INTERCONNECTION INNOVATION e-XCHANGE
U.S. DEPARTMENT OF ENERGY

Forum for the Implementation of Reliability Standards for Transmission (i2X FIRST) | 06/04/26

A DOE initiative supported by the Office of Critical Minerals and Energy Innovation (CMEI)

EPRI
ELEVATE ENERGY CONSULTING
ESIG
BERKELEY LAB

The first half of this meeting call is being recorded and may be posted on ESIG's website. If you do not wish to have your voice recorded, please do not speak during the call. If you do not wish to have your image recorded, please turn off your camera or participate by phone. If you speak during the call or use a video connection, you are presumed consent to recording and use of your voice or image.

Deep Dive NERC PRC-029 Implementation Updates - Agenda

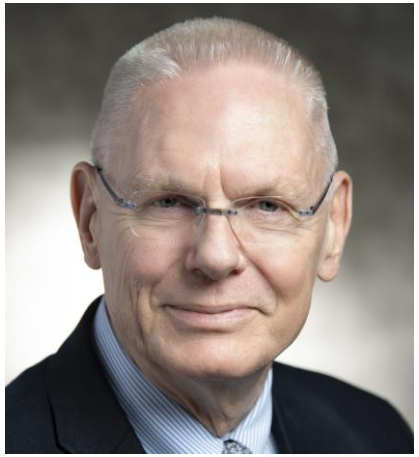
- **Meeting Introduction:** Julia Matevosyan, ESIG
- **Project 2025-05 Ride-Through Revisions:** Eugen Starschich, Siemens Energy
- **How PRC-029-01 Compliance Can Be Assessed Using IEEE 2800.2 Tools**: Jens Boemer, EPRI
- **Implementation Guidance for PRC-029-01:** Tim Taylor, SEIA & Ryan Quint, Elevate Energy Consulting
- **Developer / Generator Owner Perspective on Challenges and Solutions with PRC-029 Compliance Assessment:** Katie Iversen, AES
- **Audience Q&A and Structured Discussion**, led by Julia Matevosyan, ESIG

Key Goals and Outcomes from i2X FIRST

- To facilitate understanding and adoption of new and recently updated standards relevant for existing and newly interconnecting inverter-based resources.
- The Forum will convene the industry stakeholders to enable practical and more harmonized implementation of these interconnection standards.
- The presentation portion of the meeting will be recorded and posted, and presentation slides will be shared.
- Additionally, the leadership team will produce **a summary of each meeting** capturing:
  - Recommended best practices
  - Challenges
  - Gaps that require future work

Leadership Team

Cynthia Bothwell, Boston Government Services, contractor to DOE



Robert Reedy, Lindahl Reed, contractor to DOE

Will Gorman, Lawrence Berkley National Laboratory

Jens Boemer, Electric Power Research Institute

Julia Matevosyan, Energy Systems Integration Group

Ryan Quint, Elevate Energy Consulting

i2X FIRST Meetings – Re-cap Season 2

Season 2 focused on the practical implementation of IBR interconnection requirements and standards, covering the full project lifecycle. Focus on IEEE 2800 and new NERC Standards for IBRs (following FERC Order 901).

Key Themes:

- Standards, Compliance, and Conformity Assessment (focusing on IEEE 2800 and new NERC Standards)
- IBR Plant Design and Performance Requirements
- Modeling Requirements and Best Practice
- Change Management and Commissioning Best Practices
- Reliability Standards Implementation and Lessons Learned
- Grid-Forming IBRs and Future Reliability Needs

Follow ESIG i2X FIRST website https://www.esig.energy/i2x-first-forum/doe-i2x-season-2/ for meeting materials & recordings

i2X FIRST Meetings – Season 3

Season 3 will continue focusing on emerging reliability standards and recommended practices for conformity assessment. The series will provide deep dives into NERC standard initiatives, and IEEE 2800/2800.2 implementation.

1. **June 4, 2026, 11 a.m. - 1 p.m. ET: Deep Dive NERC PRC-029 Implementation Updates**
2. August 6, 2026, 11 a.m.- 1 p.m. ET: NERC Milestone 4 Projects and NERC Project 2022-04 EMT Modeling
3. October 2026 hybrid session during ESIG Fall Technical Workshop – IEEE 2800.2 Deep Dive
4. January 14, 2027: IEEE 2800 Updates Session

Follow ESIG i2X FIRST website: https://www.esig.energy/i2x-initiatives/#i2X-Season-3 for meeting materials & recordings and for future meeting details, agendas, and to register!

DOE i2x What's New?

NEW THIS YEAR!!!

- **I2x STITCH (Studies, Tools, and InTerconnection Consistency & Harmonization):** Nine meetings May through March. Facilitate a forum (similar format to i2x FIRST) to:
  - summarize current interconnection study approaches,
  - identify opportunities to standardize/harmonize interconnection study methods,
  - identify industry best practices, and
  - discuss remaining gaps in this focus area.

- **i2x Technical Assistance Hours -** provide technical assistance to interconnection stakeholders focused on adoption of a harmonized and/or comprehensive interconnection requirements or standards. One-one sessions with ESIG and Elevate Energy Consulting for key interconnection stakeholders.

https://www.esig.energy/i2x-initiatives/

Deep Dive NERC PRC-029 Implementation Updates - Agenda

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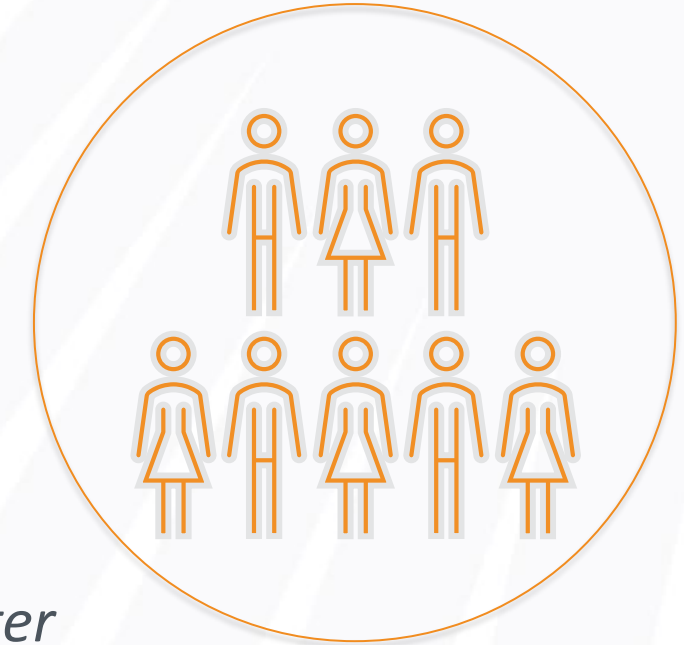
Virtual Meetings Code of Conduct

1. *Assume good faith and respect differences*
2. *Listen actively and respectfully*
3. *Use "Yes and" to build on others' ideas*
4. *Please self-edit and encourage others to speak up*
5. *Seek to learn from others*
6. *Please go to slido to ask questions: **slido.com** and enter event code **FIRST1***



Mutual Respect . Collaboration . Openness

Stakeholder Presentations

Virtual Meetings Code of Conduct

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Mutual Respect . Collaboration . Openness

Q & A Session

Interactive Group Discussion Topics

Topic #1: What is the best practice to identify legacy/inflight IBR plant's limitations to comply with NERC PRC-029

- Please go to slido to make comments and add questions of your own: **slido.com** and enter event code **FIRST1**
- For verbal commentary, please use the raise hand feature and we will call on you
- Additional related / associated questions:
  - Is equipment documentation alone sufficient evidence, if not, what is sufficient?
  - What to do when equipment hasn't been tested to PRC-029 limits?
  - How to verify limitations of an entire IBR plant, when EMT models are not available/not detailed enough/not accurate enough?
  - Are there OEM databases listing equipment capabilities and limitations relative to PRC-029 ride-through requirements?

Topic #2: What are the best practices to streamline the assessment of legacy/inflight plants' capability to comply with PRC-029?

- Please go to slido to make comments and add questions of your own: **slido.com** and enter event code **FIRST1**
- For verbal commentary, please use the raise hand feature and we will call on you
- Additional related / associated questions:
  - Can OEMs streamline the assessment of existing equipment capabilities and provide same information to all equipment users?
  - Can acceptable evidence of limitations be agreed upon and same set produced for all IBR plants or are the plant-by-plant nuances?
  - Are there any lessons learned that should be considered for new IBR plants (e.g. IBR unit type tests, IBR unit compatibility certification, modeling details, documentation, support contracts with OEMs etc.)?

RELIABILITY | RESILIENCE | SECURITY

POWERING TODAY. PROTECTING TOMORROW.

NERC

Project 2025-05 Ride-Through Revisions

Revisions to PRC-029-1

Eugen Starschich, Drafting Team Chair
Rajat Majumder, Drafting Team Vice Chair

June 4th, 2026

FERC Order No. 909

FERC Order No. 909 - Timeline

- FERC Issued Order No. 909 on **July 24, 2025**
  - Approved NERC Standard PRC-029-1
  - Approved Implementation Plan for Standard PRC-029-1

- Effective Date of FERC's rule **August 28, 2025**

- Effective Date of PRC 029-1 **October 1, 2026 (USA)**

- FERC directed NERC to submit a responsive modification to PRC-029-1
  - Submit within 12 months of the effective date of FERC's rule: **August 28, 2026**

FERC Order No. 909 - Modifications

Address 3 concerns within modification

- Provide greater clarity on documentation obligations to support exemptions for legacy IBRs
- Address limited exemptions for IBR facilities currently under development but not in-service on the effective date of PRC-029-1
- Address targeted and limited exemptions for High-Voltage Direct Current (HVDC) connected IBRs

FERC Order No. 909 - Timeline

Anticipated Actions	Date
SAR modifications by DT and approval	February 2026
30-day formal comment period with ballot	April 16 – May 18, 2026
20-day formal comment period ballot	June 2026
5-day final ballot	July 2026
Board adoption	August 2026

Clarify exemption documentation requirements contained in Requirement R4

Clarity for Requirement R4 Documentation

- Drafting Team determined a non-exhaustive list of *specific* acceptable documents would create additional questions

- Established a list of *documentation categories* that would provide technical evidence for hardware limitation(s)
  - *Equipment vendor documentation of the hardware limitation;*
  - *Written engineering analysis;*
  - *Test results;*
  - *Operational data experience supported by an engineering analysis*

Clarity for Requirement R4 Documentation

PRC 029-1 Requirement R4, Part 4.3.1

4.3.1 When existing hardware causing the limitation is replaced, the exemption for that Ride-through criteria no longer applies.

- Drafting team provided additional clarity on the “hardware causing the limitation” by further definition of this term:

  NOTE: In the context of this standard, the hardware causing the limitation sought in Requirement R4 shall be understood as an integrated system of components.

  For the purpose of this standard, integrated system means a combination of components such that a replacement of any subset of components would not allow the combination of components to remove the previously documented limitation.

Example #1

Converter is the hardware directly causing the limitation and converters on wind turbines comprising the IBR are planned for replacement - however, a replacement converter that would facilitate compliance with the Ride-through Criteria is not commercially available or technically feasible (this could be due to a replacement converter facilitating compliance not being commercially available, being commercially available but its use causing other wind turbine components to operate outside of their design envelope i.e., non-compatible, or the replacement converter being available but unsuitable for the application i.e., doesn't fit dimensionally).

Exemption is therefore applicable for the Integrated set/combination of components that would need replaced to facilitate compliance - the entire wind turbine and its subcomponents, including converter, generator, nacelle/drivetrain, hub, blades, pitch and yaw systems, tower, foundation, etc.

Example #2

Converter is again the hardware directly causing the limitation. In this example - the converters on a subset (let's assume 10%) of the total turbines comprising the IBR require replacement of their converters due to equipment failures/maintenance trigger. For this example, there is a commercially available replacement converter that would facilitate compliance with Ride-through Criteria. Although converters on a subset of the turbines are now compliant-capable, the exemption remains on the plant level.

Extend exemption eligibility to IBR projects in active development with limited scope

Exemption for "Long-lead Time" Projects

New Inverter-Based Resources that will be **in-service** after the effective date of PRC-029-1 will qualify for hardware limitation exemptions if the project meets the following criteria:

1. *An executed interconnection agreement by the effective date of PRC-029-1;*

   AND
2. *An executed equipment procurement contract for hardware causing the limitation, prior to the first day of the first month following FERC effective date of PRC-029-1*

These dates are in alignment with FERC's directive to keep the allowable exemptions limited in scope.

PRC-029-2: in-service

Footnote 10 clarifies “in service” definition:

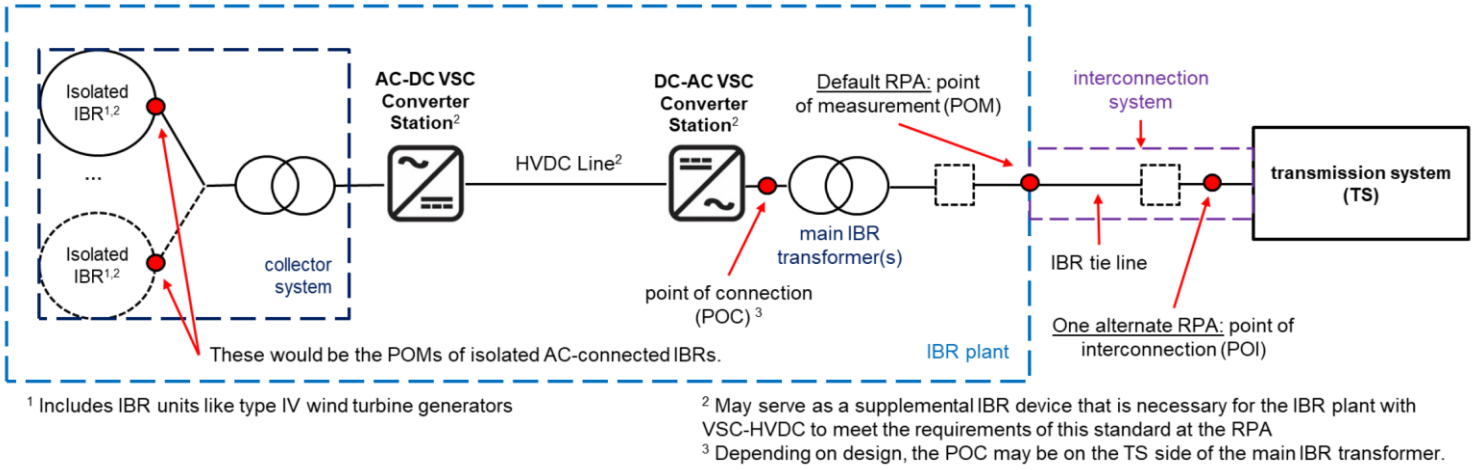
[10] For the purpose of this Standard the "in-service date" will have the same meaning as in the FERC pro forma LGIA.

STANDARD LARGE GENERATOR INTERCONNECTION AGREEMENT (LGIA)

In-Service Date shall mean the date upon which the Interconnection Customer reasonably expects it will be ready to begin use of the Transmission Provider’s Interconnection Facilities to obtain back feed power.

Recognize Ride-through performance capabilities and thermal design limitations associated with HVDC-connected IBRs using DC or AC chopper technology

HVDC Choppers



IEEE Std 2800-2022

- Applied in systems where HVDC system connects remote/islanded network to the transmission system (TS)
- HVDC system decouples the islanded network from the TS and therefore from TS faults
- During TS faults, the surplus energy from the islanded network is dissipated as heat in the resistors of AC or DC choppers
- The chopper approach ensures a reliable power recovery from the islanded networks after TS fault clearance

Why do HVDC Choppers Require Additional Exemption?

NERC

PRC 029-1 Attachment 1

7. *If voltage is continuously varying over time, it is necessary to add the duration within each band of Tables 1 and 2 over any 10 second time period.*
8. *The specified duration of the mandatory operation regions and the permissive operation regions in Tables 1 and 2 is cumulative over one or more disturbances within any 10 second time period.*
9. *The IBR 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.*

This criteria requires the choppers to continue to absorb energy for an infinite number of 10-second time periods without considering any thermal limitations.

Proposed Solution – PRC-029-2

PRC 029-2 Attachment 1

12. A VSC-HVDC connected Inverter-Based Resource is not required to comply with items 7, 8, and 9 when it includes an AC or DC chopper and it reaches its designed hardware thermal energy absorption limit. In that case:

- *The energy absorption capability of the chopper shall be designed to be at least 2 seconds at the rated power of the VSC-HVDC system.*
- *The Generator Owner shall coordinate with the Transmission Planner, Transmission Owner and Transmission Operator to establish mutually agreed operational measures based on the VSC-HVDC capabilities.*
- *The Generator Owner documents the chopper capability, the associated thermal limitation that may limit the Inverter-Based Resource from meeting Items 7, 8, or 9.*
- *This documentation shall be provided to the associated Transmission Planner(s), Transmission Owner(s), Transmission Operator(s).*

Proposed Solution – PRC-029-2

PRC 029-2 Attachment 1

- Proposed HVDC exemption is targeted and limited in scope while looking to the future reliability of the Bulk Power System
- Only **two** generator connections in operation or construction in North America are utilizing AC or DC chopper technology
- Transmission Planer(s), Transmission Owner(s) and Operator(s) are invited to collaborate with the Generator Owner on mutually agreed-upon design and performance considerations

NERC

Discussion

How PRC-029-01 Compliance Can Be Assessed Using IEEE 2800.2 Procedures and Tools

i2X FIRST—Season 3

Jens C. Boemer
Jose Cordova

Thursday, June 4, 2026

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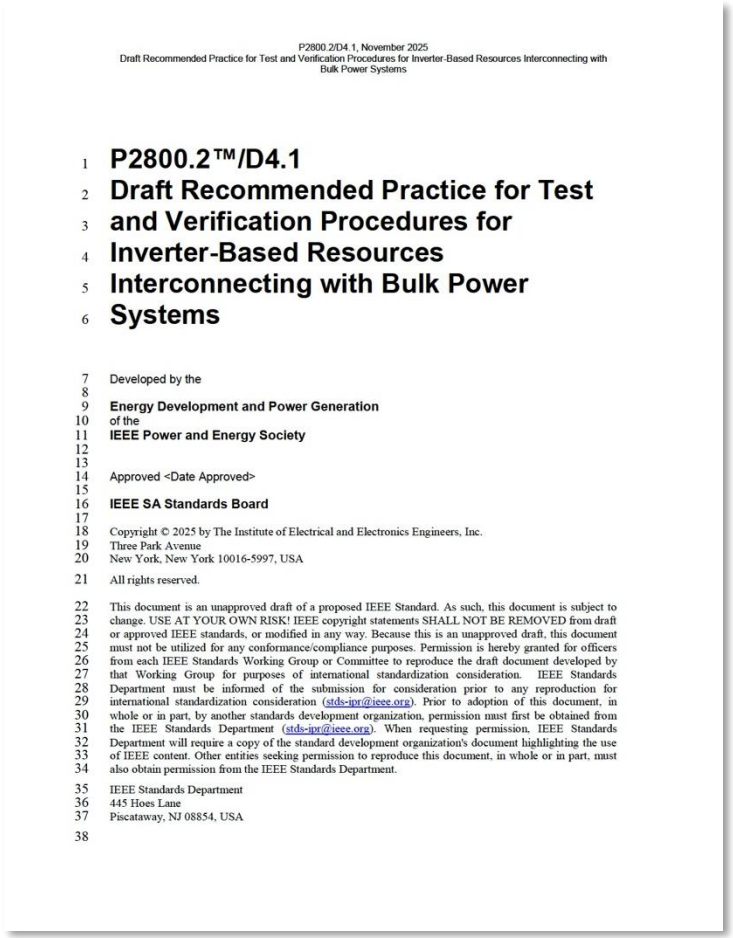
IEEE Std 2800.2™-2026

- Harmonizes **test and verification** procedures for **conformity assessment** of **large solar**, **wind** and **storage plants**, and **any IBR connected via VSC-HVDC** like offshore wind
- A **consensus-based** IEEE Recommended Practice developed by over ~170 Working Group participants from utilities, system operators, transmission planners, IBR developers & OEMs, and consultants over 4 years
- Passed the IEEE SA ballot among 231 SA balloters with high approvals **(>96% approval**, >90% response rate)
- **Expected to be published in June 2026**



P2800.2/D4.1, November 2025
Draft Recommended Practice for Test and Verification Procedures for Inverter-Based Resources Interconnecting with Bulk Power Systems

P2800.2™/D4.1
Draft Recommended Practice for Test and Verification Procedures for Inverter-Based Resources Interconnecting with Bulk Power Systems

Developed by the

Energy Development and Power Generation
of the
IEEE Power and Energy Society

Approved <Date Approved>

IEEE SA Standards Board

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Available from IEEE at https://standards.ieee.org/ieee/2800.2/10616/
Latest Draft 4.1 is available via IEEExplore at
https://ieeexplore.ieee.org/document/11261433

Technical Foundation Enables Paradigm Shift Towards *Conformity Assessment*

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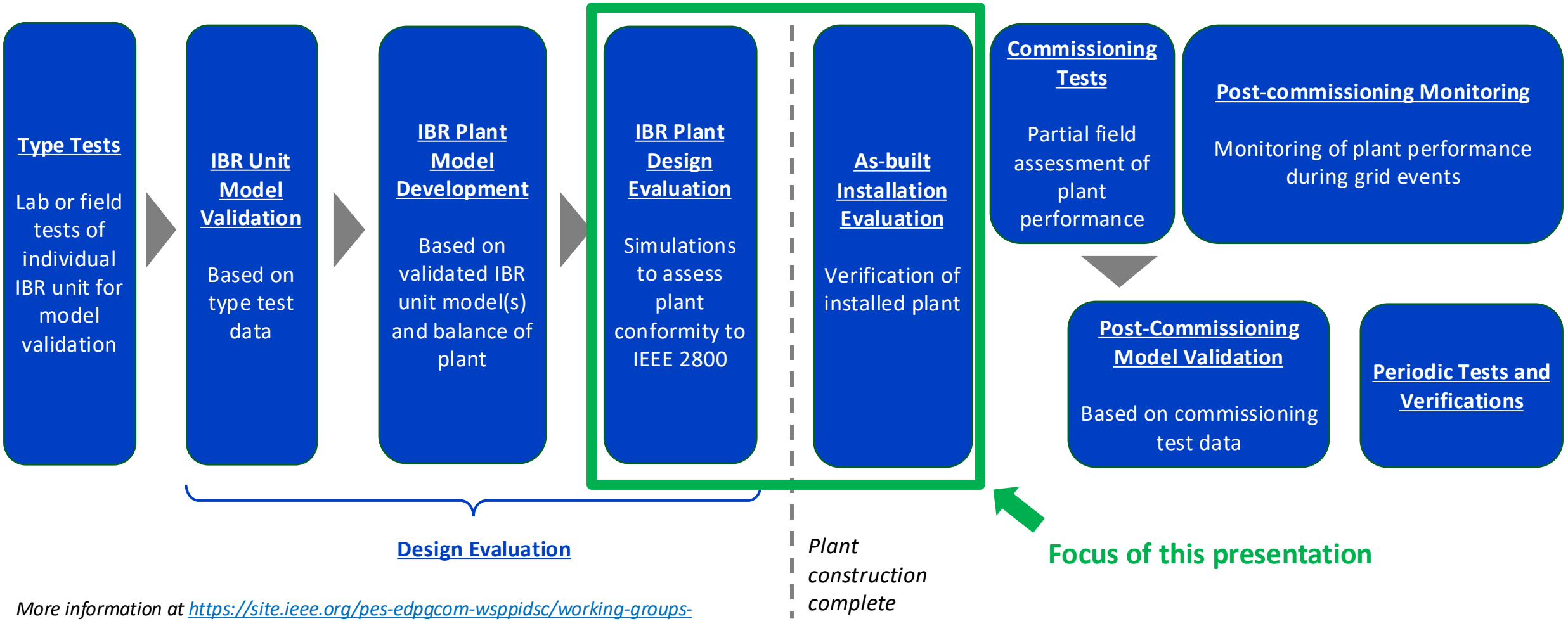
IEEE 2800-2022 and IEEE 2800.2 Conformity Framework



More information at https://site.ieee.org/pes-edpgcom-wsppidsc/working-groups-and-task-forces/ and expression of interest to participate here.

Could this support PRC-029-1 compliance assessment?

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First Things First—How similar are the ride-through requirements in PRC-029-1 and IEEE 2800-2022?

- Refer to the EPRI presentation at the i2X Forum Hybrid Workshop in March 2025.
- Covered requirements for voltage and frequency ride-through.
- Deep dive on key technical differences between the standards.
  - Some of these differences will be highlighted in this presentation.

PRC-029-1 establishes ride-through requirements similar to IEEE 2800-2022 but leaves out some important technical details on performance.

Need a recap?

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How Voluntary IBR Standards Can Support with Implementation of Mandatory IBR Standards: *Let's do a more detailed mapping…*

Mandatory IBR Standards (NERC)

- Capability and performance standards:
  - Voltage and frequency ride-through: **PRC-029**
  - …
- Measurement and performance monitoring standard: **PRC-028**
  - Equipment-level
  - Collector system feeder-level
  - Plant-level
- Model validation & verification standard: **MOD-026**
  - Equipment-level
  - Plant-level
- Performance mitigation standard: **PRC-030**
- Facility standards: **FAC-001, FAC-002**

Voluntary IBR Standards (IEEE)

- **IEEE 2800** (IBR Interconnection Standard)
  - Capability and performance requirements: **Clauses 4–9**
  - Measurement data for performance monitoring and model validation: **Clauses 11**
  - Test and verification requirements: **Clause 12**
    - …
    - Post-commissioning monitoring: Subclause **12.2.7**
    - Periodic tests: Subclause **12.2.8**
    - Periodic verification: Subclause **12.2.9**
- **IEEE 2800.2** (Conformity assessment standard)
  - Type test of IBR equipment: **Clause 5**
  - Equipment model validation: **Clause 6**
  - IBR plant design evaluation: **Clause 7**
  - Post commissioning model validation: **Clause 10**
  - Post-commissioning monitoring: **Clause 11**

ISOs/RTOs Implementation and Adoption

- **IBR Facility Interconnection Requirements**
- **IBR Modeling Guidelines** / Performance Verification Tests

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Classification: Public

PRC-029 requirements R1 – voltage and frequency ride through and exceptions

NERC Requirement		IEEE 2800.2 Test	Criteria for verification	EPRI's IBR CA Module
R1 – Each Generator Owner shall ensure the **design** and **operation** is such that each IBR **meets or exceeds Ride-through requirements**, in accordance with the "must Ride through zone" as specified **in Attachment 1**,		Tables 43 & 46—Balanced low-voltage disturbance ride-through tests, Tables 45 & 48—Unbalanced low-voltage disturbance ride-through tests, and Tables 44 & 47—Balanced high-voltage disturbance ride-through test	7.2.2 Voltage disturbance ride-through requirements of IEEE Std 2800™-2022. (See footnote *)	☑ Supported
except in the following conditions: [Violation Risk Factor: High] [Time Horizon: Operations Assessment]	To **clear fault**	-	-	⊗ Not supported
	Voltage outside of **hardware limit (R4)**	-	-	⊗ Not supported (coordinated with GO)
	Instantaneous **+seq phase angle shift** of 25 degrees (at high side of MPT)	Tables 51 & 52—Positive-sequence voltage phase angle change ride-through tests	Clause 7.3.2.4 Voltage phase angle changes ride-through of IEEE Std 2800™-2022.	☑ Supported
	V/Hz exceed 1.1 p.u. for 45 seconds or 1.18 p.u. for 2 seconds	IEEE 2800 does recognize ride-through performance to situations where the V/Hz is within "capability limits" but does not specify a "definitive" V/Hz limit [Difference between IEEE 2800-2022 and PRC-029-1]	When a timer that counts [cumulative] duration of when the V/Hz condition at the high-side of the main power transformer exceeds 1.1 p.u. and 1.18 pu for 45 and 2 seconds respectively runs out, then a trip does not constitute non-conformity.	⊗ Not supported

* Check slides on different interpretations of voltage ride-through
◊ These are not requirements for the plant to trip, rather allows the plant to trip

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PRC-029 requirements M1 – Measures to demonstrate IBR design according to R1

NERC Requirement	IEEE 2800.2 Test	Comments
M1. Each Generator Owner shall have evidence **to demonstrate the design of each IBR will adhere to Ride-through requirements**, as specified in Requirement R1. Examples of **evidence may include**, **but are not limited** to **dynamic simulations, studies, plant protection settings, and control settings design evaluation.**	Clause 7.3 Procedures for IBR plant capability and performance assessment Clause 8 As-built installation evaluations • *Evaluation at the time of commissioning to verify that the IBR units, collector system, supplemental IBR device(s), and protective functions forming an IBR plant as delivered and installed conform to the design as defined in the IBR plant design evaluation (Clause 7).* [quote from 2800.2-2026]	***"Clause 7.3 provides recommended verification procedures to assess the IBR plant conformity** with all applicable plant minimum capability and performance requirements specified in IEEE Std 2800-2022 for both normal and abnormal conditions."* (quote from Quote from IEEE 2800.2-2026) The PRC-029 standard leaves open for interpretation whether *"to demonstrate the design of each IBR will adhere to Ride-through requirement"* (quote from PRC-029-1) includes an **as-built installation evaluation** to verify the plant protection settings and control settings the field. The **PRC-029 standard includes a non-exhaustive list of example evidence** (*"but are not limited to"*, quote from PRC-029-1). ➔ **Full adoption and implementation of IEEE 2800.2-2026 would close that potential gap.**

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PRC-029 requirements M1 – Measures to demonstrate IBR operation according to R1

NERC Requirement	IEEE 2800.2 Test	Comments
M1. […] Each Generator Owner shall retain **evidence of actual disturbance monitoring** (i.e., sequence of event recorder, dynamic disturbance recorder, and fault recorder) **to demonstrate that the operation** of each IBR did adhere to Ride-through requirements, as specified in Requirement R1. **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 retain **evidence of actual disturbance monitoring** (i.e., sequence of event recorder, dynamic disturbance recorder, and fault recorder) data **to demonstrate that the IBR 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. PRC-029-1 Implementation plan **Entities shall not be required to comply** with the portion of Requirements R1, R2, and R3 **relating to the operation of IBRs** to meet the requirements **until the entity has established the required disturbance monitoring equipment capabilities for those IBRs** in accordance with the implementation plan for **Reliability Standard PRC-028-1**.*	**Operation language:** Clause 11 Post-commissioning monitoring • **11.1 Selecting event triggers** • **11.2 Capturing event data** • 11.3 Frequency and number of model validation instances • 11.4 IBR plant model validation using playback approach • **11.5 IBR plant conformity re-assessment** • 11.6 Reactive power capability assessment • 11.7 Harmonic distortion assessment Clause 12. Periodic tests Clause 13. Periodic verification	***Clause 11 includes evaluating an IBR plant's performance in the field during operation,*** *especially following TS events where the voltage and/or frequency at the RPA deviate from the normal operating region.* (quote from IEEE 2800.2-2026) Clause 12. Periodic tests *The commissioning test procedures specified in Clause 9 should be used for periodically testing of an IBR plant.* [quote from 2800.2] Clause 13. Periodic verification *Periodic verification takes place following any substantial changes, as defined by the TS owner or the TS operator, to the IBR plant.* [quote from 2800.2]

*Check slides on PRC-028-1

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PRC-029 requirements R2 inside the continuous operation region

Requirement		IEEE 2800.2 Test	IEEE 2800 Criteria	IBR CA Module
R2 – Each Generator Owner shall ensure the design and operation is such that the voltage performance for each IBR adheres to the following **during a voltage excursion**, unless a documented hardware limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment] **[Continuous operation region]**	2.1.1 Continue to **deliver the pre-disturbance level of Real Power** or available Real Power, whichever is less[a]	Tables 49 & 50—Frequency response capability and performance tests	Clause 6 Active-power—frequency response requirements of IEEE Std 2800™-2022.	☑ Supported
	2.1.2 **Continue to deliver Reactive Power** up to its Reactive Power limit and according to its controller settings. [a]	Tables 41 & 42—Voltage or reactive power control tests	Clause 5.2.2 Voltage Control, Clause 5.2.3 Power Factor Control, and Clause 5.2.4 Reactive power control mode of IEEE Std 2800-2022.	☑ Supported[2]
	2.1.3 **Prioritize Real Power or Reactive Power** when the voltage is less than 0.95 per unit, the voltage is within the continuous operating region[b,c]	Tables 41 & 42—Voltage or reactive power control tests Clause 7.3.3 Verifications based on review of OEM or IBR plant design documentation (qualitative)	Same as above, and Clause 7.2.2.2 Voltage disturbances within continuous operation region Check active power and reactive power prioritization when voltage level is between [0.9,0.95] [3]	☑ Supported[2] ⊗ Not supported

[a]EPRI considers these requirements as potentially problematic because to support BPS voltage and frequency response an IBR plant can provide voltage and frequency response in the continuous operation region. Refer to [EPRI Comments on PRC-029] for further information.

[b]PRC 029-1 footnote #5 states *"Except if this would occur during a frequency excursion. The Real Power response should recover in accordance with the primary frequency controller."*

[c]PRC-029 also remains silent on why a voltage threshold of 0.95 per unit is chosen in this requirement. PRC-029 does not specify reactive power capability as specified in IEEE 2800.

[1]Per 7.2.2.2 of IEEE 2800-2022: *"Voltage disturbances of any duration, for which the applicable voltage as specified in 4.3 remains within the continuous operation region, shall not cause the IBR plant to trip from the TS. The IBR plant shall remain in operation during any such disturbance and shall continue to deliver pre-disturbance level of active power or available active power, whichever is less."*

[2]IBR-CA module version 1.1 does not consider an exception per IEEE 2800 when the IBR plant reaches its reactive power capability. Future releases will include this exception.

[3]Note that IEEE 2800-2022 specifies this requirement over the full *Continuous Operation Region* which is specified as *"Except for 500 kV system nominal voltage, the continuous operation region is when the applicable voltage is ≥ 0.9 per unit and ≤ 1.05 per unit. For 500 kV system nominal voltage, the continuous operation region is when the applicable voltage is ≥ 0.9 per unit and ≤ 1.10 per unit."*

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PRC-029 requirements R2 inside the mandatory operation region

Requirement		IEEE 2800.2 Test	IEEE 2800 Criteria	IBR CA Module
R2 – Each Generator Owner shall ensure the design and operation is such that the voltage performance for each IBR adheres to the following **during a voltage excursion**, unless a documented hardware limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment] **[Mandatory operation region]**	2.2 **Inverter- Based Resource shall exchange current***, up to the maximum capability to provide voltage support, on the affected phases during both symmetrical and asymmetrical voltage disturbances, either under: • **Reactive Power priority by default;** or • Real Power priority if required	Tables 43 & 46—Balanced low-voltage disturbance ride-through tests, Tables 45 & 48—Unbalanced low-voltage disturbance ride-through tests, and Tables 44 & 47—Balanced high-voltage disturbance ride-through test Clause 7.3.3 Verifications based on review of OEM or IBR plant design documentation (qualitative)	Clause 7.2.2.3 Low- and high-voltage ride-through within the mandatory operation region, Clause 7.2.2.3.4 Current injection during ride-through mode, and Clause 7.2.2.6 of IEEE Std 2800-2022 Check active current and reactive current prioritization when voltage level is between [0.9,0.1]	☑ Supported ☑ Supported ☑ Supported ⊗ Not supported

*Key differences between IEEE 2800-2022 and PRC-029-1 R2:

In IEEE 2800, the fault current injection requirements apply at IBR unit terminals. The primary reason being that the control that dictates characteristic of fault current injection reside in IBR units.

- The IBR unit is required to inject current, up to IBR unit's maximum current rating, dependent on voltage deviation from nominal at the IBR unit terminal. The IBR unit does not have any information about the voltage on the high-side of the main power transformer.
- The winding configuration of IBR unit and main power transformer further complicates this during unbalanced faults on the transmission system.
- During unbalanced faults, IBR unit is required to inject negative-sequence current dependent on terminal negative-sequence voltage.

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PRC-029 requirements R2 inside the permissive operation region

Requirement		IEEE 2800.2 Test	IEEE 2800 Criteria	IBR CA Module
R2 – Each Generator Owner shall ensure the design and operation is such that the voltage performance for each IBR adheres to the following **during a voltage excursion**, unless a documented hardware limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment] **[Permissive operation region]**	2.3 Inverter- Based Resource **may operate in current blocking mode** if necessary to avoid tripping. Otherwise, comply with R2.2	Tables 43 & 46—Balanced low-voltage disturbance ride-through tests, Tables 45 & 48—Unbalanced low-voltage disturbance ride-through tests, and Tables 44 & 47—Balanced high-voltage disturbance ride-through test	Clause 7.2.2.3 Low- and high-voltage ride-through within the mandatory operation region, Clause 7.2.2.3.4 Current injection during ride-through mode, and Clause 7.2.2.6 Restore output after voltage ride-through of IEEE Std 2800-2022	☑ Supported
	2.3.1 If an Inverter-Based Resource enters current blocking mode, it **shall restart current exchange in less than or equal to five cycles** of positive sequence voltage returning to a continuous operation region or mandatory operation region	Same as above	7.2.2.3.3 Low and high-voltage ride-through performance	☑ Supported

[3]IBR-CA module version 1.1 does not have a PASS/FAIL output for this criteria. Visual/manual inspection is possible.

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PRC-029 requirements R2 (all regions) – restore real power output

Requirement		IEEE 2800.2 Test	IEEE 2800 Criteria	IBR CA Module
R2 – Each Generator Owner shall ensure the design and operation is such that the voltage performance for each IBR adheres to the following **during a voltage excursion**, unless a documented hardware limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment]	2.4 Each Inverter-Based Resource **shall not itself, cause voltage** at the high-side of the main power transformer **to exceed** the applicable high voltage **thresholds and time durations** in its response **as voltage recovers** from the mandatory or permissive operation regions to the continuous operation region.*	Tables 43 & 46—Balanced low-voltage disturbance ride-through tests, Tables 45 & 48—Unbalanced low-voltage disturbance ride-through tests, and Tables 44 & 47—Balanced high-voltage disturbance ride-through test	Subclause 8.3.2 (Limitation of overvoltage over one fundamental frequency period), and Figure 14—RMS overvoltage limits for an IBR plant at the RPA of IEEE Std 2800-2022. Check voltage at the high-side of the main power transformer not exceeding high-voltage threshold when transitioning from mandatory or permissive operation to continuous operation region. [See this slide for more details]	☑ Supported but manual[3]
	2.5 Each Inverter-Based Resource shall **restore Real 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 blocking mode)	Tables 43 & 46—Balanced low-voltage disturbance ride-through tests, Tables 45 & 48—Unbalanced low-voltage disturbance ride-through tests, And Tables 44 & 47—Balanced high-voltage disturbance ride-through test	Clause 7.2.2.6 Restore output after voltage ride-through of IEEE Std 2800-2022	☑ Supported but with a tolerance (±%) according to 2800

* IEEE 2800 has a similar requirement in subclause 8.3.2 (Limitation of overvoltage over one fundamental frequency period) but it is embedded in the power quality clause. The limitation of OV requirement does not align with high-voltage ride-through requirement

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PRC-029 requirements R3 – frequency ride through

Requirement		IEEE 2800.2 Test	IEEE 2800 Criteria	IBR CA Module
R3 – Each Generator Owner shall ensure the design and operation is such that each IBR meets or exceeds **Ride-through requirements during a frequency excursion event** whereby the System frequency remains within the "must Ride-through zone" according to Attachment 2 and the absolute rate of change of frequency (RoCoF)9 magnitude is less than or equal to 5 Hz/second, unless a documented hardware limitation exists in accordance with Requirement R4. [Violation Risk Factor: High] [Time Horizon: Operations Assessment]	**Ride through according to Attachment 2** and the absolute rate of change of frequency **(RoCoF) magnitude is less than or equal to 5 Hz/secon**d, unless a documented hardware limitation exists in accordance with Requirement R4.	Frequency ride-through capability (this is different from performance). Review of OEM or IBR plant design documentation (qualitative) as specified in IEEE 2800.2-2026 in *Clause 7.3.3.4 IEEE 2800—Clause 7.3.2 Frequency disturbance ride-through requirements, and deadband setting for Clause 6.1 Primary frequency response (PFR) and Clause 6.2 Fast frequency response (FFR)*	Clause 7.3.2.3 Frequency disturbances within the mandatory operation region of IEEE Std 2800-2022	⊗ Not supported*

*IBR-CA module version 1.1 does not support assessment of frequency disturbance ride-through performance. Future releases will include this test.

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IEEE 2800/.x Can Support PRC-029-1 Compliance Assessment

- **Most of the requirements in PRC-029-1 can be mapped** to the requirements established in IEEE 2800-2022. This presentation focused on mapping them to each other while highlighting technical differences between the standards.

- **PRC-029-1** establishes ride-through requirements similar to IEEE 2800-2022 but **leaves out some technical details** on performance.

- Contents in IEEE 2800-2022 and **IEEE 2800.2-2026 may support in closing the technical gap to comply with PRC-029-1** in addition to enhance grid reliability through IBR performance.

- In most cases, **EPRI tools such as IBR-CA module** may be utilized to verify IBR performance compliance with PRC-029-1. Additional testing and improvements will be added in the future soon.

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Tools for Automating of IBR Conformity Assessment

- Using tools to automate IBR conformity assessment can **save time** and **manage risk**.

- Many such tools are or will be emerging… EPRI's *independent* **IBR-CA Module** Version 1.1 is available at 3002034778

- It can be used to determine whether the given **model** **or** **measured** **IBR plant performance conforms** to what is asked from a standard or grid code.
  - Currently focused on **IEEE 2800-2022 and 2800.2-2026** tests and criteria.
  - Can also be used to determine whether a given **IBR unit** is "**compatible**" with IEEE 2800-2022 requirements.

➢ **Application examples** are reviewed in detail in **EPRI's *Application of IBR Standards Collaborative Forum***
  - ➢ Feedback can be used to make improvements to the beta software.

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Tests Supported by IBR-CA Module (Version 1.1)

Flat Run

➢ *For IBR plants with energy storage systems, run certain tests at P = ICR; 0; and ICAR.*

Voltage Ride-Through & TrOV

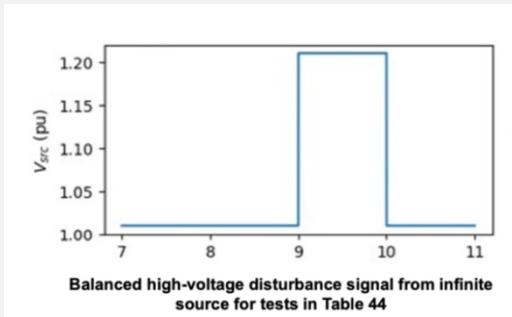
Balanced low-voltage ride through

Unbalanced low-voltage ride through

Balanced high-voltage ride through

Tables 43 & 46 balanced and unbalanced low-voltage ride-through tests

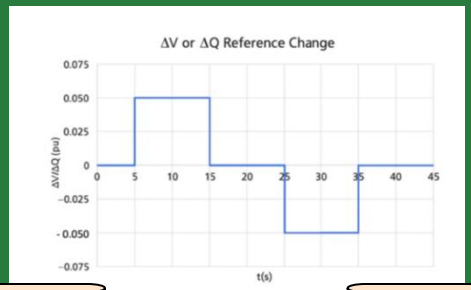
Tables 44 & 47 balanced high-voltage ride-through tests



Balanced high-voltage disturbance signal from infinite source for tests in Table 44

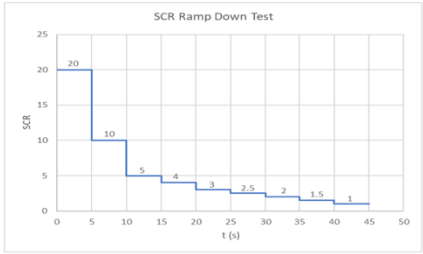
May be used to verify PRC-029-1 R1, R2-2.2, 2.3, 2.4, 2.5

Voltage Control



May be used to verify PRC-029-1 R2-2.1.2 and 2.1.3.

Short-Circuit Ratio



Primary Frequency Control

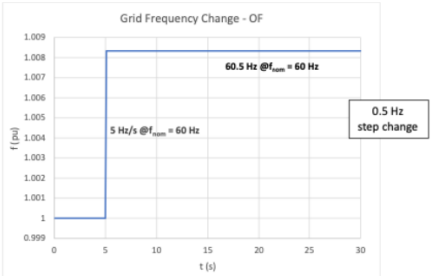


Figure 47 — Example over-frequency response performance test signal and minimum simulation duration (frequency > nominal system frequency)

May be used to verify PRC-029-1 R2-2.1.1.

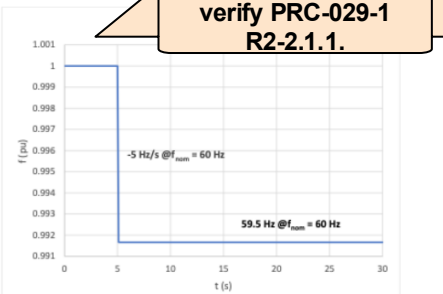
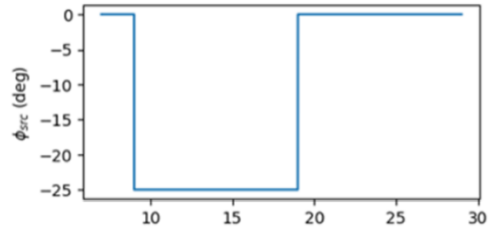


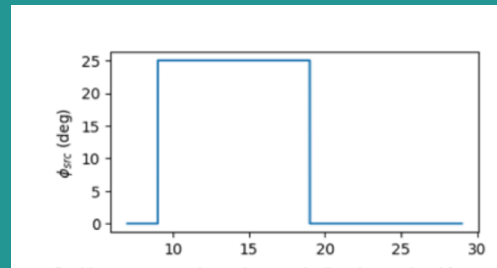
Figure 48 —Example under-frequency response performance test signal and minimum simulation duration (frequency < nominal system frequency)

Phase Angle Jump



Positive-sequence voltage phase angle disturbance signal from infinite source for tests in Table 48

May be used to verify PRC-029-1 R1



Positive-sequence voltage phase angle disturbance signal from infinite source for tests in Table 48

Additional tests that go beyond IEEE 2800 and PRC-029-1 will be added in future.

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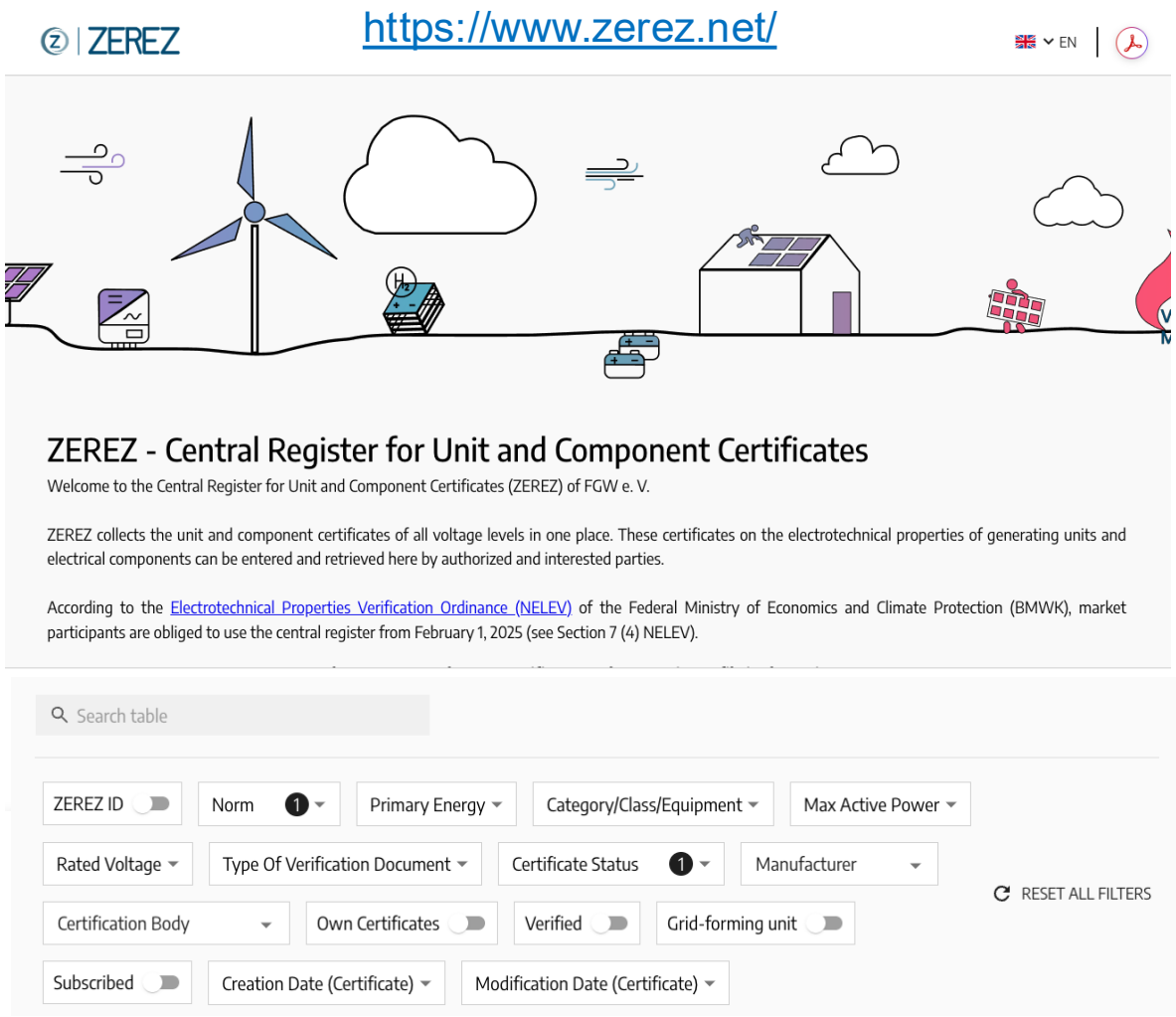
Could a central database like this one in Germany help with PRC-029-1 compliance?

Overview

- Collects the **unit** and **component certificates** of all voltage levels in one place.
- There are currently **2081 certificates** and **13,135 units** on file in the register.
- **Certificates can be** entered and **retrieved by** authorized and **interested parties**.
- Certificates can be published and managed by **manufacturers** and **certification bodies**.
- A customized data interface **enables network operators** to **process** all available **certificates**.

IEEE 2800-2022 and requirements for IBR units certified in this database have similar scope and depth.

Central Register for Unit and Component Certificates (ZEREZ) of FGW e. V.



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Related EPRI Offerings

(1) **IBR ID/CA Tool** – *Inverter **B**ased **R**esource Performance **Id**entification and **C**onformity **A**ssessment **Tool*** *V1.1* 3002034778

Need

- Ability to **identify performance characteristics** of an IBR simulation model and validate its performance across various simulation domains. Also to **verify conformance** against any standards/grid codes that may be present

Objective

- **Develop and deliver a** performance identification and conformance verification **tool** that can be used to test IBR models across various simulation domains.

Scope

1. Define **list of tests**, both time domain and frequency domain to be used to identify performance and verify conformance.
2. Develop **software modules** that can apply and carry out the tests across EMT and positive sequence domain
3. Verify performance and conformance of **both generic and user defined models**.
4. Deliver software

(2) Application of IBR Standards – ***Collaborative Forum*** More information at: 3002032085

Need

- New **IBR interconnection and reliability standards** apply to **plant owners/ developers** and will shape design and operation of IBR plants. Same standards are being adopted and enhanced by **transmission companies**.

Objective

- **Provide a collaborative forum** to exchange challenges and learnings, considering **new and existing plants.** Improve operational efficiency and **mitigate compliance risks.**

Scope

1. Support ***interpretation*** of various IBR standards (***IEEE and NERC***) and ***provide conformity/compliance procedures***
2. Provide generic IBR model parameters for existing grid-following (GFL) and advanced ***grid-forming (GFM)*** IBRs that conform with IEEE 2800, NERC Reliability Standards, etc.
3. Provide application examples:
   - Use of ***conformity assessment tool***
   - ***Guidelines*** for ***utilization*** of IBR capabilities
4. Provide ***thought leadership*** and ***facilitate development*** of IBR standards

Confirmed participating funders: 8x as of June 2026

Ameren
DUKE ENERGY
GREAT RIVER ENERGY
ISO new england
NEW YORK STATE OF OPPORTUNITY | NY Power Authority
pjm
Portland General Electric
SMUD

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DRAFT PRC-029-1 Implementation Guidance

Tim Taylor, *Manager, Solar and Storage Reliability Initiatives, SEIA*
Ryan Quint, PhD, PE, *President and CEO, Elevate*

June 2026

SEIA Solar Energy Industries Association®

Who We Are

- Trade Organization for Solar and Storage
- 1200 Members
  - Manufacturers, installers, contractors, developers, EPCs, service providers, others
- Focus Areas
  - State and Federal Legislation
  - Regulatory
  - Research and Public Affairs
  - Codes and Standards
  - Education

NERC Implementation Guidance

- Developed by industry, for industry
  - Vetted and submitted through pre-qualified organizations
  - SEIA became pre-qualified organization January 2026

- Examples or approaches to illustrate how registered entities could implement a Reliability Standard
  - Not the only approach
  - If endorsed by the ERO Enterprise, the ERO Enterprise would give the example deference during NERC CMEP* activities

https://www.nerc.com/our-work/compliance-guidance/implementation-guidance
CMEP – Compliance Monitoring and Enforcement Program

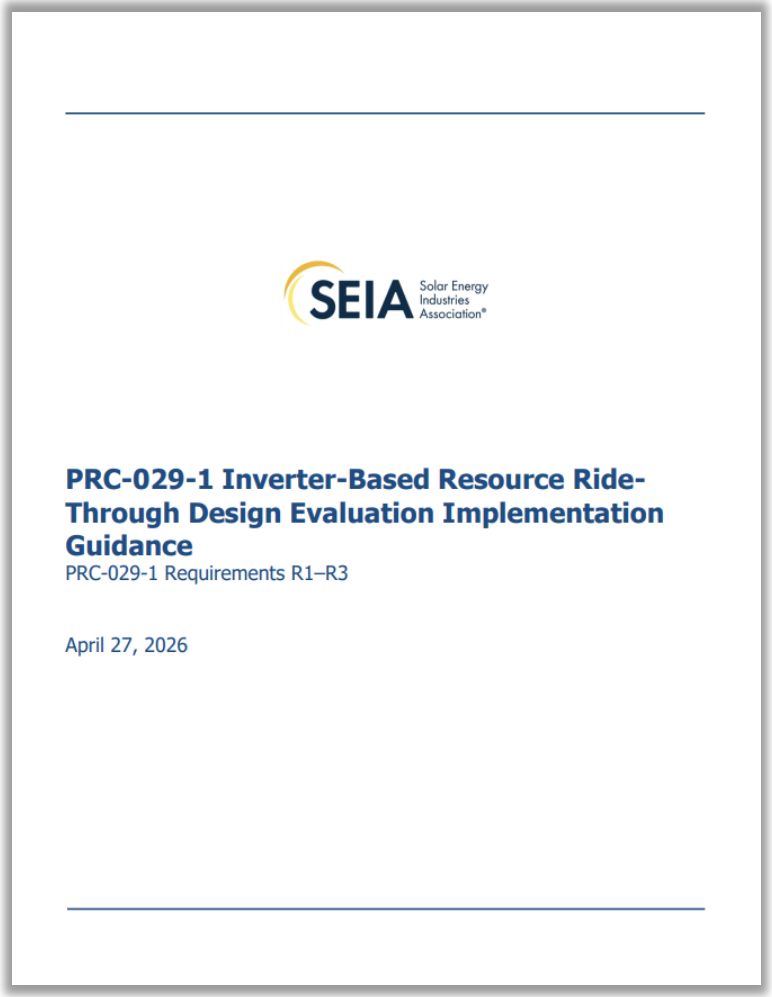
SEIA Solar Energy Industries Association®

Implementation Guidance for PRC-029-1 R1-R3

- Developed by SEIA, SEIA members, and Elevate Energy Consulting
- Why Implementation Guidance for PRC-029-1?
  - Due to technical complexity of IBR ride-through evaluations
  - Approaching compliance dates: BES IBRs – October 1, 2026 Category 2 IBRs – January 1, 2027
- Only R1 – R3. PRC-029-1 R4 is under revision
- Focused on “design” elements and not “operation”

Draft IG Disclaimer

- The Implementation Guidance (IG) document presented herein is still currently under review by the ERO Enterprise and thus still in DRAFT status
- Wanted to share the technical details of the IG with industry regardless, to help elevate industry understanding and practices



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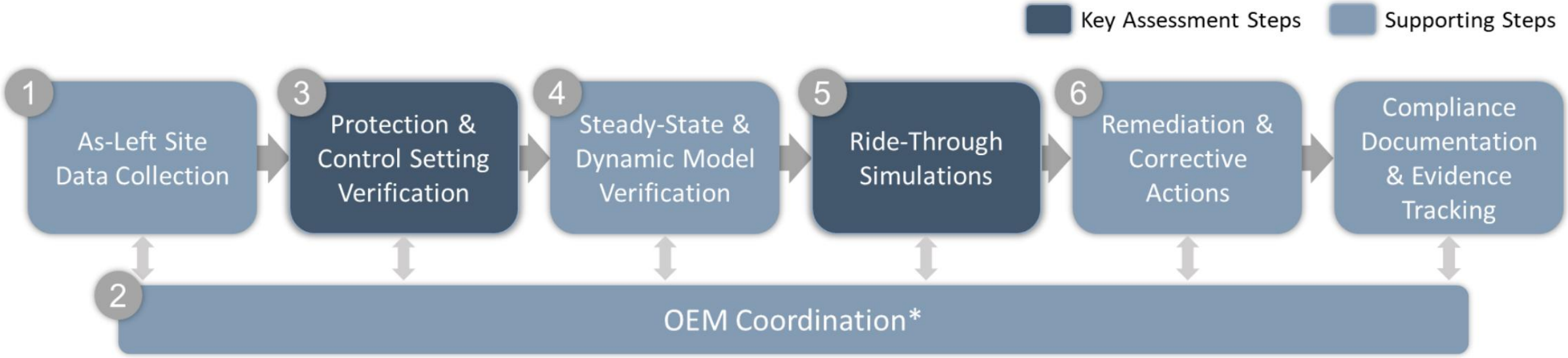
IBR Ride-Through Design Evaluation Approach



** IBR unit and PPC OEM coordination is key throughout the process. Additionally, third parties such as engineering, procurement, and construction (EPC) teams, protection and control engineering, field personnel, SCADA engineering, and modeling/studies experts may be required.*

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Outcomes and Applicable Actions

#	Outcome	Applicable Action
1	Compliant IBR plant design	Evidence compilation and retention
2	Software-based updates required, which may include (but are not limited to) one or more of the following: • IBR unit ride-through setting modifications • IBR unit protection setting adjustments • IBR unit control settings changes • PPC control settings • PPC protection setting adjustments • BOP protection setting adjustments • Modifying protections or adjusting controls to achieve ride-through performance	• Update dynamic models to reflect changes (as needed) • Coordinate equipment changes with field personnel • Coordinate with the TP and PC per applicable FAC-002-4 qualified change criteria[9] • Communicate and coordinate with the BA, RC, and TOP per applicable requirements in IRO-010 and TOP-003 data specifications • Update documentation and compliance evidence (e.g., protection coordination study (PRC-019), models (MOD-032), etc.)
3	Hardware-based limitation identified	Prepare documentation and evidence in accordance with Requirement R4 (as needed)

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Step 1: As-Left Site Data Collection

Data	Typical Formats
Required Data	
General site information	.pdf
Generator interconnection agreement (GIA) and GIA in-service date ("back-feed date")	.pdf
As-left BOP relay settings	.rdb, .urs, .xlsx
As-left inverter protection and control settings	.xlsx, .pdf
Protection and control single line diagram	.pdf
IBR unit manual(s)	.pdf
IBR plant aggregate dynamic model(s)	PSS®E, PSLF, TSAT, or PSCAD files
IBR unit/plant ROCOF protection information	.pdf
IBR unit/plant consecutive voltage disturbance ride-through capability	.pdf
As-left PPC protection and control settings	.xlsx, .pdf
Any other protection information/data not included above	.pdf, .xlsx
Specifications from the TP, PC, RC, TO or TOP regarding active/reactive power prioritization and dynamic response time that could affect PRC-029-1 compliance	.pdf, email
Helpful Data	
IBR plant control narrative	.pdf
IBR unit ride-through capability (i.e., maximum capability settings)	.xlsx, .pdf
IBR unit active and reactive capability curve	.pdf
Existing PRC-019 and PRC-024 reports (or pre-existing PRC-029-1 reports, if applicable)	.pdf
Existing MOD-025 and MOD-026/-027 reports	.pdf
Model user guide (particularly for user-defined models or EMT models)	.pdf
Existing model quality testing report	.pdf
Protection coordination philosophy	.pdf
Transformer factory acceptance test (FAT) report	.pdf
IBR plant reactive power study report	.pdf
Parameter verification report	.pdf

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Step 2: OEM Coordination

- Collection of detailed IBR unit or PPC data
- Some settings hard-coded and/or not accessible by user/owner
- Early engagement encouraged
- Provide OEM(s) with clear checklist of information/data or list of questions

- Relevant application notes, technical memos, or other reporting provided by the OEM on an IBR unit make/model level
- IBR unit model validation and test reports
- IBR unit voltage and frequency ride-through capability
- IBR unit voltage and frequency ride-through as-left settings (if required from the OEM)
- Accurate, verified, and validated IBR unit steady-state and dynamic models reflecting settings configured to support compliance with PRC-029-1
- IBR unit phase jump, ROCOF, and anti-islanding protection settings
- IBR unit consecutive disturbance ride-through capability and/or statements regarding adherence to PRC-029-1 requirements
- Filtering and measurement windows for frequency calculations used in frequency protections
- Filtering and measurement windows for voltage measurements used in voltage protections
- Parameter verification report or other documentation of as-left settings including IBR protection and control and PPC settings
- Coordination with plant personnel and BOP protection engineering teams, as needed

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Step 3: Protection and Control Verification

- **IBR Unit Voltage and Frequency Ride-Through Settings**
  - As-left IBR unit voltage ride-through settings
    - Confirm alignment with voltage ride-through criteria
    - Instantaneous overvoltage or other protections not accessible to owner/user
    - “Instantaneous trip settings based on instantaneously calculated voltage measurements with less than filtering lengths of one cycle (16.6 millisecond)”
  - As-left IBR unit frequency ride-through settings
    - Frequency measured over a period of time (typically 3-6 cycles) for protection functions
    - “Instantaneous or single points of [frequency] measurement”
  - OEM-provided IBR unit maximum equipment capabilities
- **IBR Unit Additional Protection Settings**
  - ROCOF protection and phase jump protection
  - Consecutive voltage ride-through capability

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Step 3: Protection and Control Verification

- **IBR Unit Control Modes and Settings**
  - Fault/voltage ride-through mode thresholds and settings
  - Current blocking/momentary cessation
  - Ride-through mode current priority
  - Fault current injection settings (e.g., K-factor settings) and maximum fault current levels
  - Negative sequence current injection during ride-through events
- **PPC Control and Protection Settings**
  - PPC voltage, frequency, or other IBR plant protection settings
  - PPC protection measurement windows and filtering
  - PPC reactive power-voltage control settings (schedule, deadband, droop, ramp rate limits, reaction/response time, etc.)
  - PPC active power-frequency control settings (deadband, droop, ramp rate limits, reaction/response time, etc.)

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Step 3: Protection and Control Verification

- **Balance of Plant Relay Settings**
  - As-left BOP voltage protection settings:
    - Collector system feeder relays
    - Medium voltage bus relays
    - High voltage bus relays o IBR plant tie line relays
    - Dynamic and shunt reactive power device relays
  - As-left BOP frequency protection settings
    - BOP frequency protection filtering
  - Instantaneous tripping based on instantaneously calculated voltage measurements with filtering lengths of less than one cycle
  - V/Hz relaying at high side of the main power transformer (MPT)
  - BOP protection settings that may impact ride-through performance (i.e., other additional considerations)

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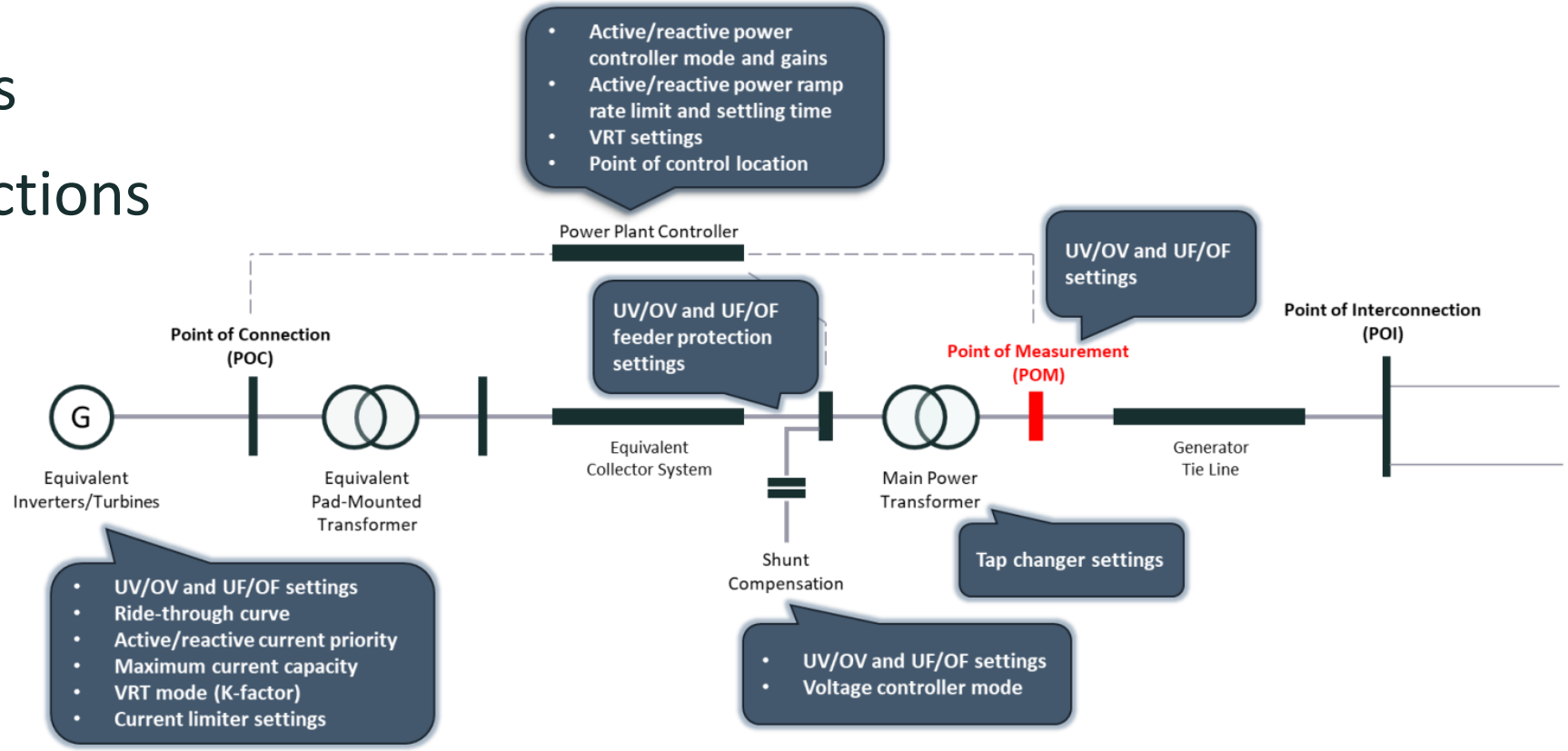
Step 4: Model Verification

- IBR plant configuration
- IBR units
- Power plant controllers
- Balance of plant protections



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Model Selection Disclaimer

- Simulation results only as reliable as accuracy of models used
- Known modeling and simulation limitations recognized, evaluated by modeling SME
- Certain protection and control functions not represented in some simulation domains; protection and control verification (Step 3) key in those situations
- Existing IBRs may only have a phasor domain transient (PDT) model and may not have an EMT model. Thus, PDT-based simulations are used in such situations.
  - When verified (and ideally validated) EMT model exists and is trusted by GO, conducting simulation tests in the EMT domain is generally preferred.
  - Availability of EMT model for a specific IBR site does not guarantee greater accuracy than a PDT model
  - Generally, one should use a verified (and ideally validated) dynamic model ***trusted*** for its intended use, in alignment with Transmission Planner expectations.

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Step 5: Ride-Through Simulations

#	Base Case	Simulation Test	PDT Sim	EMT Sim	Tested Requirements
1	Max Lagging PF	Low Voltage Ride-Through (LVRT)	☑	☑	R1, R2.2, R2.3
2	Max Leading PF	Low Voltage Ride-Through (LVRT)	☑	☑	R1, R2.2, R2.3
3	Max Lagging PF	High Voltage Ride-Through (HVRT)	☑	☑	R1, R2.2
4	Max Leading PF	High Voltage Ride-Through (HVRT)	☑	☑	R1, R2.2
5	Max Lagging PF	Small Voltage Disturbance	☑	☑	R2.1
6	Max Leading PF	Small Voltage Disturbance	☑	☑	R2.1
7	Max Lagging PF	P Recovery and Q Response	☑	☑	R2.2, R2.3, R2.4, R2.5
8	Max Leading PF	P Recovery and Q Response	☑	☑	R2.2, R2.3, R2.4, R2.5
9	Max Lagging PF	Consecutive Faults	☑	☑	R1
10	Max Leading PF	Consecutive Faults	☑	☑	R1
11	Max Lagging PF	Phase Angle Jump (EMT only)		☑	R1 (exception)
12	Max Leading PF	Phase Angle Jump (EMT only)		☑	R1 (exception)
13	Max Lagging PF	ROCOF Ramp (EMT only)		☑	R3
14	Max Leading PF	ROCOF Ramp (EMT only)		☑	R3
15	Max Lagging PF	Asymmetrical Fault (EMT only)		☑	R2.2
16	Max Leading PF	Asymmetrical Fault (EMT only)		☑	R2.2

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Step 6: Remediation and Corrective Actions

- **Identify Required Remediations:** Determine necessary software, protection, control, configuration, and BOP modifications required.
- **Iterative Design Validation:** Often requires multiple rounds of testing and settings adjustments; findings from reviews and simulations drive additional corrective actions.
- **Establish Final Design:** Final set of modifications defines the post-modification IBR plant design that satisfies ride-through and performance requirements (or requires exemptions).
- **Post-Modified State Testing:** Perform post-modification eval and simulations, where feasible, to verify acceptable performance; recognize some aspects not modeled.
- **Implement Changes:** Develop a coordinated plan for plant personnel, OEMs, protection engineers, compliance teams.

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Next Steps for PRC-029-1 IG

Approval Process

- Awaiting response from ERO Enterprise
- Will address any questions or concerns raised, if applicable
- Will widely share with SEIA members and industry stakeholders, if approved

Next Priority Focus

- Early planning for SEIA-coordinated development of MOD-026-2 Implementation Guidance

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PRC-029 Developer/GO Perspective

Katie Iversen

Sr. Manager, Generator Modeling & Power System Studies

i2x June 4, 2026

AES' US Businesses portfolio

14.3 GW operating

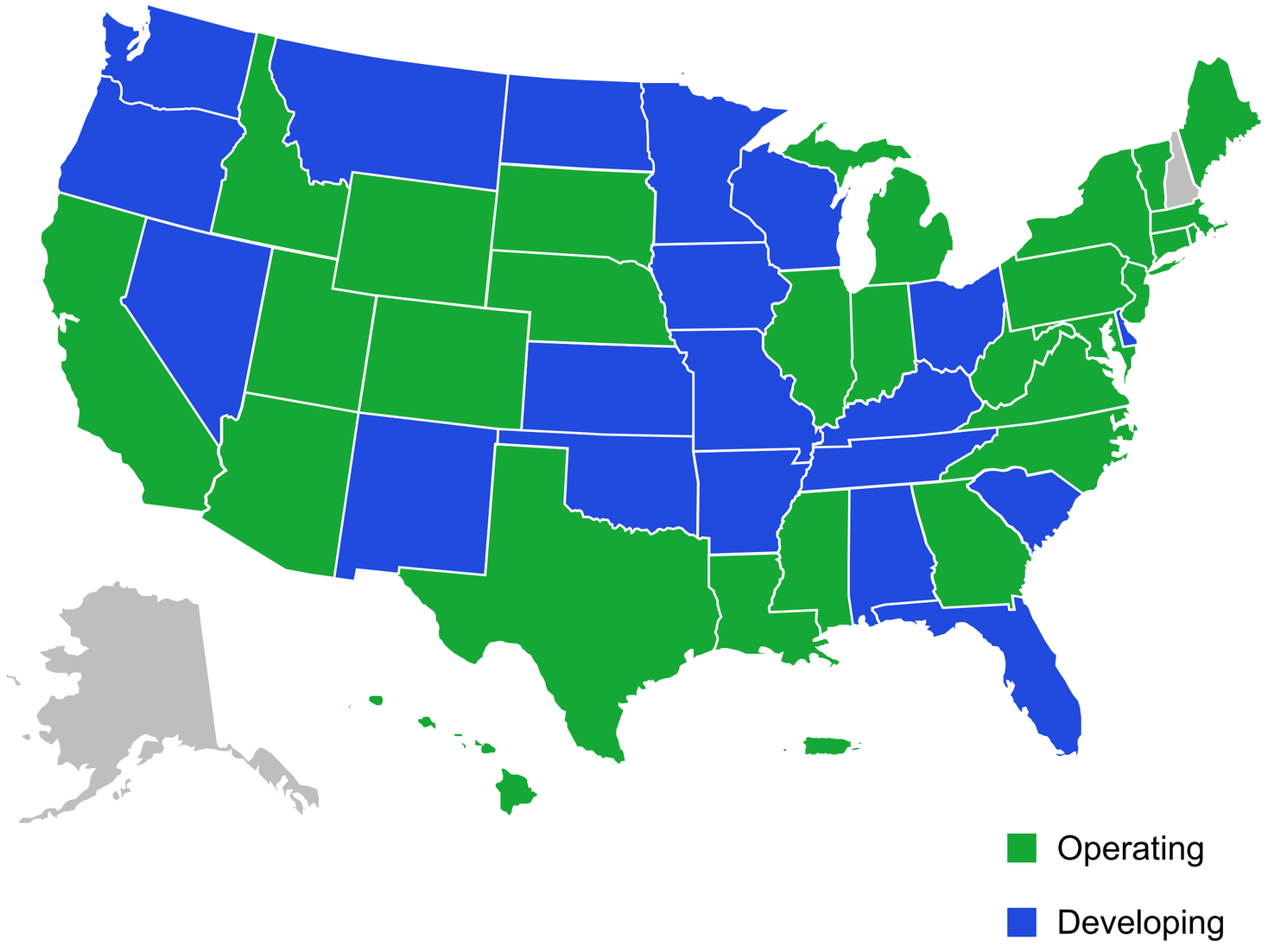
6.4 GW
solar

2.1 GW
wind

2.5 GW
battery energy storage

3.3 GW
flexible capacity

50+ GW in development



Presentation Overview

- Background & History
- Clarifications for Subject Matter Experts
- Ride-Through Settings & Documentation
- Tips & Recommendations for Gos/Developers and OEMs
- Future

Background & History

- Multiple disturbances
- Generator behavior during disturbances did not support the grid
- Industry responses
  - NERC Alerts
  - IEEE2800
  - PRC-024-3
  - NOGRR245, Interconnection Agreement updates
  - PRC-029

PSA for Subject Matter Experts

NERC Standards exist for reliability – a reliable grid is important for your assets

PRC-029 may not be the only ride-through requirement for your asset

- Interconnection Agreement or PPA requirements
- IEEE2800
- NOGRR245

Design reports, settings, and other material are stored and provided for enforcement activities

Ride-Through Settings & Documentation

- Maximum ride-through settings are provided
  - Maximum setting recommendations have changed
  - Maximum settings are not always selected as “recommended” or “default”
- Attachment items should be addressed, beyond VRT/FRT capabilities

Tips & Recommendations for OEMs

- Plan for overlapping ride-through requirements (e.g. PRC-029 & IEEE2800) in documentation and settings
- Provide and create documents
  - Distributed to customers easily and broadly
  - Used for all requests related to ride-through compliance “one stop shop”
  - Revision history
    - Explain changes and flag those that introduce lesser performance
- Address all hardware/software deviations that exist in products, such as buffer additions/ZVRT add-ons
- Include information on specific hardware limiting equipment from typically meeting PRC-029
- Streamline setting updates & setting documentation

Tips & Recommendations for Developers

Operations

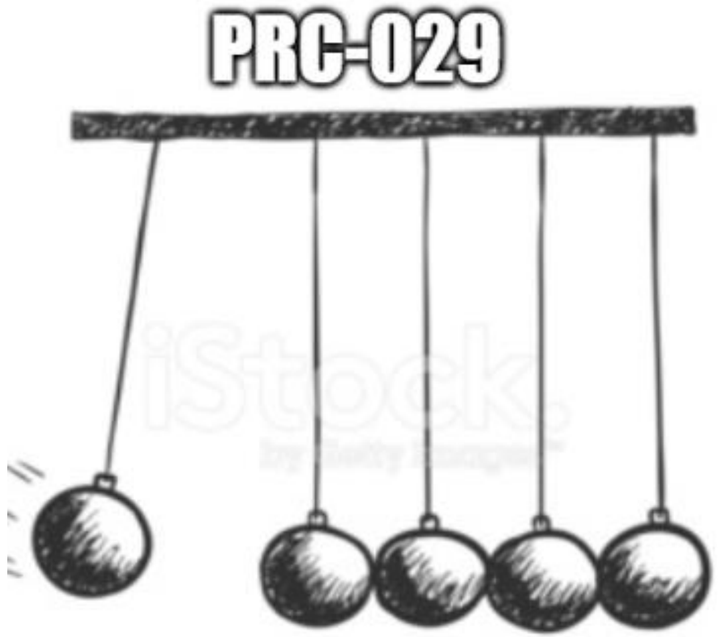
- Previous settings are unlikely to comply, maximums are a must
- Relays must also be evaluated
- Prepare for hardware limitations for legacy units
- Prepare for setting updates and lead times for all sites

Development

- Ensure new site are planned for PRC-029 compliance for all protection
- Update contracts

PRC-029 Triggers and Next Steps

- Hardware Limitations communicated to
  - PCs, TPs, TOPs, RCs, and CEA
- Updates triggered by PRC-029
  - Models and reports
- PRC-028 Recording
  - Event Happens
  - Check for PRC-029 Ride-Through



Recap

Background & History

→ Events that led to PRC-029

→ Clarifications for SMEs

PRC-024 to PRC-029

→ Major changes to compliance

→ Incorporating lessons from events

Ride-Through Settings & Documentation

→ OEM capabilities

Tips & Recommendations for Gos/Developers/OEMs

→ Assessments & Documentation

PRC-029 Triggers and What’s Next

→ Hardware Limitations

→ Updates to Studies

→ Events