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

Forum for the Implementation of Reliability Standards for Transmission (i2X FIRST) | 10/21/25

A DOE initiative supported by the Office of Energy Efficiency and Renewable Energy

BERKELEY LAB

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ESIG

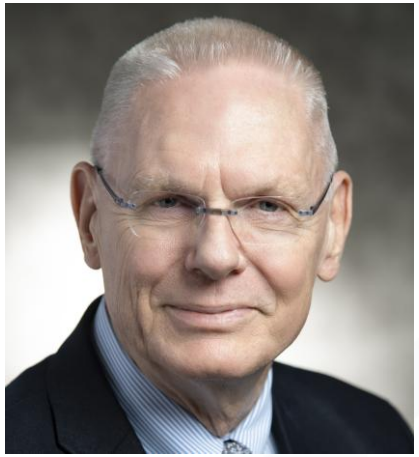
The first half of this meeting call is being recorded and may be posted on ESIG's website. If you do not wish to have your voice recorded, please do not speak during the call. If you do not wish to have your image recorded, please turn off your camera or participate by phone. If you speak during the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

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

Summary of the last meeting: IBR Plant Modeling Requirements and Best Practices

- **Meeting Introduction:** Julia Matevosyan, ESIG
- **IBR Plant Modeling Requirements – NYISO Perspective:** Bruno Leonardi, NYISO
- **IBR Plant Modeling Requirements – Developer/Consultant Perspective:** Kasun Samarasekera, Elevate Energy Consulting
- **IBR Modeling: Where Do We Go From Here?:** Andrew Isaacs and Lukas Unruh, Electranix
- **Q&A and Structured Discussion**, led by Julia Matevosyan, ESIG
  - How can IBR Plant Modeling Requirements be Improved?
  - Requirements for Continuous IBR Plant Model Maintenance?

Meeting summary, recording & presentations are posted here

Key Themes from the Last Meeting

- **Enhanced Modeling Framework:** NYISO is advancing IBR modeling to align with FERC 901, NYSRC B5, and NERC guidance—balancing model fidelity with timely project delivery as well as reliability and resource adequacy needs.
- **EMT as a Continuous Process:** EMT studies are becoming standard and iterative, with screening tools identifying projects needing deeper analysis throughout development and pre-COD stages.
- **Verification & Validation Gaps:** Real-world mismatches between models and equipment behavior highlight the need for standardized commissioning-based verification and consistent “as-left” model updates.
- **Standardization & Data Management**: Efforts like IEEE 2800-2022 adoption, DLL “real-code” wrappers, and proposed “.IBR” mapping files aim to improve consistency, traceability, and automation across OEMs and projects.
- **Future Priorities:** Broader automation, improved PPC and communication-delay modeling, and advanced screening for weak-grid and SSO risks will enhance reliability and reduce expert-dependence.

Upcoming i2X FIRST Meetings – Season 2

1. May 27, 2025, 11 a.m. - 1 p.m. ET – **Season 2 Kick-Off**
2. June 24, 2025, 11 a.m.- 1 p.m. ET – **NERC Milestone 3 Standards**
3. July 22, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Design Evaluation with Applicable Requirements I**
4. August 26, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Design Evaluation with Applicable Requirements II**
5. September 23, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Modeling Requirements and Best Practices**
6. **October 21, 2025, 11 a.m.- 1 p.m. ET – Challenges with IEEE2800-2022, Planned Revisions**
7. November 25, 2025, 11 a.m.- 1 p.m. ET – Change of Management during IBR Plant Interconnection Process and Commissioning, How to Maintain Conformity
8. December 16, 2025, 11 a.m.- 1 p.m. ET – IBR Plant Commissioning Best Practices I
9. January 27, 2026, 11 a.m.- 1 p.m. ET – IBR Plant Commissioning Best Practices II
10. February 24, 2026, 11 a.m. - 1 p.m. ET – Grid Forming IBR Specifications and Testing Requirements I
11. March 16, 2026 hybrid event during ESIG Spring Workshop: Grid Forming IBR Specifications, Testing Requirements, Lessons Learned

Sign up for all future i2X FIRST Season 2 Meetings here

Follow ESIG i2X FIRST website https://www.esig.energy/i2x-first-forum/ for meeting materials & recordings and for future meeting details & agendas

Challenges with IEEE2800-2022, Planned Revisions – Agenda

- **Meeting Introduction:** Julia Matevosyan, ESIG
- **Update on IEEE P2800.2:** Andy Hoke, NREL
- **Potential areas and issues for forthcoming IEEE P2800 Revision:** Manish Patel, Silicon Ranch
- **Forthcoming IEEE project authorizations, including a new GFM IBR Recommended Practice:** Jens Boemer, EPRI
- **Q&A and Structured Discussion**, led by Julia Matevosyan, ESIG
  - How to handle IEEE2800 updates in areas that adopted (planning to adopt) IEEE 2800-2022?
  - How to handle identified issues in IEEE2800-2022 until the update come out?
  - What are the expectations with IEEE 2800.2 adoption after it has been approved?

Two Trainings – November and December 2025

ESIG Interconnection Studies Short Course

WHEN: November 17-19, 2025

WHERE: Manatee Lagoon, 6000 N Flagler Dr, West Palm Beach, FL 33407

MORE DETAILS:

This 3-day in-person training is intended to enhance the knowledge and ability of the current workforce through coursework **focused on best practices** for performing the study work necessary **to interconnect inverter-based resources** to the bulk power system reliably. Training participants will learn practical methods and best practices that can be leveraged into enhanced study practices across the industry. These training modules will **focus on the expected day-to-day needs of engineers performing interconnection studies, model quality tests, or inverter-based resource model and simulation work** as well as managing study practices within their organization.

MORE INFO- INTERCONNECTION STUDIES SHORT COURSE

DOE i2x / ESIG Electromagnetic Transient Training

WHEN: December 16 - 19, 2025

WHERE: Texas RE's Rio Grande Room, Austin, Texas

MORE DETAILS:

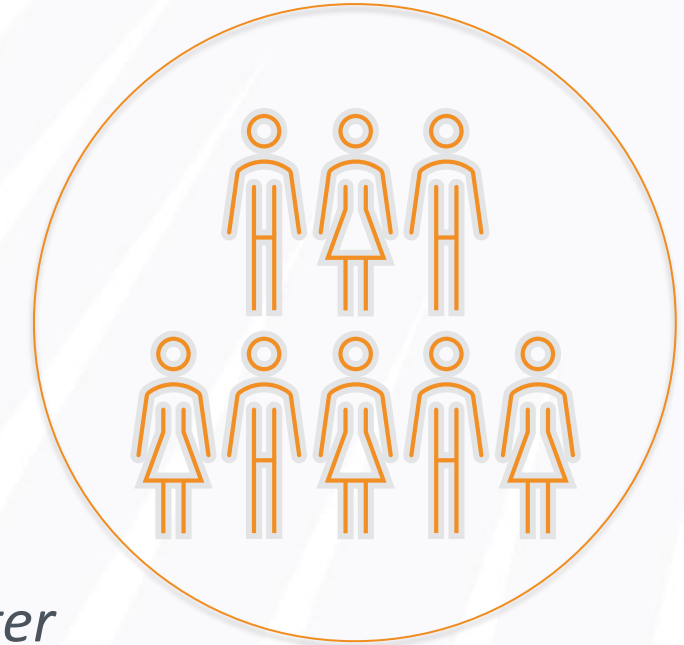
This 3-day in-person training is intended to **enhance the knowledge and ability** of the current workforce through coursework focused **on performing EMT simulations** n the current interconnection and planning paradigm. Training participants will learn **practical methods and best practices that can be leveraged into enhanced study practices across the industry**. These training modules will **focus on the expected day-to-day needs of engineers performing EMT analysis** as well as managing EMT study practices within their organization.

MORE INFO- EMT TRAINING

Thanks to NextEra and Texas Reliability Entity for hosting at their facilities!

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 **FIRST6***



Mutual Respect . Collaboration . Openness

Stakeholder Presentations

Virtual Meetings Code of Conduct

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4. *Please self-edit and encourage others to speak up*
5. *Seek to learn from others*

Mutual Respect . Collaboration . Openness

Q & A Session

Interactive Group Discussion Topics

Topic #1: How to handle IEEE2800 updates and identified issues?

- Please go to slido to make comments and add questions of your own: **slido.com** and enter event code **FIRST6**
- For verbal commentary, please use the raise hand feature and we will call on you
- Additional related / associated questions:
  - How should updates to requirements adopting IEEE 2800-2022 be handled in situations where they exist or are in development?
  - How should transmission entities think about handling any potential issues where IEEE 2800-2022 has been adopted where industry may struggle to conform to?

Topic #2: What are the expectations with IEEE 2800.2 adoption after it has been approved

- Please go to slido to make comments and add questions of your own: **slido.com** and enter event code **FIRST6**
- For verbal commentary, please use the raise hand feature and we will call on you
- Additional related / associated questions:
  - What are the expectations with IEEE 2800.2 adoption after it has been approved?
  - Is it expected that areas that adopted IEEE 2800-2022 will adopt it too or have they developed their own conformity assessment processes in the meantime and stick to that? Combination of the two?

Assessing IBR conformity to transmission interconnection requirements: An overview of IEEE P2800.2 status and technical content

Update to i2X FIRST

ANDY HOKE, IBR INTERCONNECTION WORKING GROUP CHAIR

MANISH PATEL, SECRETARY
JENS BOEMER, BOB CUMMINGS, DIVYA KURTHAKOTI,
JULIA MATEVOSYAN, MAHESH MORJARIA, STEVE WURMLINGER, VICE CHAIRS

October 24, 2025

Some content derived from IEEE 2800 WG and Jens Boemer, 2800 WG Chair

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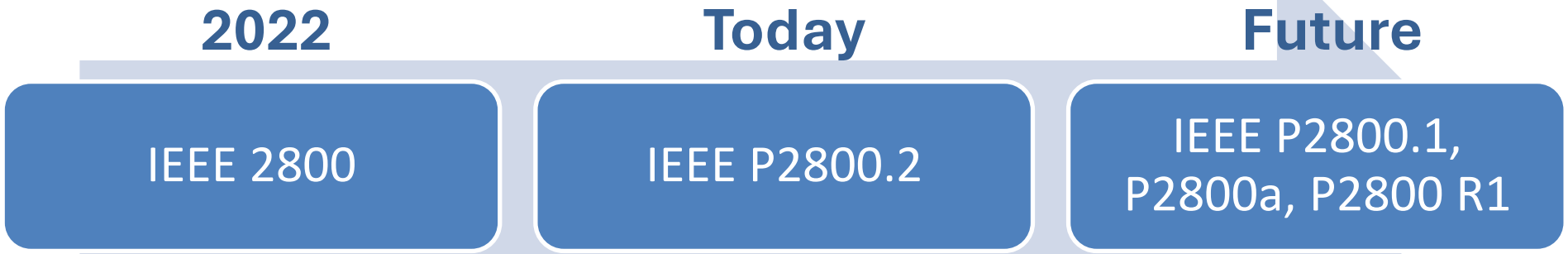
Acknowledgements and disclaimers

- General disclaimer:
  - The views presented in this presentation are the personal views of the individuals presenting it and shall not be considered the official position of the IEEE Standards Association or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE, in accordance with IEEE Standards Association Standards Board Bylaws 5.2.1.6.

- Draft standard disclaimer:
  - P2800.2 is an unapproved draft of a proposed IEEE Standard. As such, the document is subject to change, any draft requirements and figures shown in this presentation may change.

- For those working group members whose effort on the standard was partially or fully supported by the U.S. DOE's National Renewable Energy Laboratory, the following statement applies:
  - This work was supported in part by the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office and Wind Energy Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government.

IEEE standards for transmission-connected IBRs



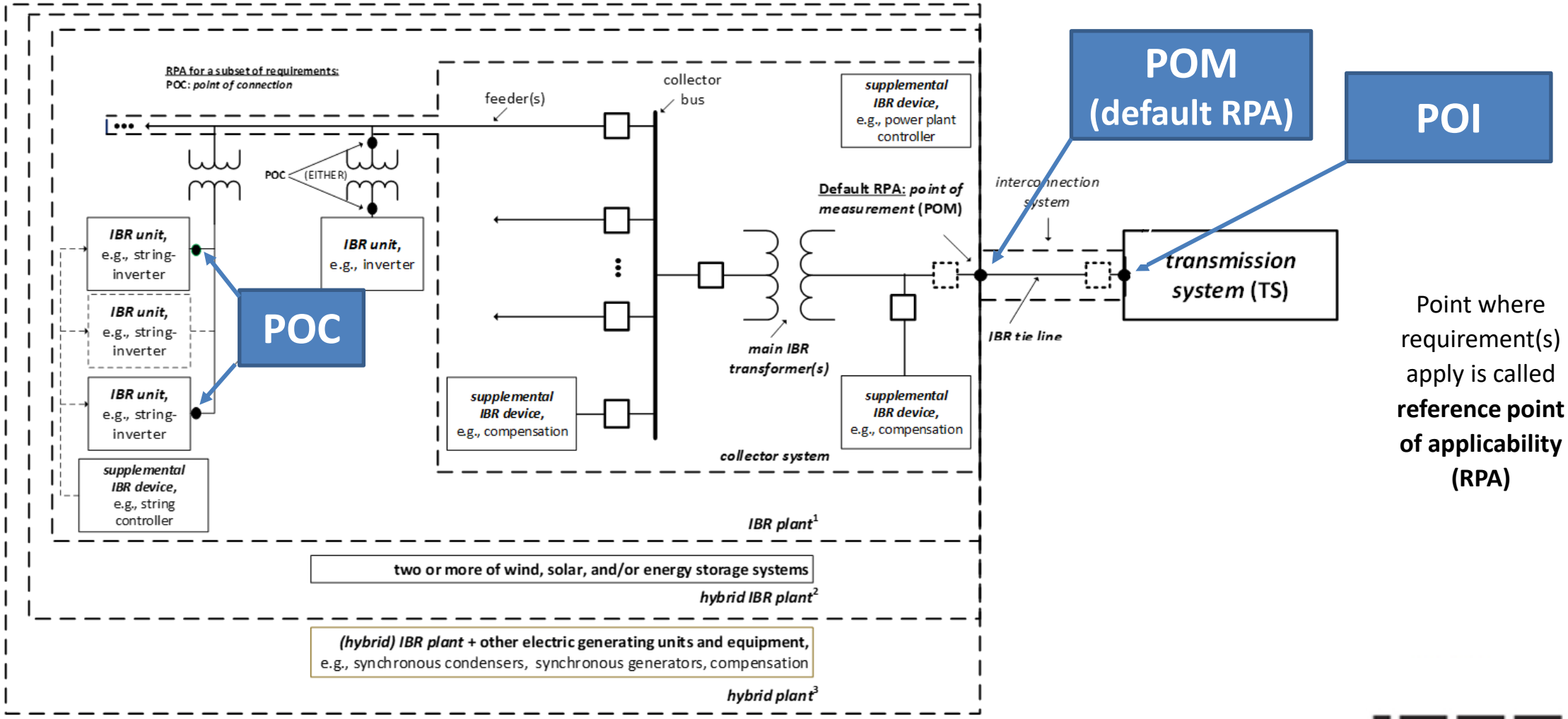
- **Interconnection requirements for IBRs on transmission and subtransmission**
- 2800 (mostly) applies at the plant level
- Adopted by >20 utilities and ISOs and counting
- Ride-through aspects incorporated into PRC-029-1

- **Recommended conformity assessment procedures for 2800**
- Currently in IEEE-SA balloting
- Expect to finish in late 2025, publish early 2026

- **P2800a:** Amendment to reduce barriers to grid-forming (GFM)
- **P2800.1:** GFM equipment requirements and tests
- **P2800:** Full revision
- …

Where do 2800 requirements apply?

Almost all **requirements of IEEE 2800 apply at Point of Measurement (POM)** by default



Point where requirement(s) apply is called **reference point of applicability (RPA)**

Overview of conformity assessment steps in IEEE P2800.2

Type Tests

Lab or field tests of individual IBR unit for model validation

IBR Unit Model Validation

Based on type test data

IBR Plant Model Development

Based on validated IBR unit model(s) and balance of plant

IBR Plant Design Evaluation

Simulations to assess plant conformity to IEEE 2800

Plant construction complete

As-built Installation Evaluation

Verification of installed plant

Commissioning Tests

Partial field assessment of plant performance

Post-Commissioning Model Validation

Based on commissioning test data

Post-commissioning Monitoring

Monitoring of plant performance during grid events

Periodic Tests and Verifications

IEEE P2800.2 Structure and Leaders

Subgroup	Vice Chair	Subgroup Chair(s)
2: Type tests	Steve Wurmlinger Stephen.Wurmlinger@sma-america.com	Pramod Ghimire, Michael Ropp
3: Design evaluations	Jens Boemer j.c.boemer@ieee.org	Andrew Isaacs, Alex Shattuck
4: Commissioning and as-built evaluation	Divya Chandrashekhara DKUCH@orsted.com	Chris Milan, Dave Narang
5: Post-commissioning model validation and monitoring, and periodic tests and verifications	Julia Matevosyan julia@esig.energy	Jason MacDowell, Brad Marszalkowski

Lead subgroup and coordinate with other subgroups

Facilitate subgroup calls

Draft specific verification procedures with subgroup input

Most of the detailed work occurs in the subgroups and task forces via periodic calls

Chair	Andy Hoke Andy.Hoke@nrel.gov
Secretary	Manish Patel Manish.P@ieee.org
Vice Chair	Bob Cummings
Vice Chair	Mahesh Morjaria

Compile drafts; Lead Subgroup 1 (overall document and general requirements)

Lead overall WG

Power Quality Task Force	
Co-Lead	Eugen Starschich
Co-Lead	David Mueller

Provide input to subgroups on PQ requirements verification

Frequency Scanning Task Force	
Co-Lead	Wes Baker
Co-Lead	Shahil Shah

Develop frequency scanning content

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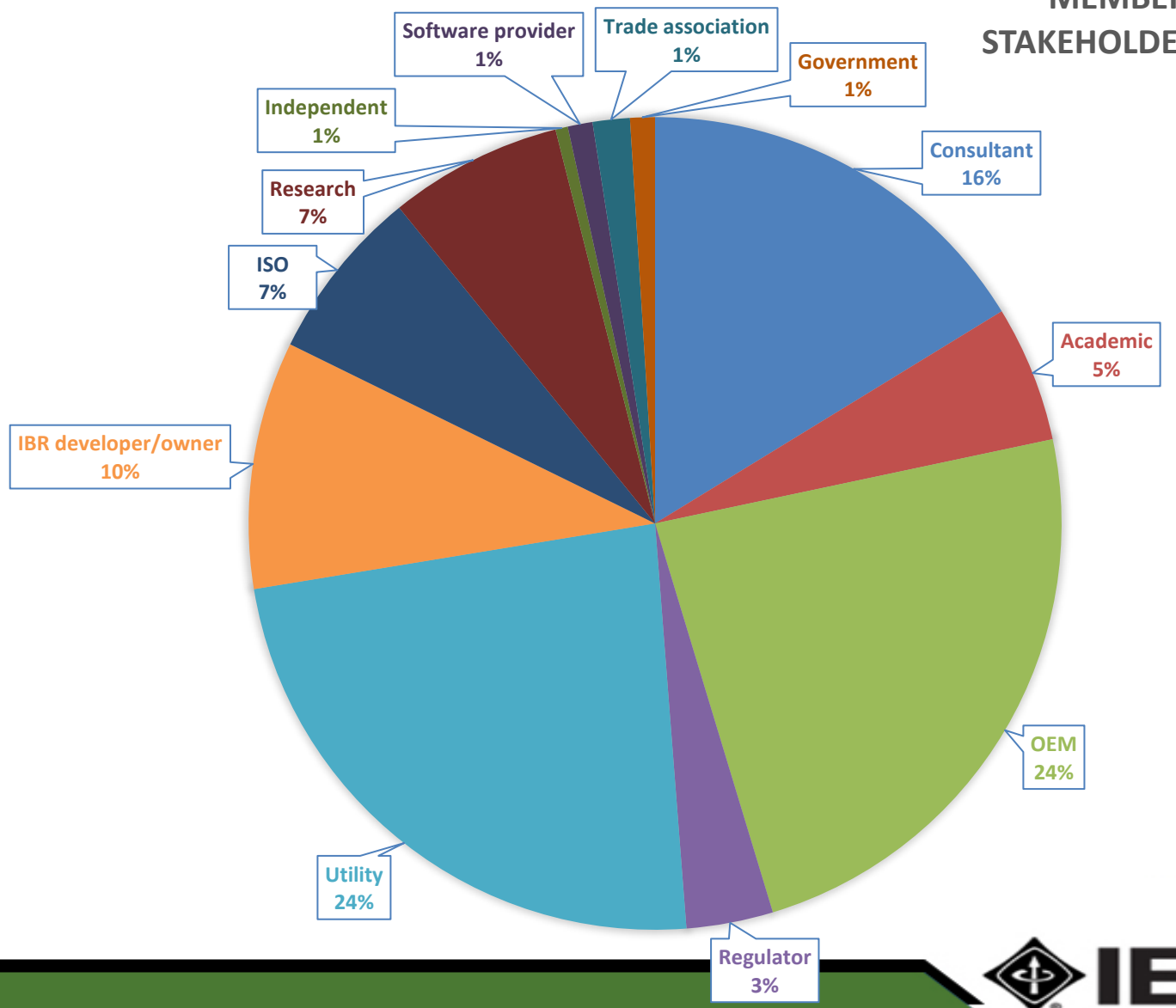
P2800.2 Working Group Membership

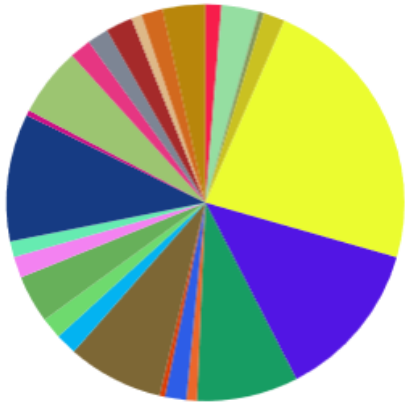
- >170 Voting members
- >50 Non-voting members
- All major stakeholder groups represented

P2800.2 WG MEMBERS BY STAKEHOLDER GROUP



IEEE P2800.2 Ballot Group:

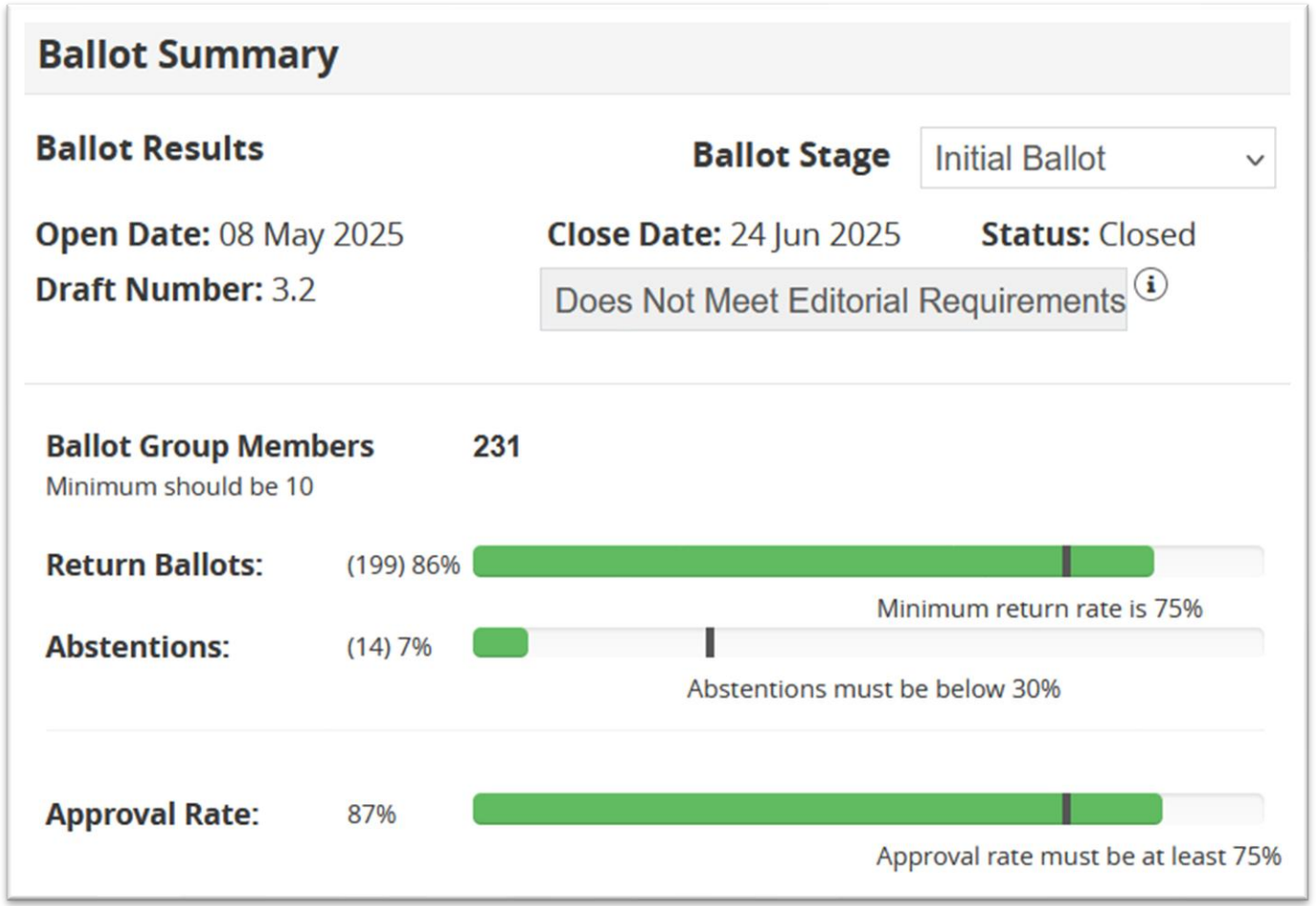
Academic-Other	3	1.29%
Academic-Researcher	7	3.03%
Academic-Student	1	0.43%
Academic-Teacher	4	1.73%
Consulting	53	22.94%
Electric utility	30	12.98%
General Interest	19	8.22%
Government - Defense/ Military	2	0.86%
Government - Other	4	1.73%
Government Regulatory Agency	1	0.43%
IBR plant developer/owner	18	7.79%
IBR plant EPC	4	1.73%
ISO or RTO	4	1.73%
Producer - Component	9	3.89%
Producer - Other	4	1.73%
Producer - Software	3	1.29%
Producer - System / Manufacturer	24	10.38%



- **231 balloters**
- Ballot group represents **all key stakeholder groups** and is not dominated by any group

Professional Association / Professional Society	1	0.43%
Research	13	5.62%
Service Provider - Design Services	4	1.73%
Service Provider - Testing	4	1.73%
Standards Developing Organization (SDO)	5	2.16%
Supplier	2	0.86%
User - Industrial	4	1.73%
User - Other	8	3.46%

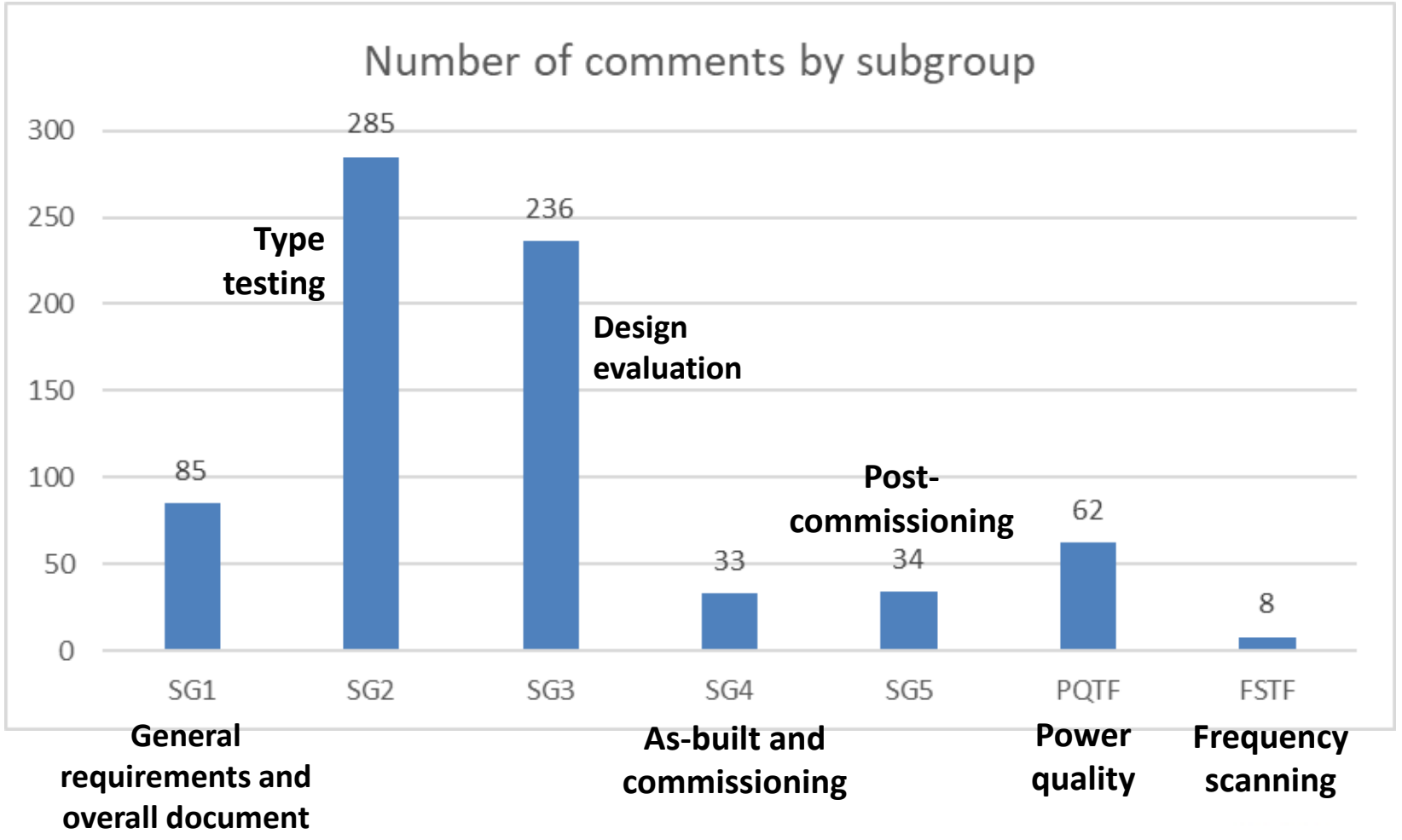
P2800.2 initial ballot results



- **87% approval**
  - **Exceeds 75% threshold to pass**
- 743 ballot comments
- 35 public comments

P2800.2 initial ballot results

- All 778 comments have been addressed by Comment Resolution Group (CRG)
  - 33 industry experts (P2800.2 leadership team plus 13 invited SMEs)
- Ballot recirculation expected to start this week



Themes in P2800.2 comments

Debate within WG: prescriptiveness vs flexibility

- Some WG members prefer more prescriptive tests for greater uniformity across plants
  - IBR deployment is more efficient if more standardized
- Other WG members prefer to leave more flexibility
  - Users can interpret standard the way that works best for them
- Overall, D4.0 is somewhat **more prescriptive** than D3.2

Themes in P2800.2 comments

Type tests:

- Increased specificity (but still fairly general/flexible)
  - For example, added tables of test profiles, updated figures
- Increased rigor of frequency and ROCOF ride-through testing

Themes in P2800.2 comments

Design evaluation:

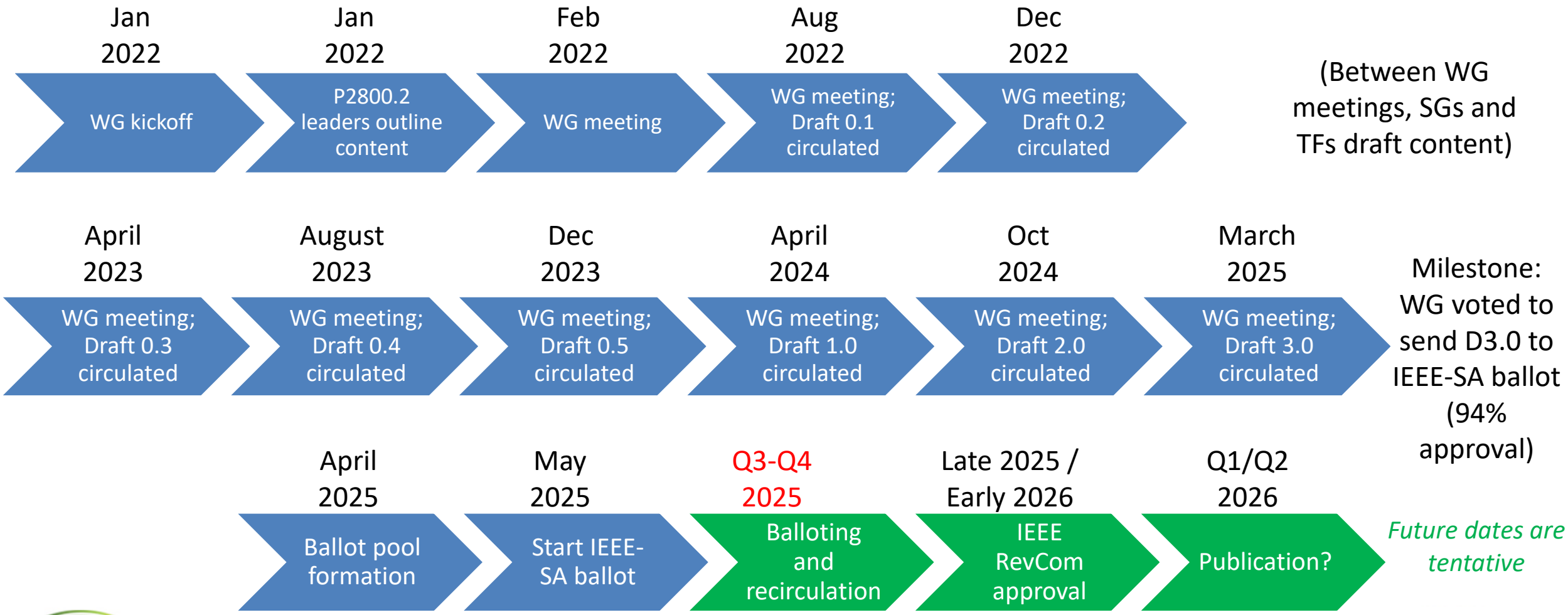
- How much to raise the bar on IBR models?
  - Overall trend was to lower the bar a bit in D4.0 relative to D3.2
- Removed partial framework for quantitative IBR unit model validation
  - Model validation is only qualitative in D4.0
- Moved guidance on non-aggregated models to annex
- Retained option to use either simple (SMIB-like) test system or detailed real-grid test system
  - Choice may depend on when in the process DE is run

Themes in P2800.2 comments

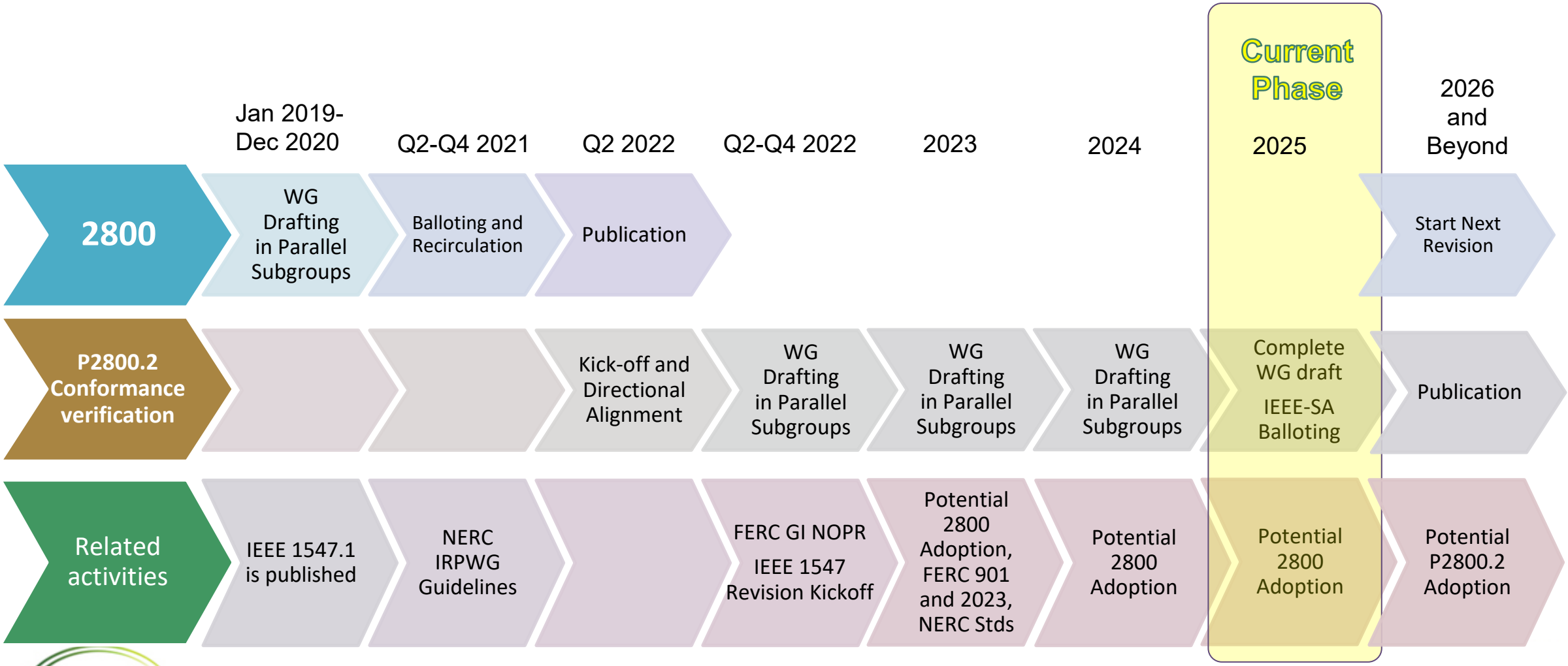
Commissioning tests:

- Increased specificity (but still fairly general/flexible)
- Added specific tests for voltage feedback, reactive power control, power factor control
  - Not required if plant will never operate in that mode
- Generally declined requests asking for alignment with specific regulatory frameworks

P2800.2 Working Group Timeline



Potential 2800 Adoption Timeline and Next Steps



Thank You

www.nrel.gov

Contact: Andy.Hoke@nrel.gov

This work was authored by the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy's Solar Energy Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

Potential Areas and Issues to Consider During Revision of IEEE 2800

Manish Patel, PhD, PE

10/21/2025

siliconranch.com

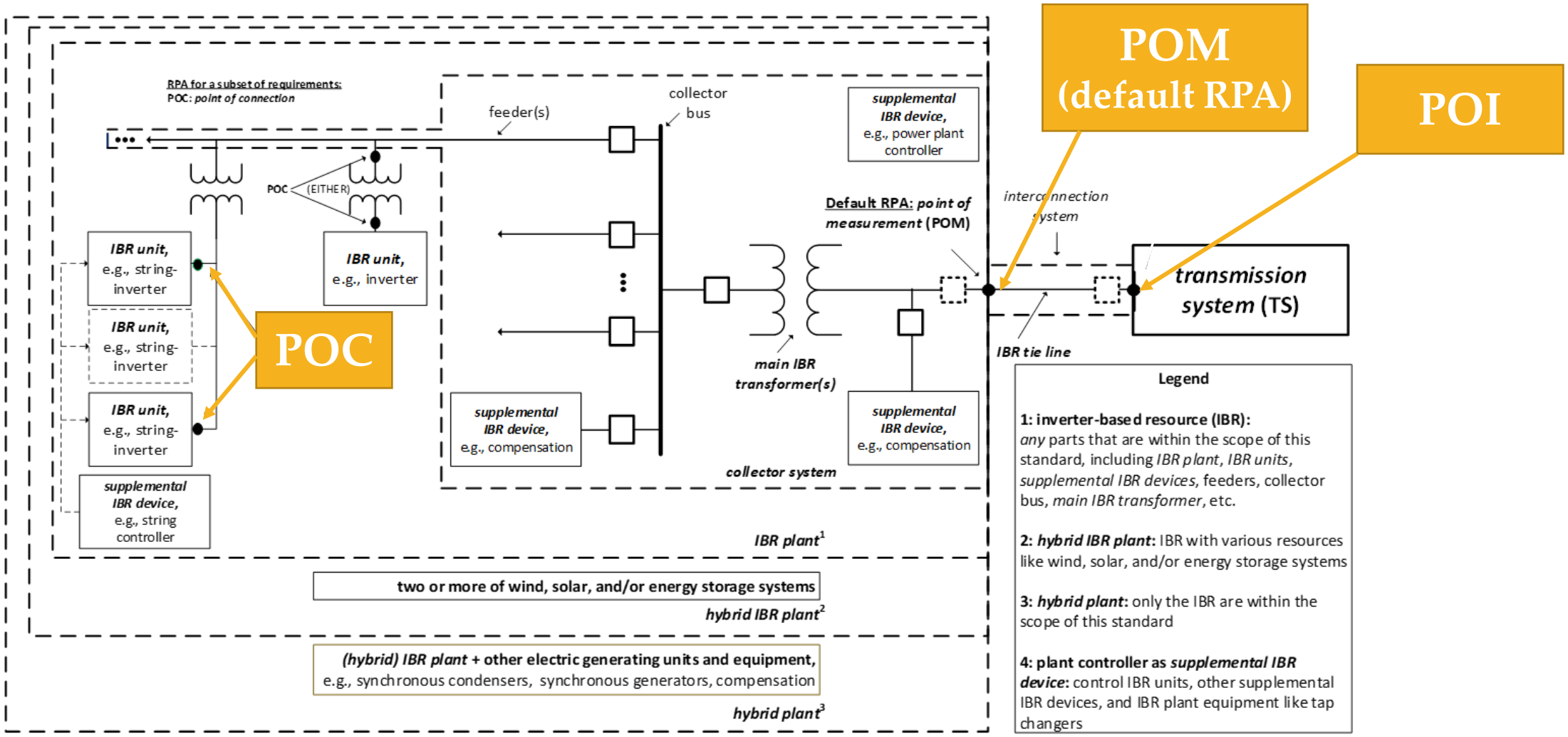
Disclaimer

The views presented in this presentation are the **personal views** of the individuals presenting it and shall not be considered the official position of the IEEE Standards Association or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE, in accordance with IEEE Standards Association Standards Board Bylaws 5.2.1.6.

Use of an IEEE standard is wholly voluntary

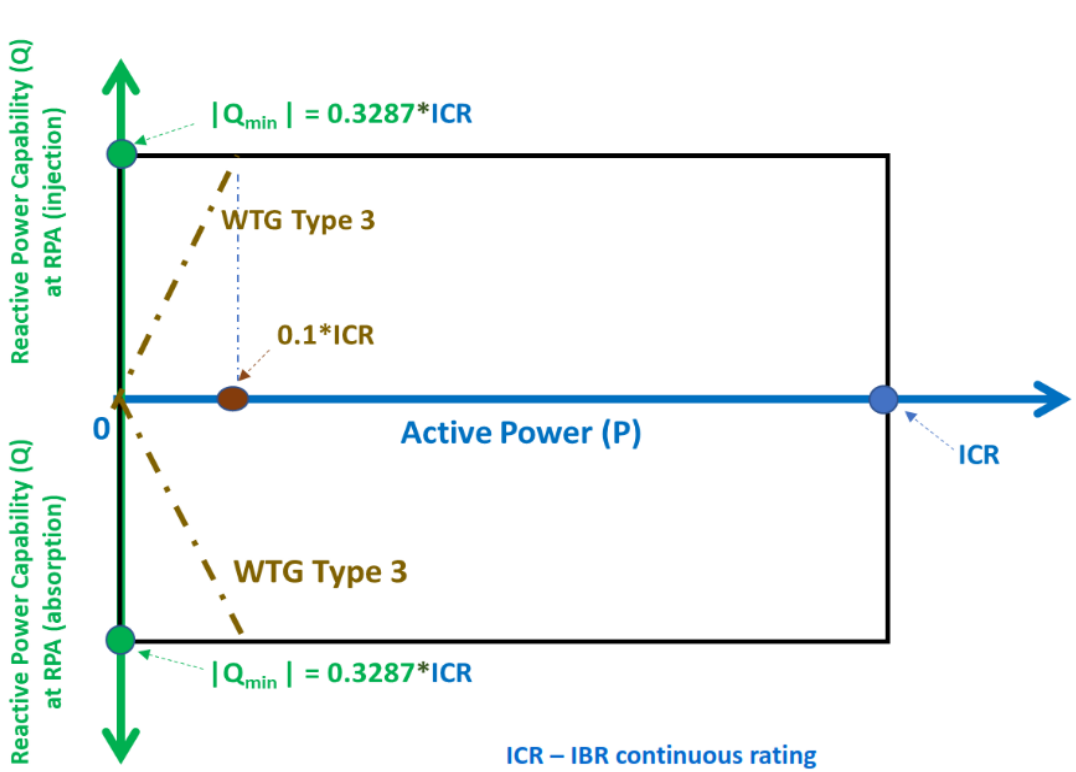
Disclaimer

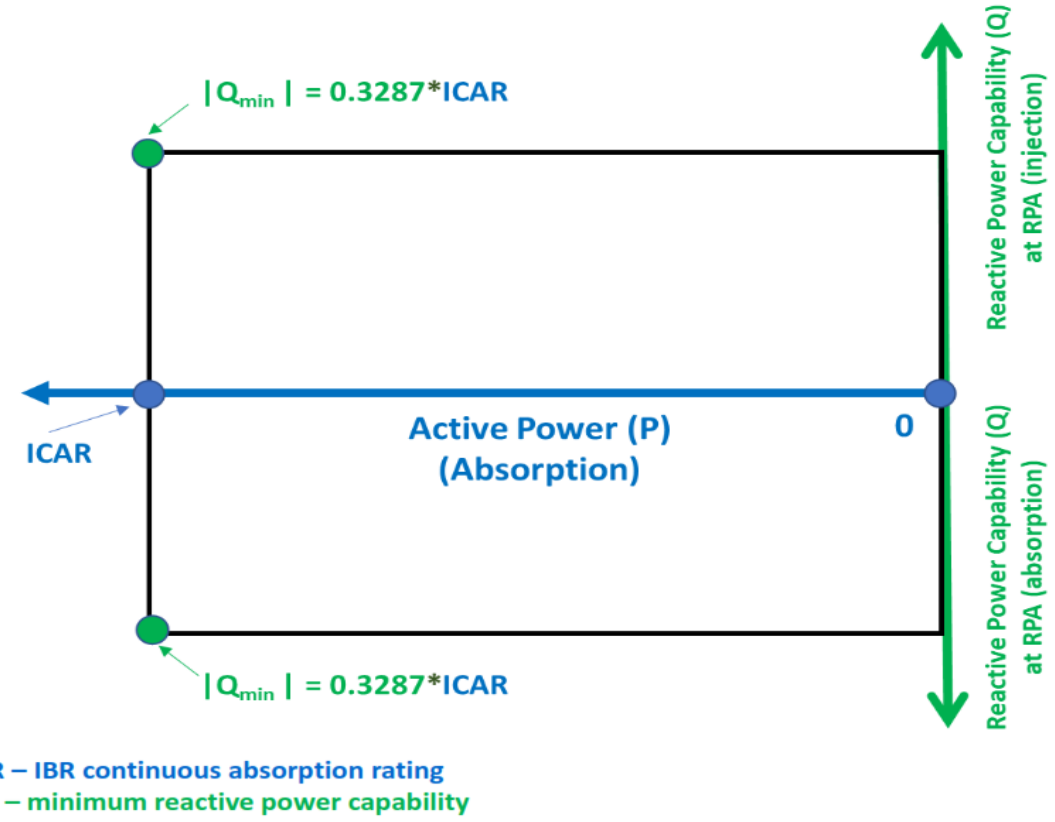
AC Interconnection



Reactive Power Capability Requirements (Clause 5.1)

- Default RPA is POM, (i.e., Plant Level Requirement)
- Minimum reactive power capability shall be met for all active power output levels (including zero). Exceptions for:
  - Type III wind (dashed brown line) and AC-connected offshore IBR plants (should language)





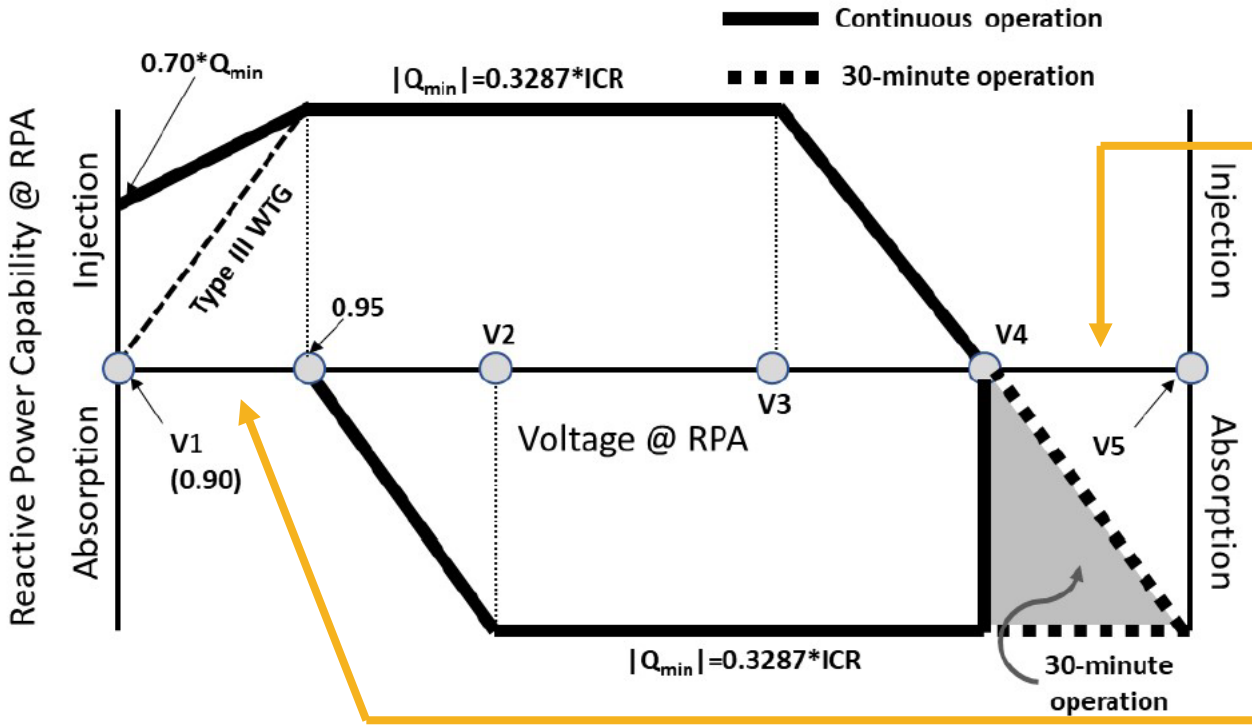
Reactive Power Capability Requirements (Clause 5.1)

— *IBR units* shall have the capability to provide reactive power support when the *primary energy source* is available and not available, and during the transition between these two resource availability states. *IBR units* shall have the capability to remain *in service* while not exporting or importing active power, except for importation of active power to cover losses, and to have the reactive power capability as defined as shown in Figure 6 and Figure 7. Note that the *type III WTGs* may have a reduced reactive power capability when the *primary energy source* is not available due to the size of the line-side converter. The utilization of this capability shall be under mutual agreement between the *IBR owner* and the *TS owner*.

Not sure why this requirement applies to IBR unit instead of IBR plant.

In case where the requirement applies at the POM, all IBR units in the plant do not need to have capability to operate at zero active power to conform to reactive power capability requirement.

Reactive Power Capability Requirements (Clause 5.1)



Plant is not required to operate at **zero** reactive power when voltage is greater than V4.

Is there a reason to require plant to operate at **zero** reactive power when voltage is less than 0.95 per unit?

Table 4—RPA voltage range[a]

TS nominal voltage at the RPA	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	V4 (p.u.)	V5 (p.u.)
< 200 kV	0.90	0.99	1.03	1.05	1.10
≥ 200 kV except 500 kV and 735 kV as below	0.90	1.00	1.04	1.05	1.10
500 kV	0.90	1.02	1.06	1.10	1.10
735 kV[b]	0.90	1.02	1.06	1.088	1.10

Voltage and Reactive Power Control Mode (Clause 5.2)

The IBR Plant shall provide following mutually exclusive modes of reactive power control functions:

- RPA Voltage control mode
- RPA Power Factor control mode
- RPA Reactive Power set point control mode

Voltage Control (Clause 5.2.2)

When in this mode, the *IBR plant* shall operate in closed-loop automatic voltage control mode to regulate the steady-state voltage at the RPA to the reference value, as adjusted by the droop function, to within 1% of the RPA voltage set point unless to do so requires reactive power exceeding the reactive power capability of the *IBR plant*. The RPA voltage set point shall be specified by the *TS operator*.

The voltage control system shall be capable of reactive power droop to provide a stable and coordinated response. The droop setting shall be settable and coordinated by the *TS operator* and *IBR operator*. The automatic voltage control shall have a range of available droop settings from 0 to 0.3 per unit voltage change for 1.0 per unit reactive power on the IICR base. The RPA voltage control settings are allowed to be adjusted locally and/or remotely as specified by the *TS operator*. The dynamic reactive power response of the *IBR plant* to a step change in the RPA voltage within the *continuous operation region* and within *IBR plant*'s reactive power capability shall be as specified in Table 5.[62, 63] Dynamic performance requirements shall be based on, and only applicable to, a defined range of TS equivalent impedance at the POM, specified by the *TS operator*.

Use of terms "reference value" and "RPA voltage setpoint" may cause confusion. Depending on droop and pre-event reactive power output, regulating voltage to within 1% of the RPA voltage set point may not be possible.

Some Transmission Planners require voltage droop control. Perhaps, standard should allow for it.

Voltage Control (Clause 5.2.2)

Table 5—Performance target range

Parameter	Performance target	Notes
Reaction time	< 200 ms	
Maximum *step response time*	As required by the *TS operator*	The slowest response shall be tuned based on the *TS operator* requirements for response time and stability given the anticipated range of grid strength, other local voltage control devices, and *overshoot* requirements. The *step response time* may typically range between 1 s and 30 s. Any switched shunts or LTC transformer tap change operation needed to restore the dynamic reactive power capability in Figure 8 shall respond within 60 s.
Damping	Damping ratio of 0.3 or higher	Damping ratio, indicative of control stability, depends on grid strength.

Actions for IBR plant to react to change in POM voltage:

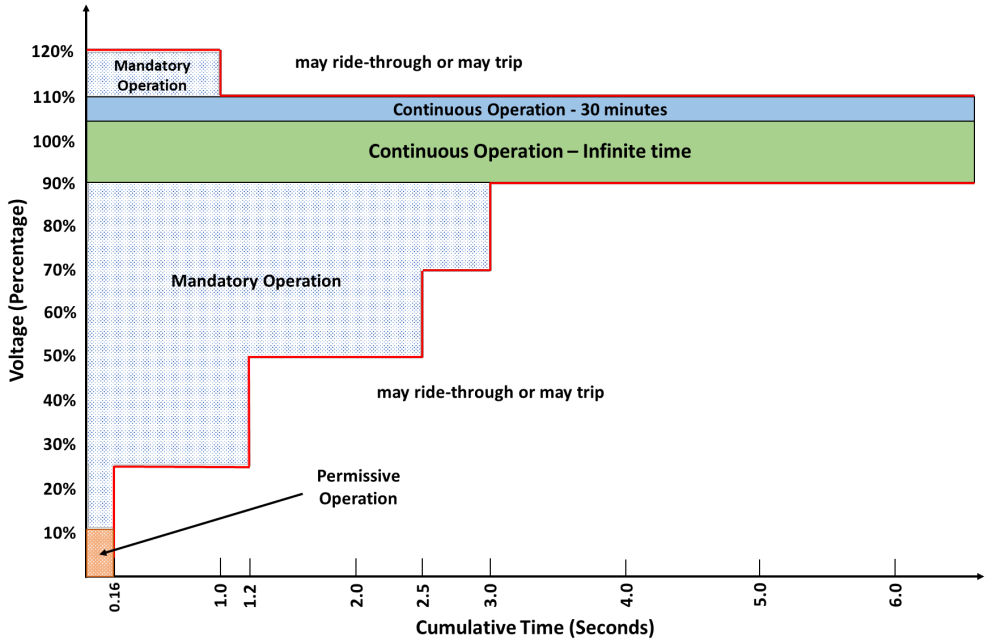
- *POM voltage measurement time*
- Communication time between POM meter and PPC
- PPC recognizing change and issuing new command to IBR units
- Communication time between PPC and IBR units
- IBR unit's recognizing new command from PPC and reacting to it

reaction time (T_{react}): The duration from a step change in a system quantity measured at a defined location until the output of the system at the same defined location measurably changes in the direction of the control effort. (Adapted from NERC Reliability Guideline—BPS connected inverter-based resource performance [B75])

Need clarification if measurement time is included or not in reaction time requirement. Included or not, what should be a reasonable reaction time?

Voltage Ride-Through Capability Requirements (Clause 7.2.2.1)

Plants with Aux Load Limitations (i.e., Wind Plant)



Applicable voltage (p.u.) at the RPA	Operating mode/response	Minimum ride-through time (s) (design criteria)
V > 1.20	May ride-through or may trip	NA
V > 1.10	Mandatory operation	1.0
V > 1.05	Continuous operation[90]	1800
V < 0.90	Mandatory operation	3.00
V < 0.70	Mandatory operation	2.50
V < 0.50	Mandatory operation	1.20
V < 0.25	Mandatory operation	0.16
V < 0.10	Permissive operation[91]	0.16

Three possible understanding:

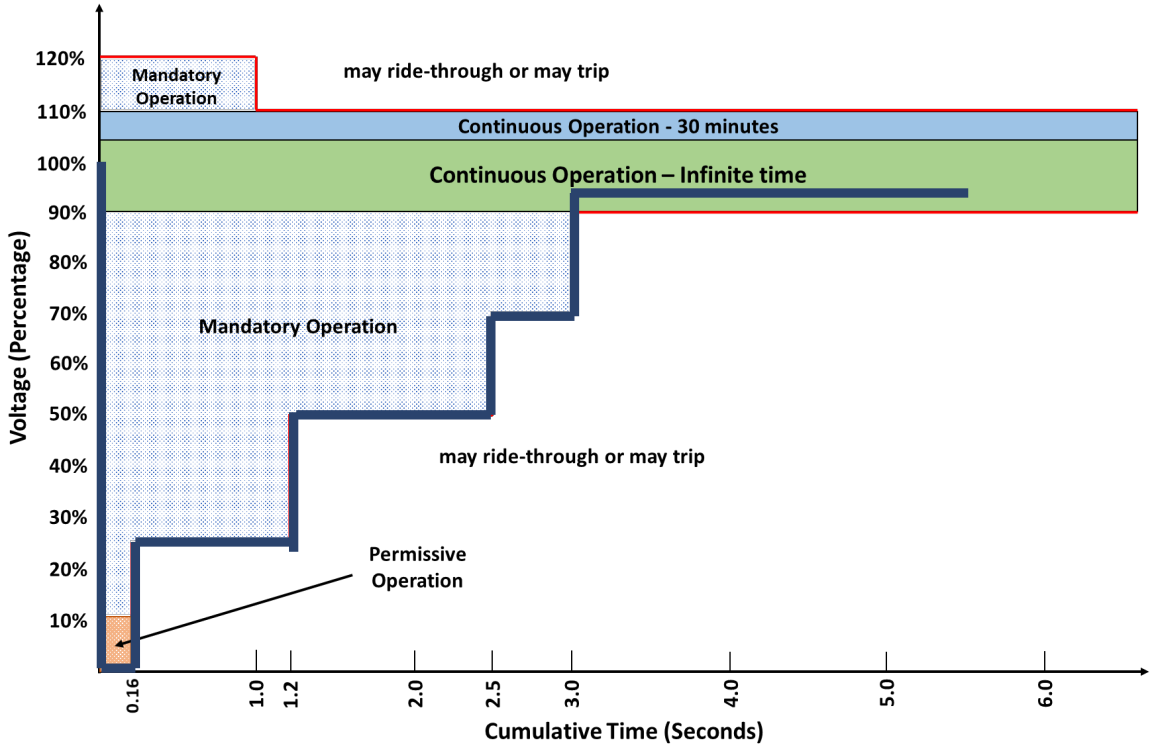
- **Voltage versus Time curve: For a given voltage, IBR plant shall not trip until the duration at this voltage exceeds ride-through curve capability.**

  ✓ **Correct understanding**

- Voltage Deviation *times* Time *Area*: Area between a nominal voltage (100%) and either a low or high voltage ride-through boundary.
- Voltage versus Time Envelope: Ride-through curves define an envelope to lay as a template over a voltage versus time trajectory.

Voltage Ride-Through Capability Requirements (Clause 7.2.2.1)

The Standard states *"IBR plant shall ride through a voltage disturbance event wherein the applicable voltage exceeds or is less than the voltage range representing the continuous operation region, except for voltage magnitude deviations more severe than the voltage thresholds and persisting for greater than the associated durations as specified."*



Based on this understanding, one interpretation of the voltage ride-through requirement is that a wind plant must withstand a ***single*** voltage disturbance event where the voltage drops to zero at time t = 0, then gradually recovers as follows:

- Rises to 0.25 pu at t = 0.16 s
- Rises to 0.5 pu at t = 1.2 s
- Rises to 0.7 pu at t = 2.5 s
- Rises to > 0.9 pu at t = 3 s

Voltage Ride-Through Capability – IEEE 2800 Versus PRC-029

PRC-029-1, Attachment 1, Item #7

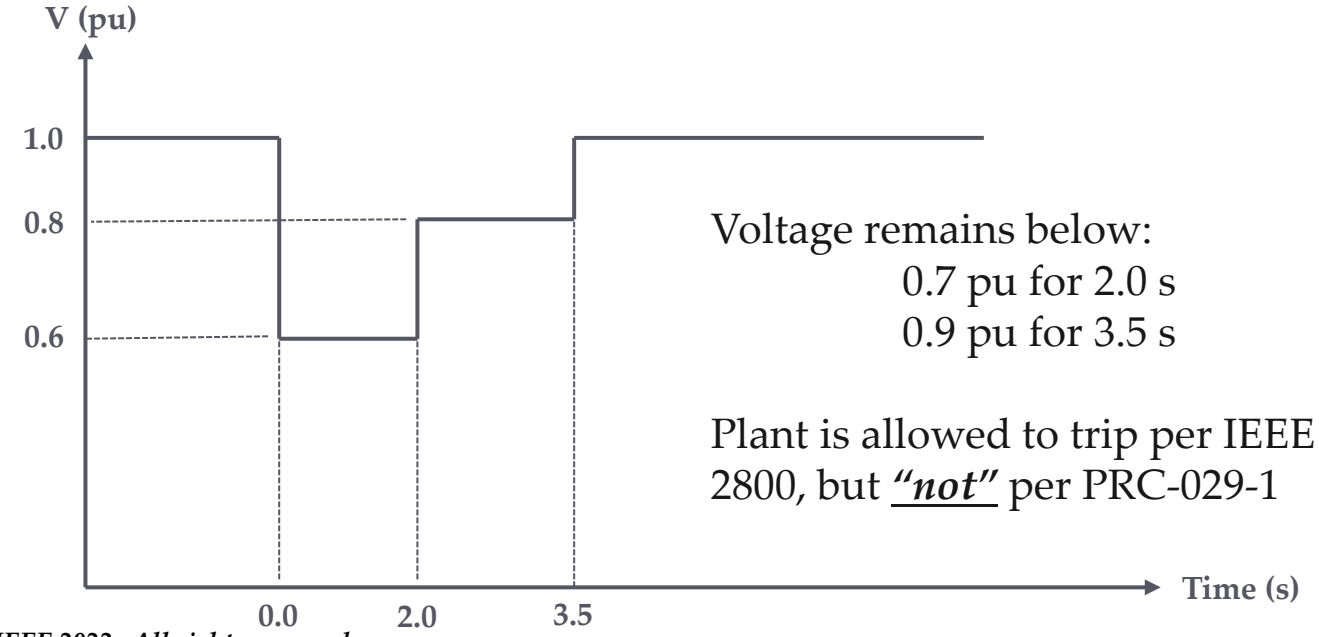
At any given voltage value, each IBR shall Ride-through unless the time duration at that voltage has exceeded the specified minimum Ride-through time duration. If the voltage is continuously varying over time, it is necessary to add the duration within each band of Tables 1 and 2 over any 10 second time period.

IEEE 2800, clause 7.2.2.1

IBR plant shall ride through a voltage disturbance event wherein the applicable voltage exceeds or is less than the voltage range representing the continuous operation region, except for voltage magnitude deviations more severe than the voltage thresholds and persisting for greater than the associated durations as specified.

Table 1: Voltage Ride-through Requirements for AC-Connected Wind IBR [13]

Voltage (per unit)[14]	Operation Region	Minimum Ride-Through Time (sec)
> 1.20	N/A[15]	N/A
≥ 1.10	Mandatory Operation Region	1.0
> 1.05	Continuous Operation Region	1800
≤ 1.05 and ≥ 0.90	Continuous Operation Region	Continuous
< 0.90	Mandatory Operation Region	3.00
< 0.70	Mandatory Operation Region	2.50
< 0.50	Mandatory Operation Region	1.20
< 0.25	Mandatory Operation Region	0.16
< 0.10	Permissive Operation Region	0.16



Voltage remains below:
0.7 pu for 2.0 s
0.9 pu for 3.5 s

Plant is allowed to trip per IEEE 2800, but ***"not"*** per PRC-029-1

Transient OV Ride-Through Requirements (Clause 7.2.3)

The *IBR plant* shall ride through transient overvoltage that do not exceed the fundamental-frequency overvoltage ride-through requirements specified in 7.2.2.1 and for which the greater of individual phase-to-phase or phase-to-ground instantaneous voltage magnitudes do not exceed the cumulative durations (minimum time) specified in Table 14. The interpretation of cumulative duration in the context of instantaneous voltage magnitudes is illustrated in the informative Figure 11. The cumulative duration shall only include the sum of durations for which the instantaneous voltage exceeds the respective threshold over a 1-min time window.[110]

Default RPA is POM

Voltage[c] (p.u.) at the RPA	Minimum ride-through time (ms)[d] (design criteria)[b]
V > 1.80	See footnote[a]
V > 1.70	0.2
V > 1.60	1.0
V > 1.40	3.0
V > 1.20	15.0

- Typically, TrOV protection is not applied at the POM. It usually is included in IBR units (POC). Hence, important to understand how TrOV at POM is reflected at POC.
  - Is aggregated model sufficient? OR a non-aggregated model should be used?
- Plant is allowed to trip if TrOV is above the specified threshold for a duration longer than specified, even if fundamental-frequency phasor component of applicable voltage is withing the mandatory or continuous operation region.
  - My interpretation is that TrOV ride-through requirement is an exception to fundamental frequency voltage ride-through requirements.
- Challenge is to show conformance to TrOV ride-through requirements.

Consecutive Volt Deviation RT Capability Req (Clause 7.2.2.4)

Default RPA is POM.

Requirements are too complicated, and it is impractical to test many different scenarios.

IBR Plant shall ride-through multiple excursions outside of continuous operating region with following exceptions:

- The *IBR plant* may trip for disturbances for which the cumulative duration of voltage deviations within the applicable time window specified in 7.2.2.1 (i.e., 10 s or 3600 s) exceeds (i.e., undervoltages less than or overvoltages greater than) the ride-through durations specified in Table 11 or Table 12, as applicable.
- The *IBR plant* may trip for more than four deviations of the *applicable voltage* at the RPA outside of the *continuous operation region* within any 10-s period.
- The *IBR plant* may trip for more than six deviations of the *applicable voltage* at the RPA outside of the *continuous operation region* within any 120-s period.
- The *IBR plant* may trip for more than ten deviations of the *applicable voltage* at the RPA outside of the *continuous operation region* within any 30-min (1800-s) period.

Consecutive Volt Deviation RT Capability Req (Clause 7.2.2.4)

Default RPA is POM.

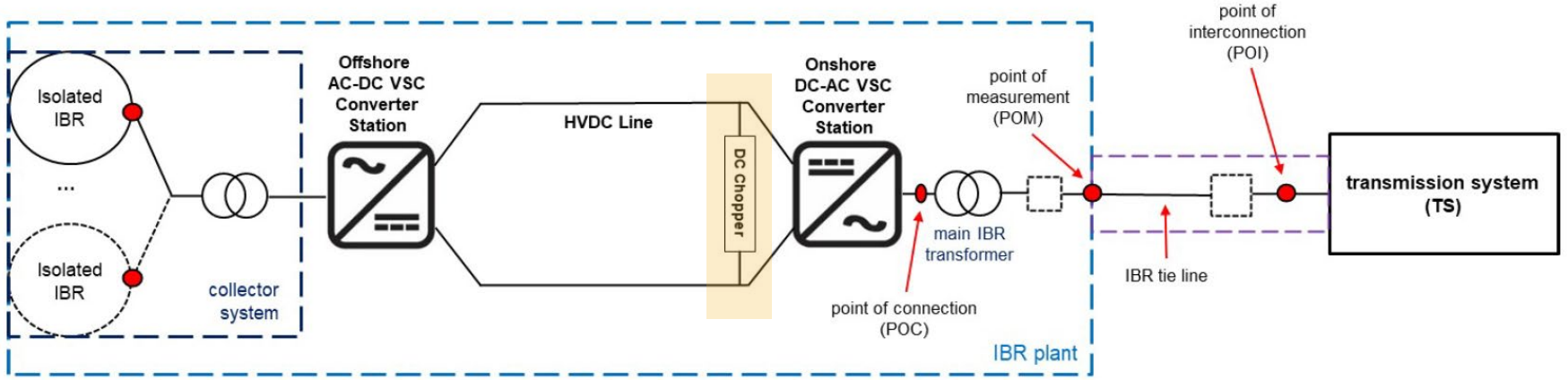
Requirements are too complicated, and it is impractical to test many different scenarios.

IBR Plant shall ride-through multiple excursions outside of continuous operating region with following exceptions:

- The *IBR plant* may trip for any voltage deviation outside of *continuous operation region* that follows the end of a previous deviation by less than 20 cycles of the system fundamental frequency.
- The *IBR plant* may trip for more than two individual deviations of the *applicable voltage* at the RPA below 50% of the nominal voltage (inclusive of zero voltage) within any 10-s period.
- The *IBR plant* may trip for more than three individual deviations of the *applicable voltage* at the RPA below 50% of the nominal voltage (inclusive of zero voltage) within any 120-s period.
- For WTG-based *IBR plants*, individual *IBR units* (WTGs) may trip to self-protect for consecutive voltage deviations that result in stimulation of mechanical resonances exceeding equipment limits.

Consecutive Volt Deviation RT Capability Req (Clause 7.2.2.4)

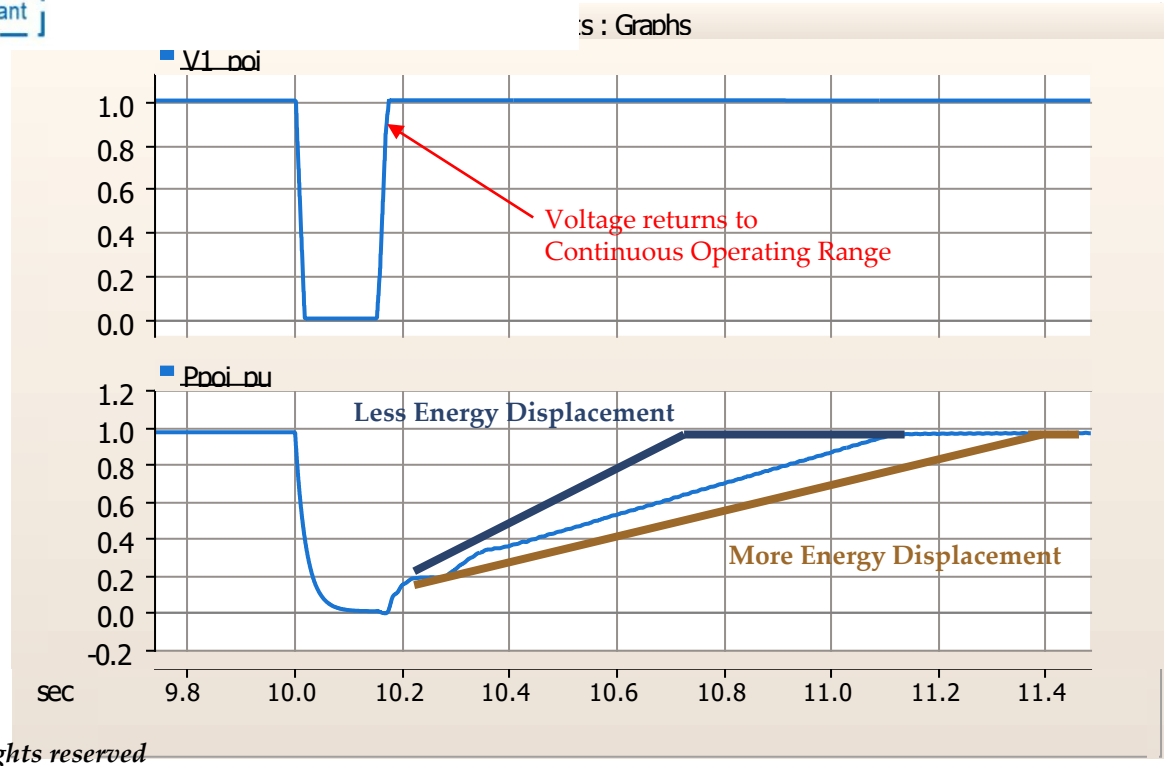
Consideration of energy displacement during fault and post-fault active power recovery



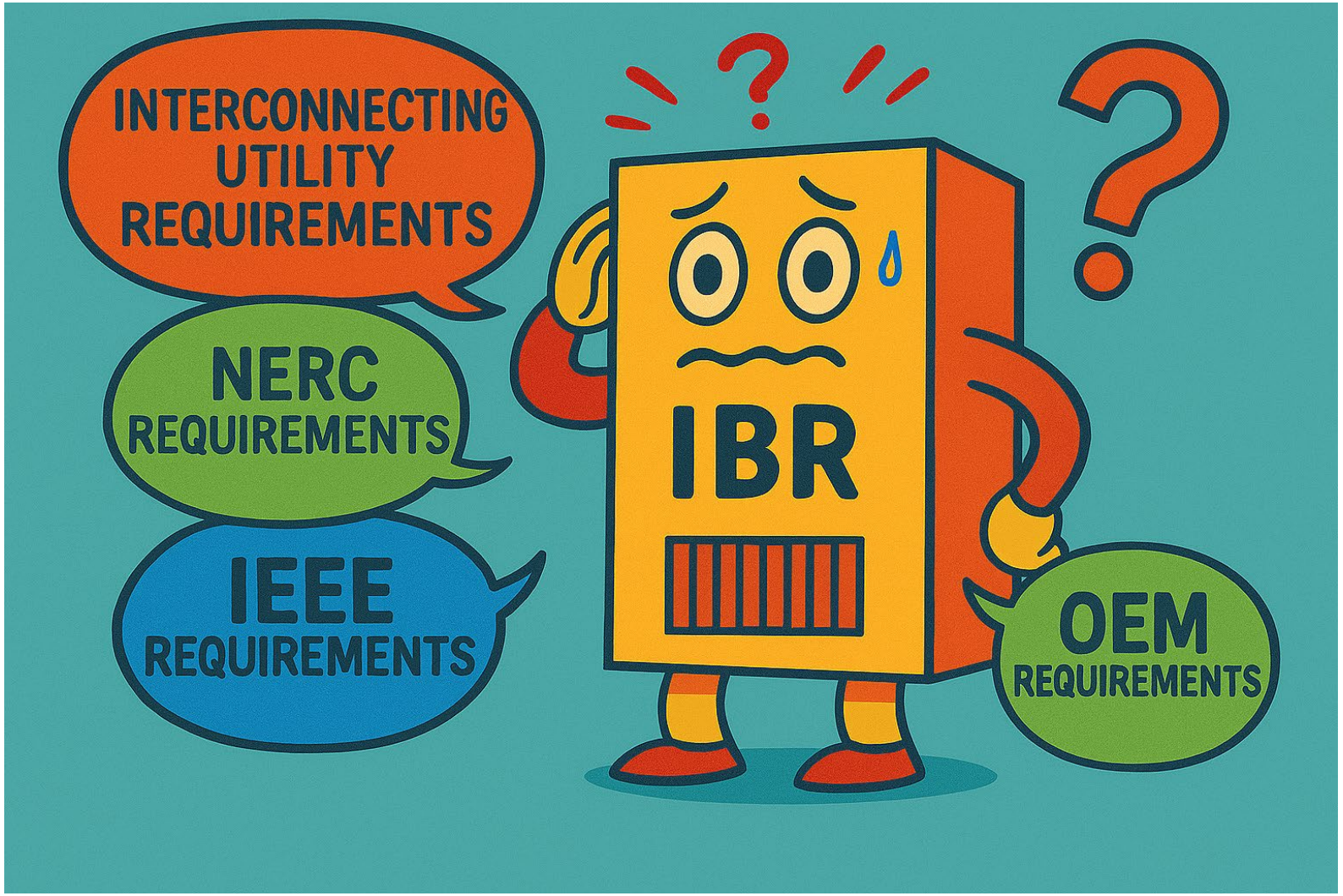
Challenging for VSC-HVDC (used with offshore wind plants) and certain type IV WTGs.

IEEE 2800 includes an exception for isolated IBRs connected via VSC-HVDC due to limitation of DC chopper to absorb energy.

Ability to conform to voltage ride-through requirements (including consecutive VRT) depends on: balance of active/reactive current during a fault + post-fault active power recovery time



Summary


INTERCONNECTING UTILITY REQUIREMENTS
NERC REQUIREMENTS
IEEE REQUIREMENTS
IBR
OEM REQUIREMENTS

Forthcoming Revision of IEEE 2800 and Development of a new IEEE Recommended Practice for GFM Equipment

i2X FIRST—Season 2
"Challenges with IEEE2800-2022, Planned Revisions"

Jens C. Boemer (jboemer@epri.com)
Technical Executive

Tuesday, October 21th, 2025

Acknowledgements and Disclaimers

- All comments provided reflect only the view of the EPRI technical experts performing the review and do not necessarily reflect the opinions of those supporting and working with EPRI to conduct collaborative research and development.
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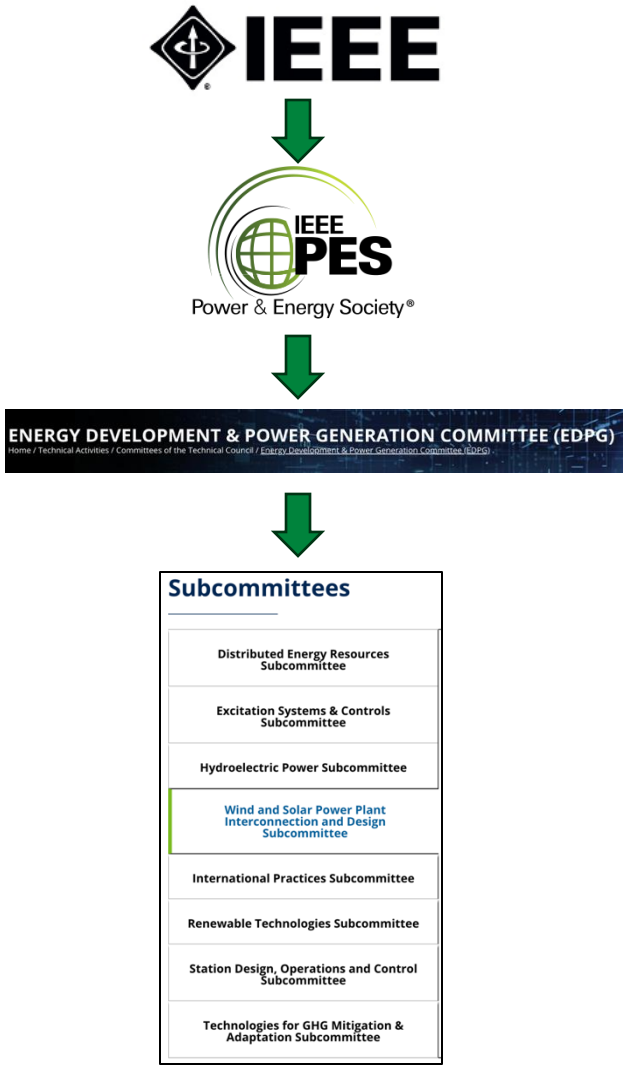
- Part of this work was supported in part by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office and Wind Energy Technologies Office.

- The views expressed in the presentation **do not necessarily represent the views of the DOE or the U.S. Government.**

Introduction to IEEE/PES/EDPG/ WSPPID-SC

Where does WSPPID-SC reside?



And what is its Scope?

Wind and Solar Power Plant Interconnection and Design Subcommittee

Scope: The ED&PGC Wind and Solar Power Plant Interconnection and Design Subcommittee (WSPPID-SC) deals with all interconnection and design matters related to the grid integration and delivery of transmission- and distribution-connected wind and solar resources. It provides liaison to and cooperates with other committees, subcommittees, working groups and task forces, including standards making groups, in IEEE and other organizations with similar interests. Areas of interest include, but are not limited to, the following: (1) Best practices on interconnection performance requirements, testing, and verification of wind and solar plants; (2) Engineering design of and experience related to wind and solar resource interconnection to T&D systems; (3) Safety- and protection-related issues of wind and solar resources interconnected to T&D systems. (4) Technologies related to interconnection such as power electronic conversion, collection systems, and storage. (5) Analytical and design tools. (6)Standards, recommended practices, application guides, and education through panel sessions, special publications and tutorials.

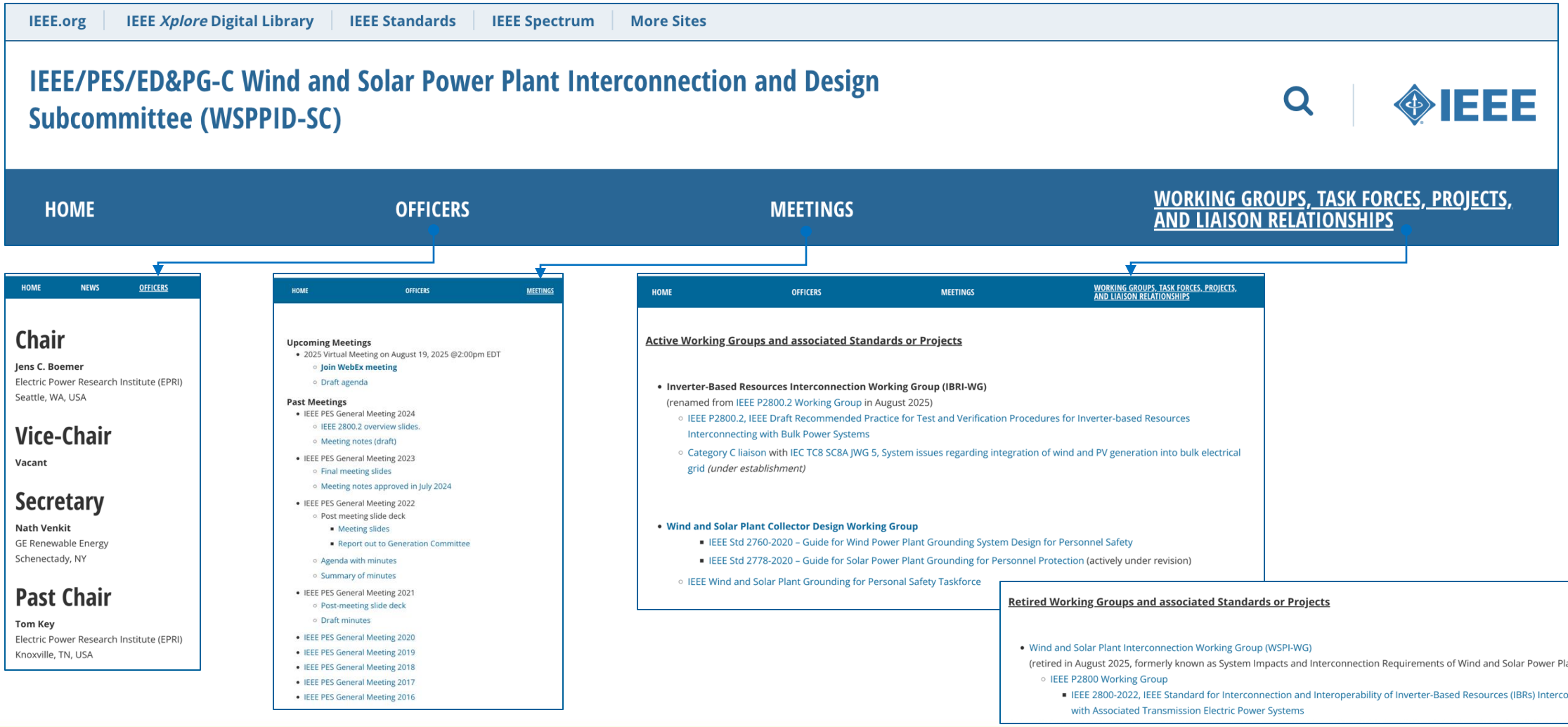
Jens C. Boemer, Chair
Electric Power Research Institute (EPRI)

IEEE SA Program Manager: Vanessa Lalitte (recently changed to Malia Zaman, website not updated yet)

Website: https://site.ieee.org/pes-edpgcom-wsppidsc/

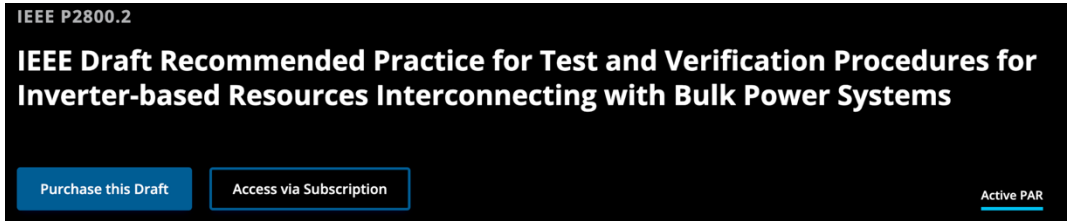
WSPPID-SC Website

https://site.ieee.org/pes-edpgcom-wsppidsc/

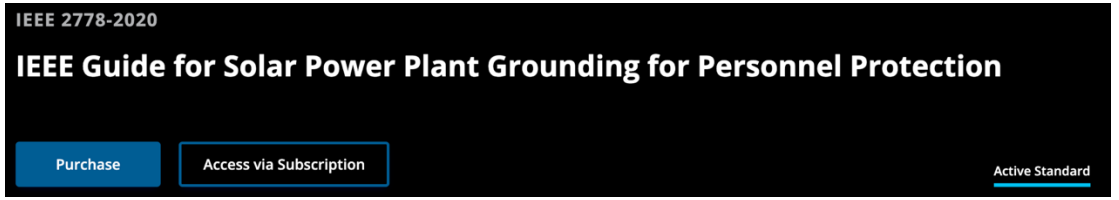


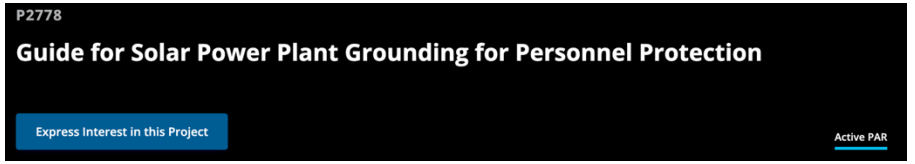
WSPPID-SC Sponsored Standards

Inverter-Based Resources Interconnection Working Group (IBRI-WG)



Wind and Solar Power Plant Collector Design Working Group (WSPPCD-WG)





How To Express Interest in IEEE myProject?

Only needed if you are not already an IEEE P2800.2 / IBRI-WG member!

Instructions

1. On the myProject Home Screen, click on "**Menu**" and then on "**Manage Profile and Interests**"
2. Click on the "**Interests**" tab, then on "**Add Groups**"
3. Find "**Inverter-Based Resources Interconnection Working Group**" under PES/EDPG, or simply search for "**IBRI-WG"** — see screenshot excerpts at right
4. Click bullet under "Groups I Am Interested In" and follow instructions on screen
5. No IEEE SA membership required for this step.

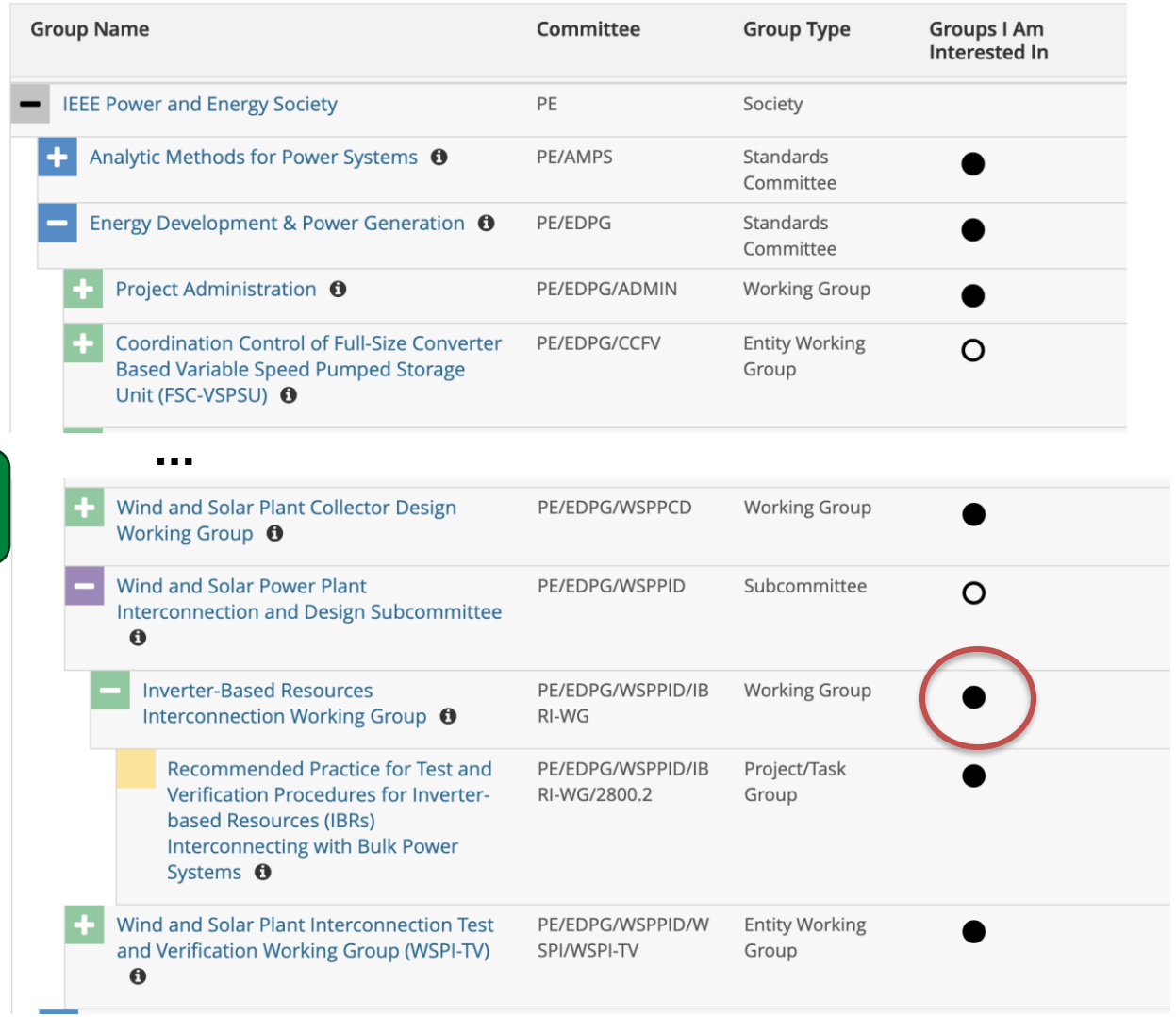
Click Direct Link Here

Why register on MyProject?

- Receive **WG meeting invitations**
- Receive **invitation to join IEEE-SA ballot pool** when a standard under the WG goes to ballot

Why does it not show forthcoming projects P2800a, P2800 R1, and P2800.1?

- **These projects are not authorized yet.**
- Will appear along with existing P2800.2 project, once approved by IEEE SASB NesCom later in 2025.



IEEE P2800/.x PARs

Inverter-Based Resources Interconnection Working Group (IBRI-WG)
of the **Wind and Solar Power Plant Interconnection and Design Subcommittee (WSPPID-SC)**
of the IEEE PES Energy Development and Power Generation Committee (IEEE/PES/EDPG-C)

Jens Boemer (Chair), Nath Venkit (Secretary), Tom Key (Past-Chair)
with contributions from
P2800.2 WG's Andy Hoke (Chair)
and Alex Shattuck (IEC TC8 SC8A JWG5 Co-convenor)

i2X FIRST Meeting
October 21, 2025

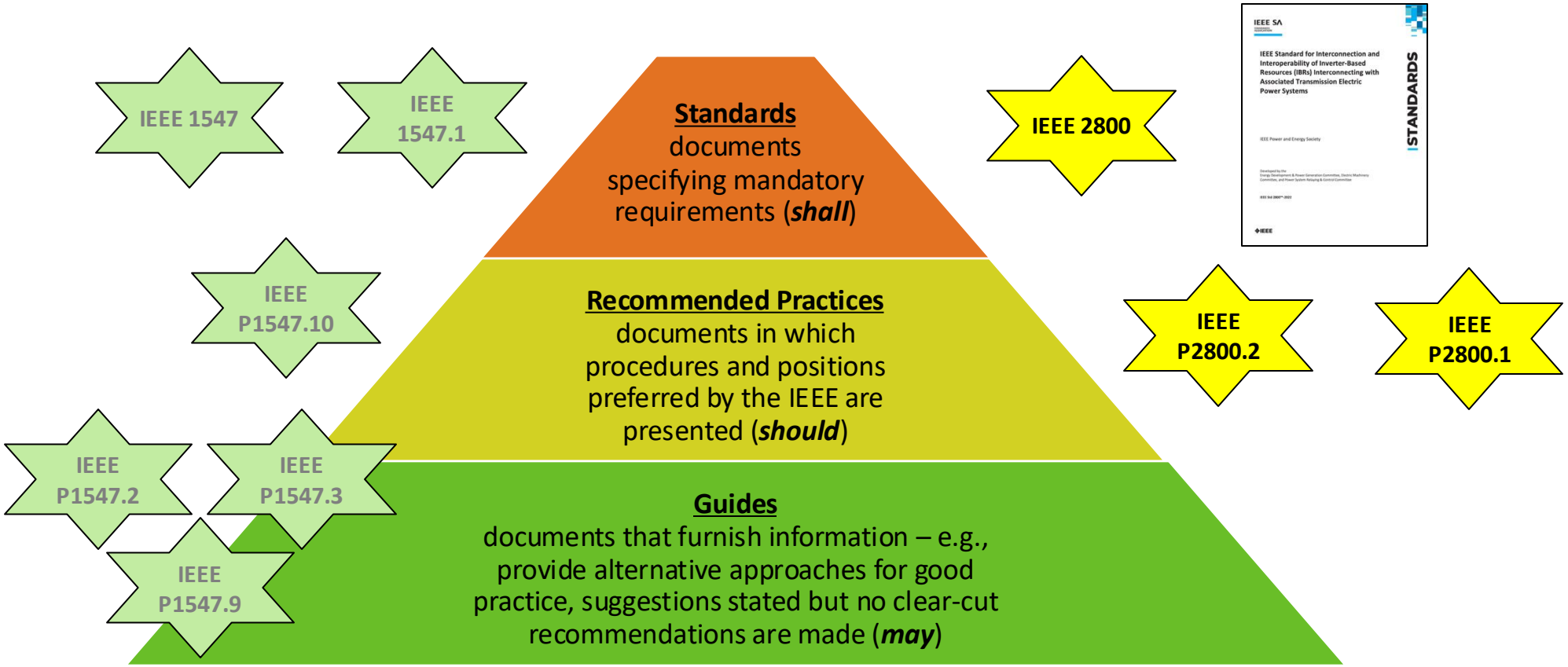
What Stakeholders have Asked for the first IEEE 2800/.x Revision Cycle

1. **Reduction of GFM barriers** in IEEE 2800 identified as most urgent
   - Will be done via an **Amendment** with narrow scope (➔ **P2800a**)
2. Specification of **optional GFM equipment** capability and standardized performance
   - Will be done in a **Recommended Practice** as soon as possible (➔ **P2800.1**)
3. **Revision of IEEE 2800-2022** based on industry learnings during adoption (➔ **P2800**)

- For item 2. (GFM project), the **same group of SMEs** should draft,
  - Redlines to amend IEEE 2800,
  - Recommended GFM specifications in IEEE P2800.1,
  - New normative reference and integration of optional specification in IEEE 2800,

  and also coordinate between **IEC and IEEE** as much as possible (**joint project**).

What is the Difference between an IEEE Standard and Recommended Practice?



IEEE 2800/.x Maintenance PARs

NesCom/RevCom Submittal Deadlines:
20 December 2024 (for January 2025 mtgs)
14 February 2025 (for March 2025 mtgs)
28 March 2025 (for May 2025 mtgs)
09 May 2025 (for June 2025 mtgs)
31 July 2025 (for September 2025 mtgs)
12 September 2025 (for October 2025 mtgs)
20 October 2025 (for December 2025 mtgs)

- *PSRC and SC21 approved joint sponsorship in Sep 2025.*
- *T&D Committee requested deferral of NesCom approval to December 2025 to explore joint sponsorship.*

PAR	Type	Scope	Request Date	Approval Date	Expected Date of SA Initial Ballot	Projected Date Submittal to RevCom	Publication Date	Expiration Date[1]	Joint with IEC?	
P2800a individual	Standard (individual)	Minimize barriers to GFM	Sep 12, 2025	~~October 2025~~ Dec 2025	Q4 2026	Q2 2027	April 2028	September 2029	No	IEC & IEEE GFM TF
P2800.1 individual	Rec. Pract. (individual)	Framework for GFM-IBRs	Sep 12, 2025	~~October 2025~~ Dec 2025	Q4 2026	Q2 2027	April 2028	September 2029	Yes	
P2800 R1 individual	Standard (individual)	Incorporation of industry learnings	Sep 12, 2025	~~October 2025~~ Dec 2025	March 2028	December 2028	April 2029	September 2029	No	P2800 & P2800.2 Subgroups

[1] Date by when balloted draft must go to RevCom. Typically, four years from request date.

Normative References & Definitions
General Requirements
Reactive Power & Voltage Control
Active-power—frequency response
Response to TS abnormal conditions
Power Quality
Protection
Modeling Data & Measurement Data
Frequency Scanning
Test & Verification
Type tests
Design evaluations
Com.Test & As-built ev.
Monitor., M&MV, PT

Legend

Mandatory (Standard, "shall")

"should"-reference

Optional (Recommended Practice, "should")

Futuristic (Guide, "may")

Last updated: 10/13/2025

Coordination within IEEE

Potential Joint Sponsors for P2800/.x PARs

Main Sponsor:

IEEE PES/
Energy Development & Power Generation
(PE/EDPG)

Responsible Subcommittee:
PES/EDPG/
WSPPID-SC

Legend:

- Joint sponsor of IEEE 2800-2022 or P2800.2
- confirmed
- informed
- interested
- to be informed

IEEE PES/
Analytic Methods for Power Systems (AMPS)
(PE/AMPS)

IEEE PES/
Energy Storage & Stationary Battery
(PE/ESSB)

IEEE PES/
Electric Machinery
(PE/EM)

IEEE PES/
Power System Communications & Cybersecurity
(PE/PSCC)

IEEE PES/
Power System Relaying and Control
(PE/PSRCC)

IEEE PES/
Substations
(PE/SUB)

IEEE PES/
Transmission and Distribution
(PE/T&D)

Other IEEE PES Standards Committees?

IEEE BOG/
Standards Committee 21: Distributed Generation, Energy Storage, and Interoperability
(BOG/SC21)

IEEE COM/
Power Line Communications Standards Committee
(COM/PLC)

IEEE PEL/
Standards Committee
(PEL/SC)

Other Standards Committees outside of IEEE PES?

Coordination within IEEE

Mapping of Potential Joint Sponsors for P2800/.x PARs

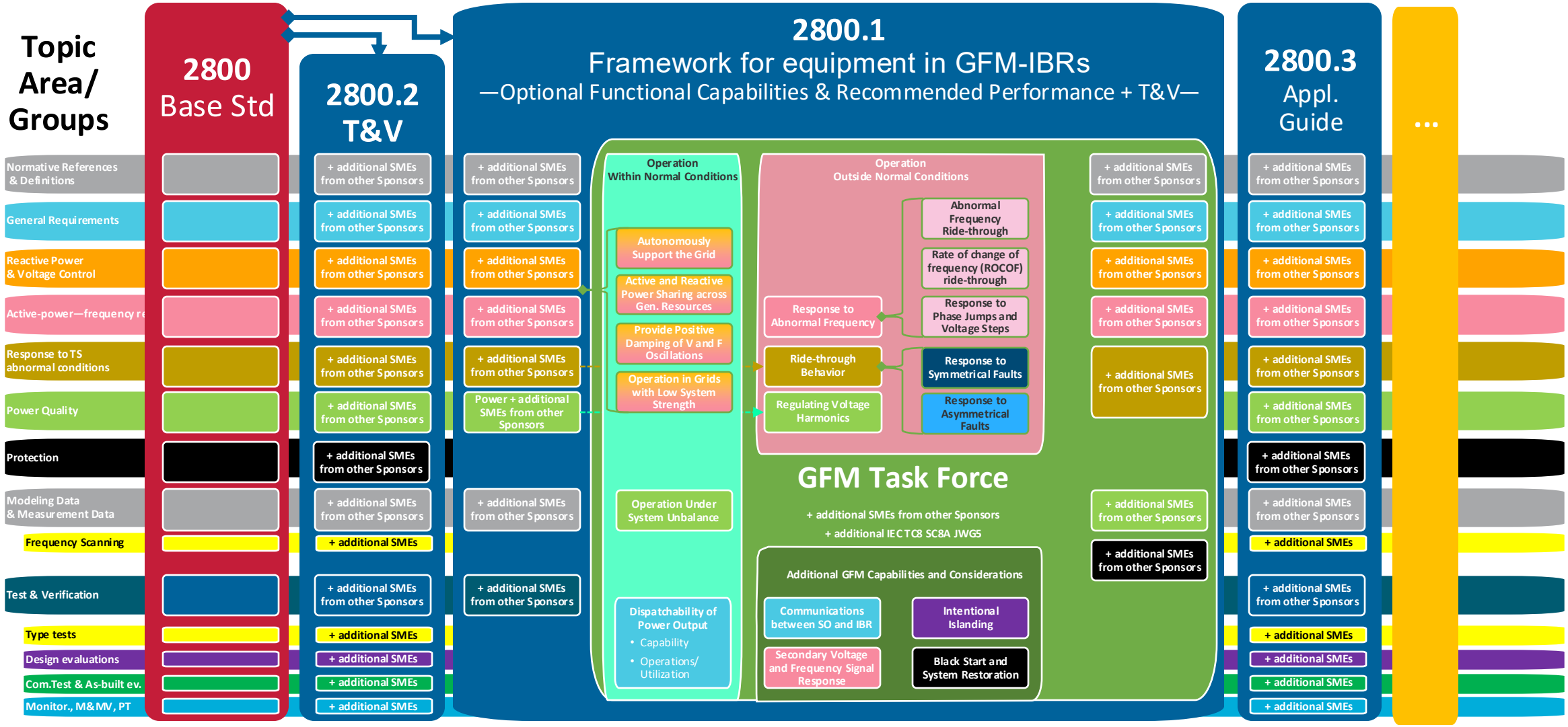
Requirements related to Clauses in IEEE 2800-2022	PE/ AMPS	PE/ ESSB	PE/ EM	PE/ PSCCC	PE/ PSRCC	PE/ SUB	PE/ TD	Other PE-Cs?	BOG/ SC21	COM/ PLC	PEL/ SC	Other Non-PE-Cs?
3. Definitions & Abbreviations	X	X	X	X	X	X	X	X	X	X	X	X
4. General requirements	X	X	X	X					X	X		
5. Q and V control	X					X	X		X		X	
6. P and f response	X	X	X				X		X		X	
7. Response to TS abnormal conditions	X	X	X		X		X		X		X	
8. Power quality			X		X	X	X		X		X	
9. Protection			X		X		X		X		X	
10. Modeling data	X	X	X	X	X	X	X		X	X	X	
11. Measurement data	X	X	X	X	X	X	X		X	X	X	
12. Test and verification	X	X	X	X	X	X	X		X	X	X	
Annexes (informative & normative)	G, H	B, K, L	D, I, J, M		D, F, I, J, M		C, D, E, F, G, H, I, J, K, L, M		D, E, F, G, I, J, K, L, M		C, D, I, J, K, L, M	

Legend: Joint sponsor of IEEE 2800-2022 or P2800.2 | confirmed | informed | interested | to be informed

All 3x PARs are under the same Working Group (IBRI-WG)

Legend

- **Mandatory** (Standard, "shall")
- "should"-reference
- **Optional** (Recommended Practice, "should")
- **Futuristic** (Guide, "may")

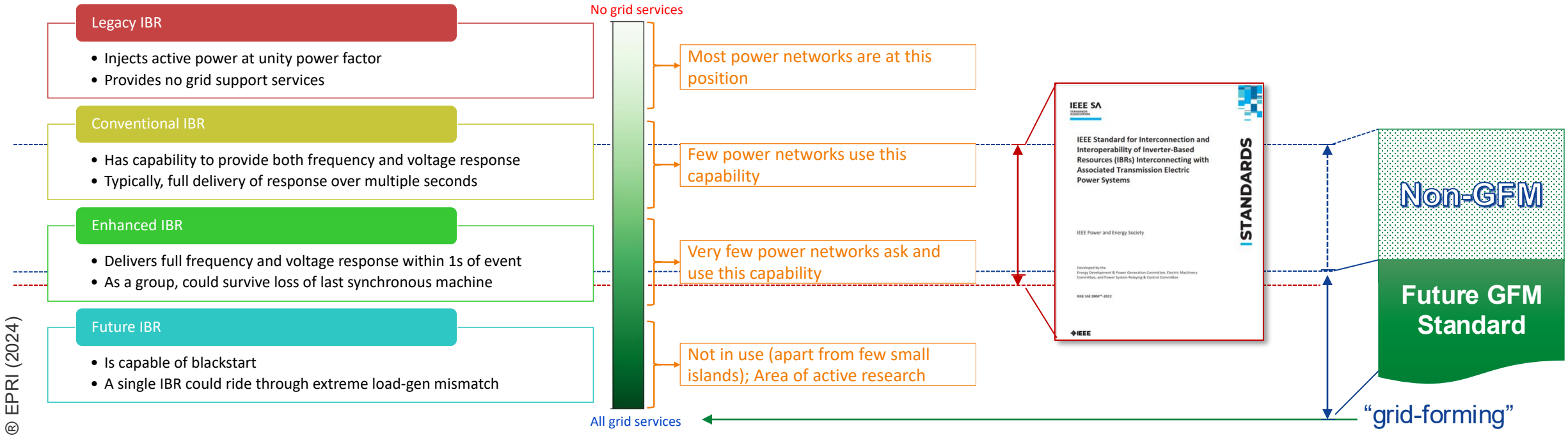


Aligning P2800.1 Project on GFM IBR Equipment with IEEE 2800/.x Series

New PARs for IEEE 2800/.x Series

Locating IEEE 2800-2022 and a Future GFM Standard

Ongoing research and learnings will have to show how close IEEE 2800-2022 requirements are to "GFM"



- While the 1st edition of IEEE 2800 is not perfect, it is an important starting point for codification of collaborative industry learning and harmonization.

➢Develop a future GFM standard as part of the IEEE 2800/.x series.

Source: EPRI, 2024

IEEE P2800a + P2800.1 + P2800

Legend

Mandatory (Standard, "shall")

"should"-reference

Optional (Recommended Practice, "should")

Futuristic (Guide, "may")

IEEE P2800a: Removal of barriers to GFM, e.g. from:

1. **correction of editorial errors**
2. **removal or amendment of normative language in:**

- Subclause 1.4 General remarks and limitations
- Subclause 3.1 Definitions
- Clause 4. General interconnection technical specifications and performance requirements
  - Subclause 4.7 Prioritization of IBR responses
- Clause 5. Reactive power-voltage control requirements within the continuous operation region
  - Subclause 5.2.2 Voltage control
- Clause 6. Active-power—frequency response requirements
  - Subclause 6.2 Fast frequency response (FFR)
- Clause 7. Response to TS abnormal conditions
  - Subclause 7.2.2.3.2 Low- and high-voltage ride-through capability
  - Subclause 7.2.2.3.4 Current injection during ride-through mode
- Clause 8. Power quality
- Annex C (informative) Inverter stability and system strength

Draft, subject to changes.
Last updated: 07/21/2025

IEEE P2800.1: GFM Framework Recommended Practice

1. **creation of a new document with outline aligning with IEEE 2800-2022**
2. **Addition of new normative language in the following parts:**

- Subclause 1.4 General remarks and limitations
- Section 2 Normative references: IEEE 2800 and IEEE 2800.2
- Subclause 3.1 Definitions
  - New term grid-forming inverter-based resource (GFM-IBR)
- Clause 4. General interconnection technical specifications and performance requirements
  - New Subclause 4.13 GFM-IBR Multi-parallel power converter operation (active and reactive power sharing across GFM-IBRs)
  - New Subclause 4.14 GFM-IBR Grid strength adaptability
  - New Subclause 4.15 GFM-IBR Frequency domain characteristics
- Clause 5. Reactive power-voltage control requirements within the continuous operation region
  - New Subclause 5.3 GFM-IBR Grid voltage regulation
- Clause 6. Active-power—frequency response requirements
  - New Subclause 6.3 GFM-IBR Inertial response
  - New Subclause 6.4 GFM-IBR Damping control
- Clause 7. Response to TS abnormal conditions
  - New Subclause 7.5 GFM-IBR Operation Under System Unbalance
  - New Subclause 7.6 GFM-IBR Resistance to V-phase angle jumps
- Clause 8. Power quality
  - New Subclause 8.4 GFM-IBR Voltage harmonics regulation
- Clause 9. Protection
- Clause 10. Modeling Data
- Clause 11. Measurement data for performance monitoring and validation
- New Clause 13. Additional GFM capabilities and performance
  - New Subclause 13.1 Intentional islanding
  - New Subclause 13.2 Overload capacity
  - New Subclause 13.3 Blackstart capability
- Annex C (informative) Inverter stability and system strength

IEEE P2800: Revision of IEEE 2800

1. **correction of editorial errors**
2. **incorporation of all amendments since the latest edition was published**
3. **revision of existing language in the following parts:**

- Clause 2. Normative references: IEEE P2800.1
- Subclause 3.1 Definitions
  - New term grid-forming inverter-based resource (GFM-IBR)
- Clause 4. General interconnection technical specifications and performance requirements
  - Subclause 4.6 Control capability requirements
  - Subclause 4.11.2 Surge withstand performance
- Clause 5. Reactive power-voltage control requirements within the continuous operation region
  - Subclause 5.2.2 Voltage control: Reaction Time > 200 ms
  - Subclause 5.2.3 Power factor control mode
- Clause 6. Active-power—frequency response requirements
  - Subclause 6.1.1. Primary frequency response: correct error in Table 6
  - Subclause Clause 6.2 (FFR): promote "may" for over-frequency to "shall"
- Clause 7. Response to TS abnormal conditions
  - Subclause 7.2.2 Voltage disturbance ride-through requirements
  - Subclause 7.2.3 Transient overvoltage ride-through requirements
  - Subclause 7.3.2 Frequency disturbance ride-through requirements
- Clause 8. Power quality
  - Subclause 8.2.1 Harmonic current distortion
  - Subclause 8.3.2 Limitation of OV over one fundamental frequency period
- Clause 9. Protection
- Clause 10. Modeling data
- Clause 11. Measurement data for performance monitoring and validation
- Clause 12 Test and verification requirements: use learnings from P2800.2
- Annex G (informative) Recommendation for modeling data
- Annex L (informative) Damping ratio

1

IEEE P2800a + P2800.1 + P2800

Legend

Mandatory (Standard, "shall")

"should"-reference

Optional (Recommended Practice, "should")

Futuristic (Guide, "may")

IEEE P2800a: Removal of barriers to GFM, e.g. from:

1. **correction of editorial errors**
2. **removal or amendment of normative language in:**

- Subclause 1.4 General remarks and limitations
- Subclause 3.1 Definitions
- Clause 4. General interconnection technical specifications and performance requirements
  - Subclause 4.7 Prioritization of IBR responses
- Clause 5. Reactive power-voltage control requirements within the continuous operation region
  - Subclause 5.2.2 Voltage control
- Clause 6. Active-power—frequency response requirements
  - Subclause 6.2 Fast frequency response (FFR)
- Clause 7. Response to TS abnormal conditions
  - Subclause 7.2.2.3.2 Low- and high-voltage ride-through capability
  - Subclause 7.2.2.3.4 Current injection during ride-through mode
  - Subclause 7.2.2.6 Restore output after voltage ride through: flexibility instead of active power ramp; allow recovery time of less than 1.0 s
- Clause 8. Power quality
- Annex C (informative) Inverter stability and system strength

Draft, subject to changes.
Last updated: 07/21/2025

IEEE P2800.1: GFM Framework Recommended Practice

1. **creation of a new document with outline aligning with IEEE 2800-2022**
2. **Addition of new normative language in the following parts:**

- Subclause 1.4 General remarks and limitations
- Section 2 Normative references: IEEE 2800 and IEEE 2800.2
- Subclause 3.1 Definitions
  - New term grid-forming inverter-based resource (GFM-IBR)
- Clause 4. General interconnection technical specifications and performance requirements
  - New Subclause 4.13 GFM-IBR Multi-parallel power converter operation (active and reactive power sharing across GFM-IBRs)
  - New Subclause 4.14 GFM-IBR Grid strength adaptability
  - New Subclause 4.15 GFM-IBR Frequency domain characteristics
- Clause 5. Reactive power-voltage control requirements within the continuous operation region
  - New Subclause 5.3 GFM-IBR Grid voltage regulation
- Clause 6. Active-power—frequency response requirements
  - New Subclause 6.3 GFM-IBR Inertial response
  - New Subclause 6.4 GFM-IBR Damping control
- Clause 7. Response to TS abnormal conditions
  - New Subclause 7.5 GFM-IBR Operation Under System Unbalance
  - New Subclause 7.6 GFM-IBR Resistance to V-phase angle jumps
- Clause 8. Power quality
  - New Subclause 8.4 GFM-IBR Voltage harmonics regulation
- Clause 9. Protection
- Clause 10. Modeling Data
- Clause 11. Measurement data for performance monitoring and validation
- New Clause 13. Additional GFM capabilities and performance
  - New Subclause 13.1 Intentional islanding
  - New Subclause 13.2 Overload capacity
  - New Subclause 13.3 Blackstart capability
- Annex C (informative) Inverter stability and system strength

IEEE P2800: Revision of IEEE 2800

1. **correction of editorial errors**
2. **incorporation of all amendments since the latest edition was published**
3. **revision of existing language in the following parts:**

- Clause 2. Normative references: IEEE P2800.1
- Clause 3. – Clause 6.
- Clause 7. Response to TS abnormal conditions
  - Subclause 7.2.2 Voltage disturbance ride-through requirements
    - 7.2.2.1 General requirements and exceptions: combine Table 11 and 12
    - 7.2.2.3.4 Current injection during ride-through mode: settling band in Table 14 and cessation of fault current injection upon fault clearance
    - 7.2.2.4 Consecutive voltage deviations RT capability: dc-circuit storage
    - 7.2.2.6 Restore output after voltage ride through: flexibility instead of active power ramp; allow recovery time of less than 1.0 s
  - Subclause 7.2.3 Transient overvoltage ride-through requirements
    - Clarify IBR plant vs. unit level requirements
    - Clarify conformity assessment (pre- and post-commissioning)
  - Subclause 7.3.2 Frequency disturbance ride-through requirements
    - Consider clarifying or specifying volts/Hz exclusion or ride-through requirements
  - Subclause 7.3.2.3.5 Rate of change of frequency (ROCOF) ride-through
    - Consider replacing the requirement based on the single number of 5 Hz/s with a time-dependent requirement curve, similar to requirements in other regions
    - Clarify conformity assessment (pre- and post-commissioning)
  - Subclause 7.3.2.4 Voltage phase angle changes ride-through
    - Remove or clarify implied exception that IBR plant may trip upon occurrence and clearance of a fault when positive-sequence phase angle change exceeds stated criterion.
    - Clarify conformity assessment (pre- and post-commissioning)
- Clause 8. – 12.
- Annex G & Annex L

1

Coordination with IEC

New PARs for IEEE 2800/.x Series

Scoping and Locating a Joint IEC/IEEE GFM Standard

Informed by system (grid) needs; specify performance-based capability requirements.

2 ***Scope 1:*** Define IEC plant-level requirements for Non-GFM IBRs at BPS

1 ***Scope 2:*** Specify GFM capability and performance for IBR equipment

Scope 3: Expand IEC plant-level requirements to harmonize with IEEE

3 ***Scope 4:*** Specify plant-level capability to operate IBR equipment during steady state conditions to maintain GFM performance during disturbances

➢**Coordinate and consider joint project(s) with IEC to extent possible.**

Source: EPRI, 2025

IEEE 2800-2022 Adoption Methods—Benefits and Risks

General Reference

- Full adoption of standard
  - general reference
  - default settings, where specified
- Specification of
  - technical minimum capability, where options are provided*
  - functional settings, where no default settings are specified*

Benefit: *Consistency to standard*

Risk: *Lacks clarity and specificity; limited customization to grid needs*

Detailed Reference & Customization

- Full or partial adoption of std
  - clause-by-clause references
- Specification of
  - technical minimum capability, where options are provided*
  - functional settings, including where default settings specified (in ranges of available settings)*

Benefit: *Clarity, specificity, and customization; phased-adoption*

Risk: *More work/time for AGIR; fragmentation of requirements*

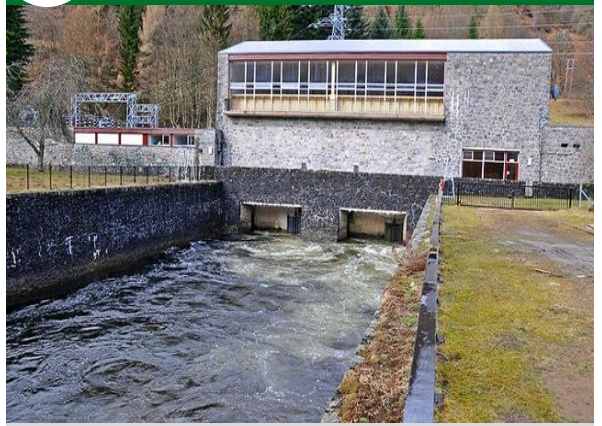
Hybrid Reference, Customization & Specification

- All on the left
- Any clarifications or modifications of requirements
  - Clause-specific own language
- Any additional requirements
  - for non-exhaustive requirem.
  - to support specific grid needs
  - conformity language prior to publication of IEEE 2800.2

Benefit: *Additional clarity and customization to grid needs*

Risk: *Inconsistencies to standard; conformity assessment challenges*

Full Specification & Customization



- All on the left, but without references and instead
  - clause-by-clause own language

Risk: *Significant work and duplication for AGIR, copyright concerns*

* Some AGIRs that adopted IEEE 2800 may not have provided these details needed for adequate adoption of IEEE 2800-2022.

What does this mean for adoption of IEEE 2800 now?

IEEE 2800-2022
(1st edition)

- For the time being, adopting IEEE 2800-2022 with an "**hybrid integration**" approach may be preferred because it can account for known deficiencies and gaps in the 1st edition of the standard.
  - ➢ *Future revisions should be informed by the adjustments entities made in their "hybrid integrations"—**call to action for all stakeholders to get engaged in the next revision (➔ starts in 2026)***

IEEE 2800-202x
(2nd edition)

- After the forthcoming revision, a "**detailed reference & customization**" approach may be preferred because it allows for partial adoption via clause-by-clause references to the 2nd edition
  - ➢ *Not all gaps identified during the adoption of the 1st edition may be sufficiently addressed in this revision.*
  - ➢ *A detailed reference to a new **IEEE 2800.1 Recommended Practice for GFM equipment** may be included.*

+ IEEE P2800.1 for GFM

IEEE 2800-203x
(3rd edition)

- For subsequent editions, a "**general reference**" approach **with the necessary specification of** technical minimum **capability** (where **options** are provided) **and** functional **settings** (where no default settings are provided) may be preferred, because it provides the broadest possible harmonization.
  - ➢ *Standards may be incrementally revised or amended as technology further matures.*

Keep adopting IEEE 2800-2022 and get engaged in its forthcoming revision!

Related EPRI Offerings

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

forthcoming

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 to date: 6x (10/20/25)

Ameren

DUKE ENERGY

GREAT RIVER ENERGY

ISO new england

NY Power Authority

pjm

➔ *A Preview Call that is open to Funders and Non-Funders is scheduled for **Wednesday, Oct 22, at 2:00pm ET**.*

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