to exceed the high voltage thresholds but certainly may contribute to the overvoltage. The SDT should consider removing this requirement and lumping it together with R2.2, adding requirements to the response time consistent with IEEE 2800-2022 Clause 7.2. If the IBR actively regulates the positive and negative sequence voltage quickly, the effect is as desired and can be readily assessed for compliance.

R3
The frequency ride-through requirements are much more stringent than IEEE 2800-2022 Clause 7.3. The SDT should provide more justification, beyond what is described in the Technical Rationale, as to why this range of frequency ride-through is required. Additionally, the SDT should ensure that due diligence has been done with vendors of the various equipment to ensure that this requirement is reasonable, and achievable with available technology.

Attachment 1
Tables 1 and 2 and numbered item 8
By using voltage bands (e.g., 0.7 <= V < 0.9) and time durations this results in a much more stringent requirement than IEEE 2800-2022 Clause 7. The SDT should consider removing the voltage bands to align with IEEE 2800-2022 Clause 7. Take this example where the red is a fictitious voltage plot:



Comparison of standards:

- IEEE 2800 Clause 7:
  - V < 0.9 pu ~ 8 seconds
  - V < 0.7 pu ~ 3 seconds
  - There is not an interpretation where the IBR has to ride through this LVRT in

IEEE 2800 Clause 7.

- PRC029 :
  - 0.7 <= V < 0.9 pu ~ 5 seconds.
  - 0.5 <= V < 0.7 pu ~ 3 seconds.
  - PRC-029 as written implies the IBR has to ride-through.

Numbered item 11
The standard should not specify how protection functions must be implemented. Instead, it should describe the required performance. Further, this requirement implies that the plant must ride through an unbounded voltage magnitude, which is not reasonable. As written, this item does not allow for tripping caused by excessive transient over-voltage (TOV) events. Power electronic devices are sensitive to voltage and current. Equipment vendors and plant designers need to have clear performance requirements to design their equipment and plants to meet and be able to protect their equipment from damage when conditions are outside of these performance requirements

Likes 0	
Dislikes 0	
Response	

Comments received from LG&E/KU

Questions

2. Provide any additional comments for the Drafting Team to consider, if desired.

Comments:
All comments below pertain to PRC-029-1.

LG&E/KU agrees with the applicability concerns of EEI and suggests removing TOs and VSC-HVDC systems from this standard.

LG&E/KU also agrees with EEI that the requirements listing the TP, PC, RC, or TOP should clarify responsibility and include the responsible entity in the applicability of this standard. Alternatively, these listings may be sufficiently replaced with a requirement to adhere to applicable Facility interconnection requirements (e.g., "preference shall be given to active or reactive power according **to applicable Facility interconnection requirements**").

The following additional comments are provided:

Requirement R1

Footnote 3 in Requirement R1 is unnecessary as the term "Ride-through" includes remaining synchronized.
The following edit should be made to Requirement R1 to clarify responsibility is only for Facilities (note "Facility" is a NERC defined term and should be capitalized) under the responsible entities ownership:
… shall ensure the design and operation ~~is such that each~~ **of its IBR Facilities** ~~facility~~ adheres to Ride-through requirements~~, in accordance with the "must Ride-through[3] zone" as~~ specified in Attachment 1, except for …
The following edit is suggested for bullet 1 under Requirement R1:

The ~~facility~~ **IBR Facility** ~~needed to~~ electrically disconnect**s** in order to clear a fault; **or**

Measure M1

Measure M1 adds to the scope of Requirement R1. Measures should only describe how compliance with the associated Requirement will be assessed, not add to the scope of the Requirement itself. For example, Measure M1 strongly suggests that "dynamic simulations" and "studies" are the only acceptable forms of evidence for determining ride-through capability. However, Requirement R1 does not have any explicit requirement to perform analysis.
Measure M1 also states disturbance monitoring data is required to demonstrate adherence to Ride-through requirements. It is unclear what is required here since IBR Facilities will be online and operating normally most of the time. The most recent draft of PRC-030-1 already includes requirements for analyzing "Ride-through performance" in situations where the IBR Facility significantly reduces active power output (which would include tripping). It is more appropriate to analyze failed Ride-through than it is to provide immense quantities of data showing the IBR Facility is operating normally.
Measure M1 references only one of the exceptions listed under Requirement R1.
The following edit is suggested for Measure M1 (responsibility issues should also be addressed, as noted previously):

Each Generator Owner ~~and Transmission Owner~~ **shall** have evidence of ~~dynamic simulations, studies, or other evidence to demonstrate~~ **that** the design **and operation** of each **of its IBR Facilities** ~~facility will~~ adhere**s** to **the** Ride-through requirements~~, as~~ specified in **Attachment 1**~~Requirement R1. Each Generator Owner and Transmission Owner have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) to demonstrate that the operation of each facility did adhere to Ride-through requirements, as specified in Requirement R1. If the Generator Owner and Transmission Owner choose to utilize~~ **If failed** Ride-through **occurs for conditions exempted in Requirement R1** ~~exemptions that occur within the "must Ride-through zone" and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then~~ each Generator Owner ~~and Transmission Owner~~ **shall** ~~also~~ have evidence of **the conditions** ~~actual disturbance monitoring (i.e. Sequence of Event~~

~~Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate that the facility failed to Ride-through during a phase jump of greater than or equal to 25 electrical degrees, and documentation from their Transmission Planner, Reliability Coordinator, Planning Coordinator, or Transmission Operator that a non-fault initiated switching event occurred~~.

Requirement R2

Requirement R2 addresses performance during the Ride-through conditions of Requirement R1 and should establish a clear link. There is also inconsistency in that Requirement R2 only exempts documented equipment limitations and none of the other exemptions in Requirement R1. The following edit is suggested for Requirement R2:

… shall ensure the design and operation ~~is such that~~ **of** the voltage performance ~~for~~ **of its IBR Facilities** ~~each facility~~ adheres to the following during **conditions requiring Ride-through** ~~a voltage excursion, unless a documented equipment limitation exists~~ in accordance with Requirement R**1**~~4~~.

Each part of Requirement R2 refers to the "voltage at the high-side of the main power transformer". Attachment 1 already states in item (6) that the applicable voltage is at the high-side of the main power transformer. Thus, each part of Requirement R2 should be condensed as follows:

~~While the voltage at the high-side of the main power transformer remains w~~**W**ithin the continuous operation region ~~as~~ specified in Attachment 1, ~~each facility~~ **IBR Facilities** shall:

Requirement R2 part 2.1.2 should be removed. Delivering reactive power "up to its reactive power limit and according to its controller settings" wouldn't appear to be anything other than normal operation.

Requirement R2 part 2.1.3 is clearly intended to mirror a similar requirement in IEEE 2800-2022 subclause 7.2.2.2. However it makes two errors, and unnecessarily restates the voltage is in the continuous operating region (Requirement R2 part 2.1 already includes this condition). Correct as follows:

If the **IBR Facility** ~~facility~~ cannot deliver both active and reactive power due to a current limit or ~~reactive~~ **apparent** power limit, when the voltage is below **0.**95 per unit ~~and still within the continuous operation region~~, then preference shall be given to active or reactive power according to requirements ~~if required by~~ **of** the Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator.

It is understood that the DT had "apparent power limit" in the first draft of this standard and has now replaced it with "reactive power limit" following comments. However, this is an error. The apparent power limit is a limit of the inverter and not the PPC as suggested in some of the comments. IEEE 2800-2022 correctly states the limit is "apparent" power. I.e., an inverter has an MVA limit and there may be times when the inverter is called on to produce more total MVA (MW and MVAR) than it is able to. It is in this case that the inverter must prioritize MW or MVAR.

The language of Requirement R2 part 2.2 is unnecessarily confusing. Attachment 1 already indicates the boundaries of the mandatory operating region and they are delineated by RMS voltages. Suggested simplification and clarification:

~~While voltage at the high-side of the main power transformer is w~~**W**ithin the mandatory operation region ~~as~~ specified in Attachment 1, ~~each~~ **an** IBR **Facility** shall **continue to** exchange current~~,~~ up to ~~the~~ **its** maximum **limit** ~~capability to~~ **and** provide voltage support**.**~~, on the affected phases during both~~

~~symmetrical and asymmetrical voltage disturbances, either under~~[6]~~:~~ • **IBR Facilities shall operate in** ~~R~~reactive power priority by default~~;~~**,** or ~~•~~ **in** ~~A~~active power priority if required by the Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator.

Footnote 6 is unnecessary for this standard. Entities that wish to specify the magnitude of current injections during disturbances should do so in their Facility Interconnection Requirements.

Suggesting the following simplification of Requirement R2 part 2.3.1:

If a**n IBR Facility** ~~facility~~ enters current block**ing** mode, it shall restart current exchange in less than or equal to five cycles of ~~positive sequence voltage~~ returning to **the** ~~a~~ continuous operation region or mandatory operation region.

Suggesting the following simplification of Requirement R2 part 2.5:

~~Each facility~~ **IBR Facilities** shall restore active power output to the pre-disturbance or available level ~~(~~**,** whichever is less~~er)~~**,** within 1.0 second ~~when the voltage at the high-side of the main power transformer~~ **upon** return**ing**~~s from the mandatory operation region or permissive operation region (including operating in current block mode),~~ **to the continuous operating region** as specified in Attachment 1, unless the Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator **specifies otherwise** ~~requires a lower post-disturbance active power level requirement or requires a different post-disturbance active power restoration time~~.

Footnote 7 introduces confusion as it pertains to “frequency excursions” which is taken to mean conditions necessitating Ride-through. In this case, Requirement R3 and R4 would apply. Suggesting removal of this footnote.

Requirement R3

Suggesting the following simplification of Requirement R3 (to align with suggestions for Requirement R1):

… shall ensure the design and operation ~~is such that each facility~~ **of its IBR Facilities** adheres to Ride-through requirements ~~during a frequency excursion event whereby the System frequency remains within the “must Ridethrough zone” according to~~ **specified in** Attachment 2 ~~and~~ **when** the absolute rate of change of frequency (RoCoF)[8] magnitude is less than or equal to 5 Hz/second.

Measure M3

Measure M3 oversteps Requirement R3 similar to the M1/R1 discussion above. Suggested revision:

Each Generator Owner and Transmission Owner **shall** have evidence ~~of dynamic simulations, studies, or other evidence to demonstrate~~ **that** the design **and operation** of each **of its IBR Facility** ~~facility will~~ adhere**s** to **the** Ride-through requirements~~, as~~ specified in **Attachment 2** ~~Requirement R3. Each Generator Owner and Transmission Owner also have evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate the operation of each facility did adhere to~~ **If failed** Ride-through ~~requirements, as specified in Requirement R3, during each frequency excursion event measured at the high-side of the main power transformer~~ **occurs for RoCoF magnitude greater than 5 Hz/second, each Generator Owner and Transmission Owner shall have evidence of the condition.**

Requirement R4

Requirement R4 is unwisely linked to the effective date of PRC-029-1. This makes sense at the initial effective date, but it excludes IBR Facilities that come in-service *after* the effective date. Further, it doesn't address failure to meet *frequency* Ride-through requirements. It appears to unnecessarily call out hardware limitations when software limitations can also be problematic. Finally, it seems to imply an exemption process exists but does not say who can grant an exemption or what the requirements for exemption are (e.g., is it subject to approval of the technical documentation?). The following revision is suggested:

If a ~~Each~~ Generator Owner ~~and Transmission Owner~~ identifies~~ying~~ **one of its IBR Facilities** ~~facility that is in-service by the effective date of PRC-029-1,~~ has known ~~hardware~~ limitations that prevent ~~the facility from~~ meeting ~~voltage~~ **the** Ride-through requirements ~~criteria as detailed in~~ **of** Requirements R1**, R2,** ~~and~~ **or** R3~~2~~, ~~and requires an exemption from specific voltage Ride-through criteria~~ **the Generator Owner** shall:

Below are suggested edits in various parts of Requirement R4 to align with the body of R4 suggested above:

(4.1) Document ~~information supporting~~ the ~~identified~~ ~~hardware~~ limitation no later than 12 months ~~following the effective date of PRC-029-1~~ **after it is identified**.

(4.1.2) Which aspects of voltage **or frequency R**~~r~~ide-through requirements ~~that~~ the IBR **Facility is** ~~would be~~ unable to meet and the capability of the equipment due to the limitation;

(4.1.4) Supporting technical documentation ~~verifying~~ **explaining** if the limitation is due to hardware that needs to be physically replaced or ~~that~~ **if** the limitation can~~not~~ be removed by software updates or setting changes, and;

(4.2) **Request an exemption from [whom?] by p**~~P~~rovid**ing**~~e~~ a copy of the information detailed in Requirement R4.1 to the applicable Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), Reliability Coordinator(s), and to the Regional Entity no later than 12 months ~~following the effective date of PRC-029-1~~ **after the limitation is identified**.

(4.2.1) Any response to additional information requested by the applicable Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), Reliability Coordinator(s), ~~and to the~~ **or** Regional Entity shall be provided ~~back to the requestor~~ within 90 days of the request.

(4.3) Each Generator Owner and Transmission Owner with a previously submitted request for exemption that ~~replace the equipment causing~~ **corrects** the limitation shall document and communicate ~~such an equipment change~~ **the correction** to the associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), and Reliability Coordinator(s) within 90 days of the **correction** ~~equipment change~~.

(4.3.1) When ~~existing equipment is replaced~~ **an exempted Ride-through limitation is corrected**, the exemption ~~for that Ride-through criteria~~ no longer applies.

Much of Requirement R4 concerns an exemption process which is poorly defined. Other standards, including others currently being developed for IBRs due to FERC directives, have utilized language requiring "Corrective Action Plans" for certain failures. The DT should consider if alignment with these

standards is appropriate and should revisit the scope of the SAR for this project. Regardless, the DT must address several key issues that it has created by introducing the exemption language:

- Who grants the exemption?
- How long does the approving entity have to grant or deny an exemption?
- Is an IBR Facility out of compliance if it has requested an exemption but the exemption has not yet been granted?
- Is there still a requirement to fix the issue if you have an exemption?
- What if an IBR Facility is unable to meet the Ride-through requirements without a significant investment (e.g., replacing every inverter with new models)?

Measure M4

Measure M4 should be substantially revised to reflect the concerns addressed in the comments above.

Attachment 1

Regarding Table 1 of Attachment 1, row 2 appears to use the incorrect operator and should be corrected as follows: "≤ 1.20 and > 1.1".

Row 4 of Table 1 and Table 2 lists "Continuous" as a time where "∞" would be more appropriate.

It is recommended to remove footnotes 12 and 14 and place "May Ride-through Zone" directly into the table, e.g., "N/A (May Ride-through Zone)".

Item (2)(b) of Attachment 1 references "hybrid plants consisting of photovoltaic (PV) and BESS" but does not address hybrid plants with other components. Item (4) says Table 2 applies to hybrid facilities with no wind. IEEE 2800-2022 clarifies that it does not apply to synchronous components of hybrid plants. PRC-029-1 needs to be more careful in its wording regarding hybrid plants.

Item (6) of Attachment 1 defines the applicable voltage as the high-side of the MPT and does not give the PC/TP/TO/etc. any flexibility to change that. Some entities with IEEE 2800-2022 requirements have adjusted the Reference Point of Applicability for Ride-through to the POI for various reasons (including that they may install monitoring equipment at that location rather than at the MPT). PRC-029-1 should not remove the flexibility of PC/TP/TO/etc. to alter the point of applicability.

Figure 1 of Attachment 1 uses the old "No-Trip Zone" label which is not used anywhere else in PRC-029-1.

Attachment 2

Regarding Table 3 of Attachment 2, "May trip" on rows 1 and 9 should be replaced with "N/A" for consistency with Table 1 and Table 2. It is unclear why the frequency values are unaligned (and exceed) IEEE 2800-2022 when the voltage Ride-through requirements of PRC-029-1 are aligned with IEEE 2800-2022. It is not prudent to exceed the requirements of IEEE 2800-2022 when 1) it already significantly exceeds PRC-024-3, and 2) it is recognized as an industry standard for utilities, developers, OEMs, etc.

Rows 5 and 6 of Table 3 have incorrect operators and row 6 includes an incorrect number (58.8 instead of 58.5).

Finally, item (1) of Attachment 2 defines the applicable frequency at the high-side of the MPT and does not give the PC/TP/TO/etc. any flexibility to change that. As noted above, some entities with IEEE 2800-2022 based requirements use the POI as the RPA for Ride-through capability.

Response