IEEE P2800.2 Update for i2X FIRST
Post-Commissioning Workshop

ESIG Spring Workshop, Austin, Texas

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

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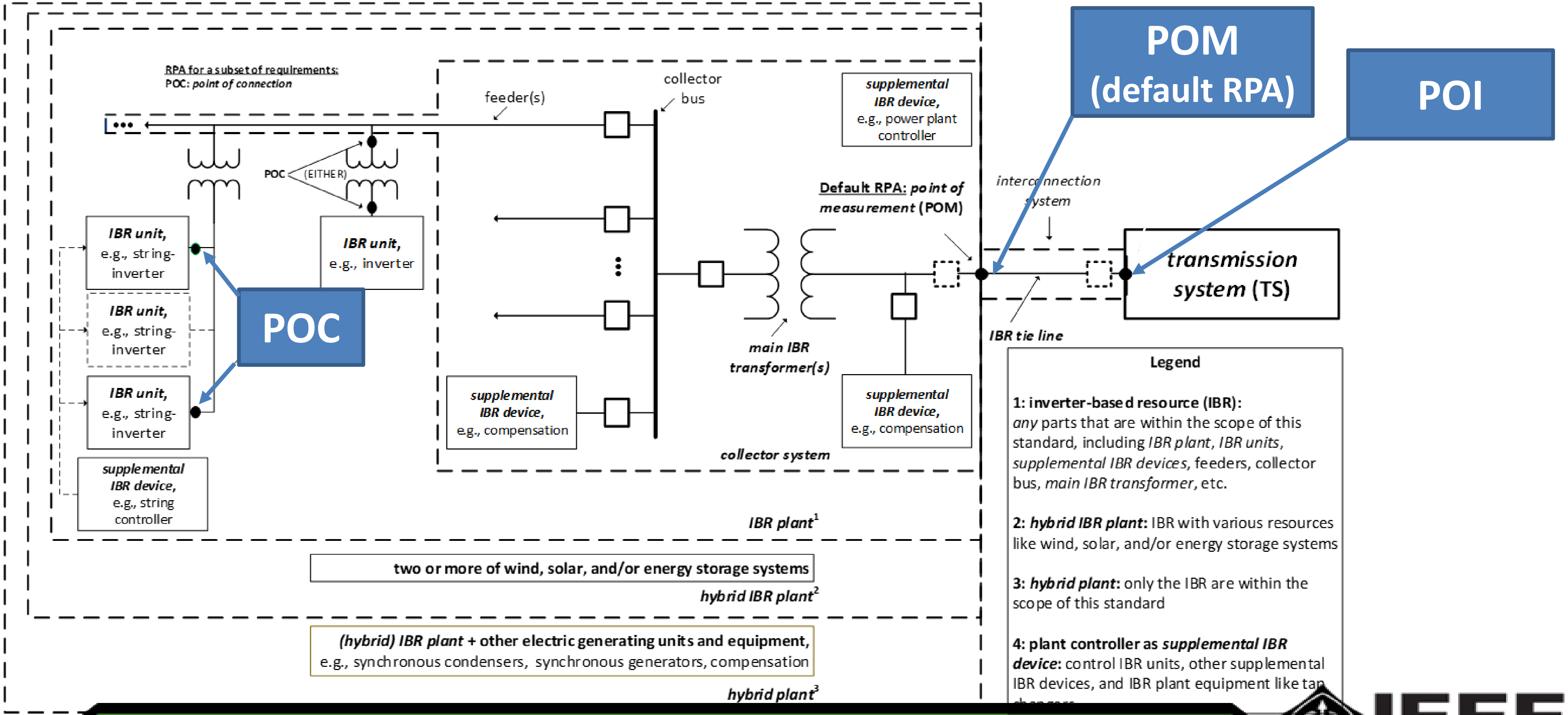
- Draft standard disclaimer:
  - P2800.2 is an unapproved draft of a proposed IEEE Standard. As such, the document is subject to change, any draft requirements and figures shown in this presentation may change.

- 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, 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 article do not necessarily represent the views of the DOE or the U.S. Government.

Where do 2800 requirements apply?

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


POM
(default RPA)
POI
POC
RPA for a subset of requirements:
POC: *point of connection*
feeder(s)
collector
bus
POC
(EITHER)
supplemental IBR device, e.g., power plant controller
Default RPA: *point of measurement* (POM)
interconnection system
IBR unit, e.g., string-inverter
IBR unit, e.g., string-inverter
IBR unit, e.g., string-inverter
IBR unit, e.g., inverter
supplemental IBR device, e.g., string controller
supplemental IBR device, e.g., compensation
supplemental IBR device, e.g., compensation
main IBR transformer(s)
transmission system (TS)
IBR tie line
collector system
IBR plant[1]
two or more of wind, solar, and/or energy storage systems
hybrid IBR plant[2]
(hybrid) IBR plant + other electric generating units and equipment, e.g., synchronous condensers, synchronous generators, compensation
hybrid plant[3]

Legend

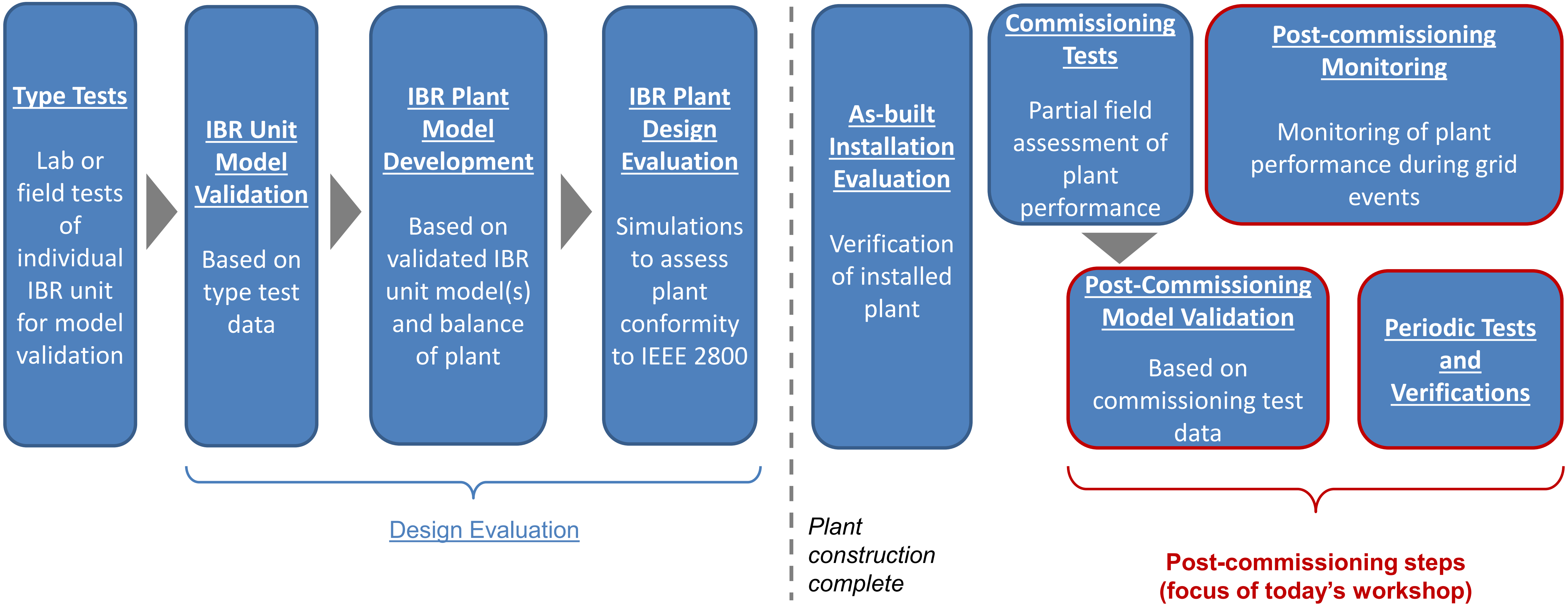
1: inverter-based resource (IBR): *any* parts that are within the scope of this standard, including *IBR plant*, *IBR units*, *supplemental IBR devices*, feeders, collector bus, *main IBR transformer*, etc.

2: ***hybrid IBR plant*:** IBR with various resources like wind, solar, and/or energy storage systems

3: ***hybrid plant*:** only the IBR are within the scope of this standard

4: plant controller as *supplemental IBR device*: control IBR units, other supplemental IBR devices, and IBR plant equipment like tap

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

Design Evaluation

Plant construction complete

As-built Installation Evaluation

Verification of installed plant

Commissioning Tests

Partial field assessment of plant performance

Post-commissioning Monitoring

Monitoring of plant performance during grid events

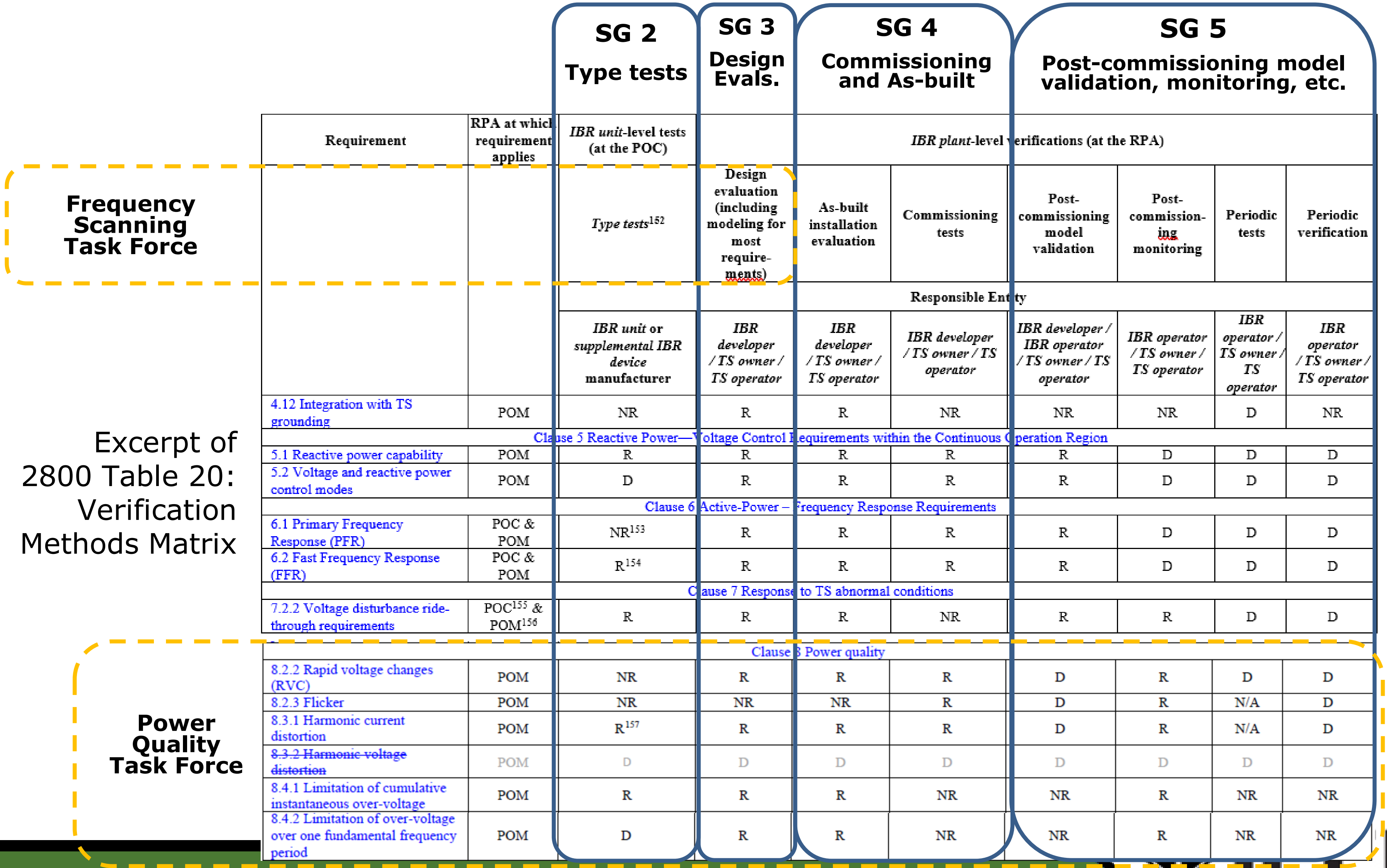
Post-Commissioning Model Validation

Based on commissioning test data

Periodic Tests and Verifications

Post-commissioning steps (focus of today's workshop)

IEEE P2800.2 Subgroup and Task Force Scopes



SG 1

Overall document and general requirements

SG 2
Type tests

SG 3
Design Evals.

SG 4
Commissioning and As-built

SG 5
Post-commissioning model validation, monitoring, etc.

Frequency Scanning Task Force

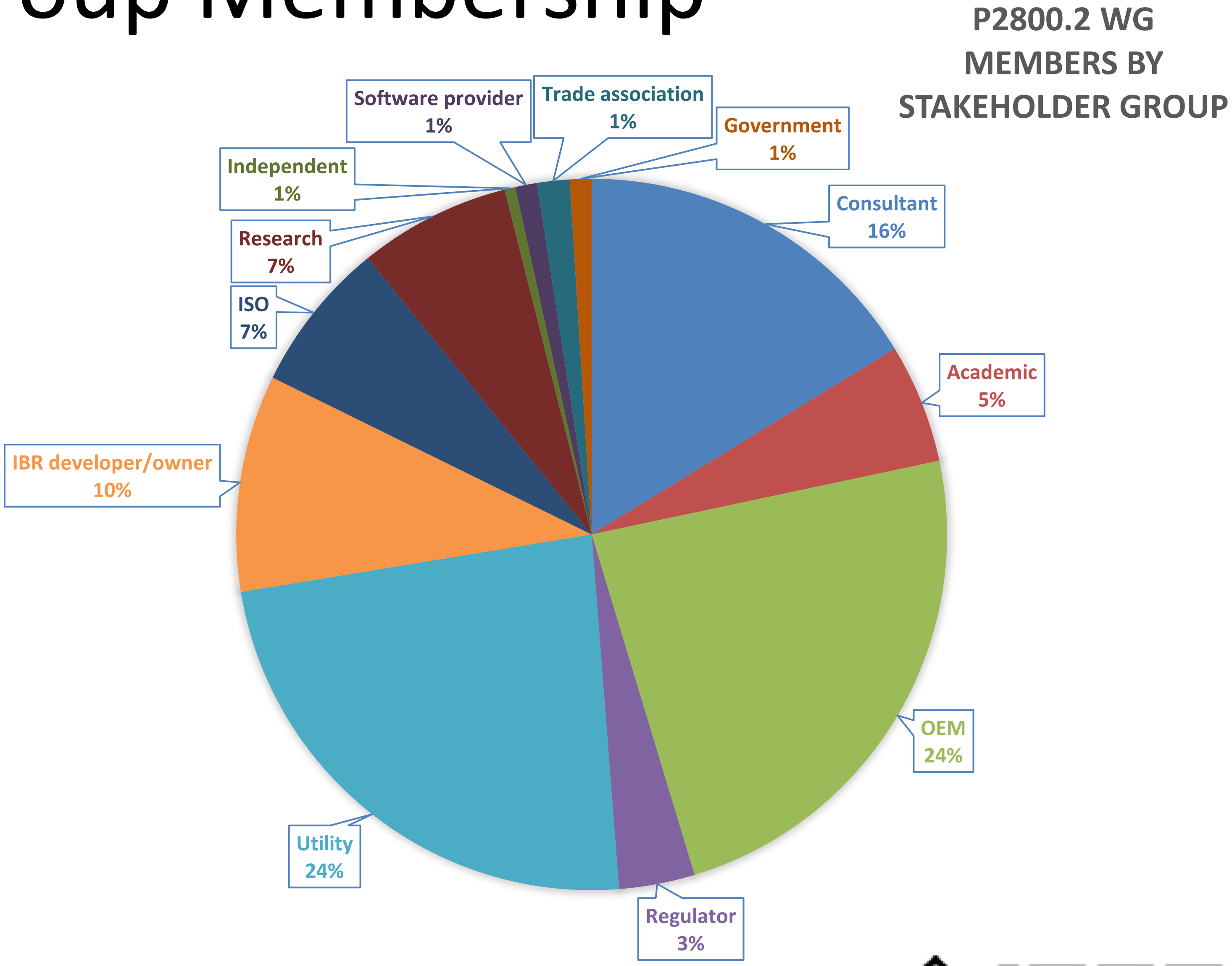
Power Quality Task Force

Excerpt of 2800 Table 20: Verification Methods Matrix

Requirement	RPA at which requirement applies	*IBR unit*-level tests (at the POC)		*IBR plant*-level verifications (at the RPA)					
		Type tests[152]	Design evaluation (including modeling for most requirements)	As-built installation evaluation	Commissioning tests	Post-commissioning model validation	Post-commissioning monitoring	Periodic tests	Periodic verification
		Responsible Entity							
		IBR unit or supplemental IBR device manufacturer	*IBR developer / TS owner / TS operator*	*IBR developer / TS owner / TS operator*	*IBR developer / TS owner / TS operator*	*IBR developer / IBR operator / TS owner / TS operator*	*IBR operator / TS owner / TS operator*	*IBR operator / TS owner / TS operator*	*IBR operator / TS owner / TS operator*
4.12 Integration with TS grounding	POM	NR	R	R	NR	NR	NR	D	NR
Clause 5 Reactive Power—Voltage Control Requirements within the Continuous Operation Region									
5.1 Reactive power capability	POM	R	R	R	R	R	D	D	D
5.2 Voltage and reactive power control modes	POM	D	R	R	R	R	D	D	D
Clause 6 Active-Power – Frequency Response Requirements									
6.1 Primary Frequency Response (PFR)	POC & POM	NR[153]	R	R	R	R	D	D	D
6.2 Fast Frequency Response (FFR)	POC & POM	R[154]	R	R	R	R	D	D	D
Clause 7 Response to TS abnormal conditions									
7.2.2 Voltage disturbance ride-through requirements	POC[155] & POM[156]	R	R	R	NR	R	R	D	D
Clause 8 Power quality									
8.2.2 Rapid voltage changes (RVC)	POM	NR	R	R	R	D	R	D	D
8.2.3 Flicker	POM	NR	NR	NR	R	D	R	N/A	D
8.3.1 Harmonic current distortion	POM	R[157]	R	R	R	D	R	N/A	D
~~8.3.2 Harmonic voltage distortion~~	POM	D	D	D	D	D	D	D	D
8.4.1 Limitation of cumulative instantaneous over-voltage	POM	R	R	R	NR	NR	R	NR	NR
8.4.2 Limitation of over-voltage over one fundamental frequency period	POM	D	R	R	NR	NR	R	NR	NR

P2800.2 Working Group Membership

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



P2800.2 Working Group Timeline

Jan 2022
WG kickoff

Jan 2022
P2800.2 leaders outline content

Feb 2022
WG meeting

Aug 2022
WG meeting; Draft 0.1 circulated

Dec 2022
WG meeting; Draft 0.2 circulated

(Between WG meetings, SGs and TFs draft content)

April 2023
WG meeting; Draft 0.3 circulated

August 2023
WG meeting; Draft 0.4 circulated

Dec 2023
WG meeting; Draft 0.5 circulated

April 2024
WG meeting; Draft 1.0 circulated

Oct 2024
WG meeting; Draft 2.0 circulated

March 2025
WG meeting; Draft 3.0 circulated

WG currently voting whether to send D3.0 to IEEE-SA ballot

Future dates are tentative and assume WG vote passes

April 2025
Ballot pool formation

May 2025
Start IEEE-SA ballot

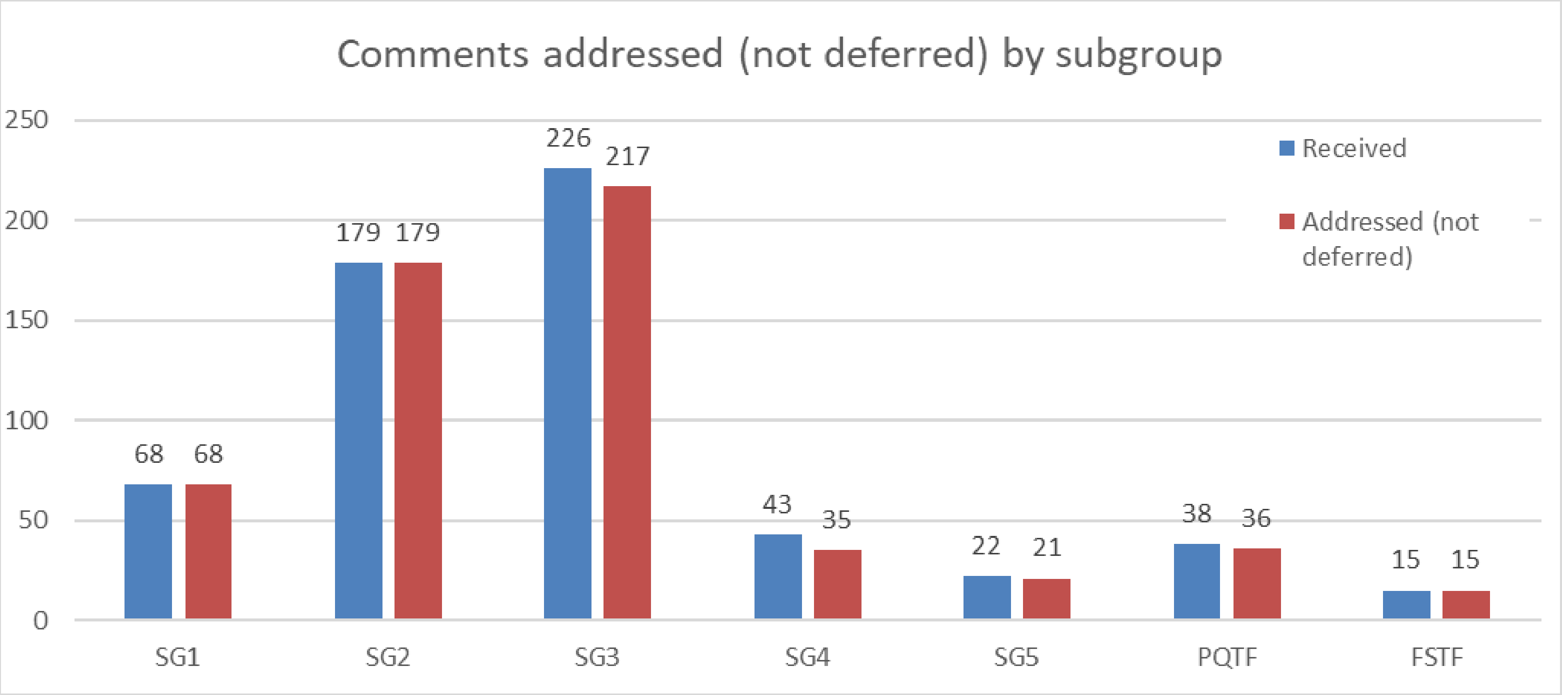
Q3-Q4 2025
Balloting and recirculation

Late 2025 / Early 2026
IEEE RevCom approval

Q1/Q2 2026
Publication?

Summary of comment resolutions (D2.0 → D3.0)

- 591 comments received on Draft 2.0
- 97% addressed. Remaining comments deferred*
  - 27% accepted (verbatim)
  - 48% revised (some change made)
  - 21% rejected (no change made)**



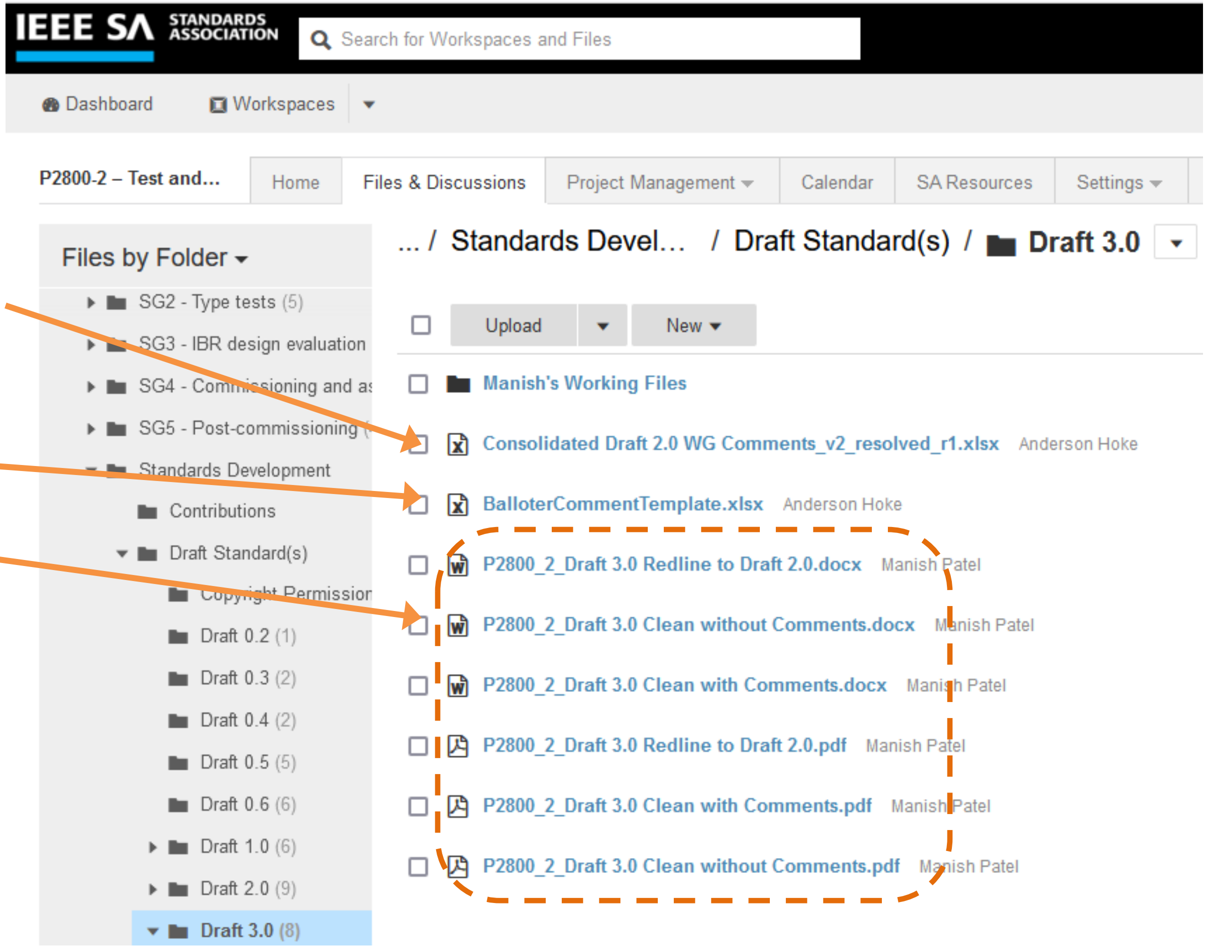
*Some deferred comments will be automatically resubmitted because they were assigned to wrong group and hence were not considered until too late. Affected commenters have been notified.

**Some comments were rejected with a response inviting commenter to resubmit for future consideration

Draft 3.0 currently under review and voting

- Draft 3.0 available for comment and voting until March 24
  - https://ieee-sa.imeetcentral.com/p2800-2/folder/WzIwLDE5MjM0OTQyXQ
- Resolutions of comments on D2.0 can be seen here (and in redlines)
- Use comment spreadsheet template
- Use page/line numbers from D3.0 Clean
- Voting open to WG members only

- If vote passes, next step is IEEE-SA balloting. Expected to take about 9 months
- If vote fails, WG will continue to revise


IEEE SA STANDARDS ASSOCIATION
Search for Workspaces and Files
Dashboard
Workspaces
P2800-2 – Test and...
Home
Files & Discussions
Project Management
Calendar
SA Resources
Settings
Files by Folder
Upload
New

SG2 - Type tests (5)
SG3 - IBR design evaluation
SG4 - Commissioning and as
SG5 - Post-commissioning (
Standards Development
Contributions
Draft Standard(s)
Copyright Permissio
Draft 0.2 (1)
Draft 0.3 (2)
Draft 0.4 (2)
Draft 0.5 (5)
Draft 0.6 (6)
Draft 1.0 (6)
Draft 2.0 (9)
Draft 3.0 (8)

... / Standards Devel... / Draft Standard(s) / Draft 3.0

☐ Manish's Working Files
☐ Consolidated Draft 2.0 WG Comments_v2_resolved_r1.xlsx Anderson Hoke
☐ BalloterCommentTemplate.xlsx Anderson Hoke
☐ P2800_2_Draft 3.0 Redline to Draft 2.0.docx Manish Patel
☐ P2800_2_Draft 3.0 Clean without Comments.docx Manish Patel
☐ P2800_2_Draft 3.0 Clean with Comments.docx Manish Patel
☐ P2800_2_Draft 3.0 Redline to Draft 2.0.pdf Manish Patel
☐ P2800_2_Draft 3.0 Clean with Comments.pdf Manish Patel
☐ P2800_2_Draft 3.0 Clean without Comments.pdf Manish Patel

Should D3.0 be sent to ballot?

- Sending draft to ballot does not means it’s ready to publish. It means draft is stable enough to start the ballot.
- If motion to go to ballot is approved, it allows WG leadership to initiate IEEE Mandatory Editorial Coordination (MEC), IEEE sponsoring committee review, and ballot pool formation
  - These are required steps that cannot happen until WG approves
- All WG members and interested parties will be invited to join IEEE-SA ballot pool
- Balloting is expected to take 4-5 recirculations over ~9 months and generate >1000 comments. This is likely true regardless of whether we start now.
- Content will be refined through IEEE-SA balloting process
- My opinion: Draft has the necessary content. WG could continue to refine the draft in the WG, but there are diminishing returns. We should start the ballot now.
  - Will WG agree? Do you agree?

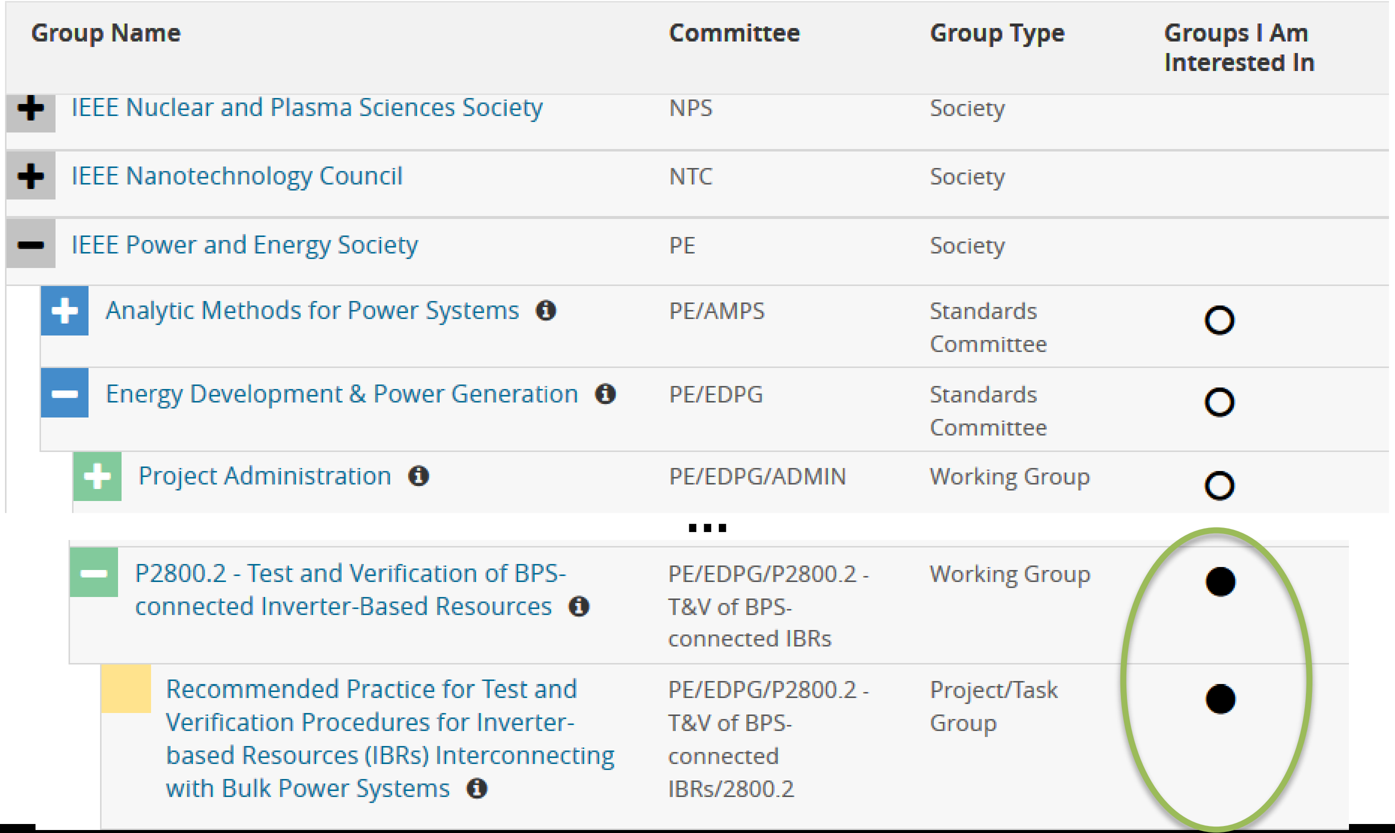
How to join P2800.2 ballot pool

- Invitations will be sent to all who have expressed interest in P2800.2 via IEEE MyProject (instructions on next slide)
  - In past, people have missed ballot invitation due to spam filters and not recognizing the invitation. Must respond within defined time window; cannot join ballot after that.
- Invitations will also be sent to relevant IEEE committees/subcommittees
- WG leadership will forward invitations to WG members and listservs
- Will also share with i2X FIRST

- Balloters are expected to review the draft and vote.
  - If you join ballot but don’t vote, WG leadership will be annoyed.
- Negative votes must be accompanied by comments to be counted. Positive and abstain voters can also submit comments.

How To Express interest in IEEE myProject?

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 P2800.2 under PES/EDPG per screenshot excerpts below
4. Click bullets under “Groups I Am Interested In” and follow instructions on screen



Group Name	Committee	Group Type	Groups I Am Interested In
+ IEEE Nuclear and Plasma Sciences Society	NPS	Society	
+ IEEE Nanotechnology Council	NTC	Society	
− IEEE Power and Energy Society	PE	Society	
+ Analytic Methods for Power Systems	PE/AMPS	Standards Committee	○
− Energy Development & Power Generation	PE/EDPG	Standards Committee	○
+ Project Administration	PE/EDPG/ADMIN	Working Group	○
…			
− P2800.2 - Test and Verification of BPS-connected Inverter-Based Resources	PE/EDPG/P2800.2 - T&V of BPS-connected IBRs	Working Group	●
Recommended Practice for Test and Verification Procedures for Inverter-based Resources (IBRs) Interconnecting with Bulk Power Systems	PE/EDPG/P2800.2 - T&V of BPS-connected IBRs/2800.2	Project/Task Group	●

Potential 2800 Adoption Timeline and Next Steps

	Jan 2019-Dec 2020	Q2-Q4 2021	Q2 2022	Q2-Q4 2022	2023	2024	Current Phase 2025	2026 and Beyond
2800	WG Drafting in Parallel Subgroups	Balloting and Recirculation	Publication					Start Next Revision
P2800.2 Conformance verification			Kick-off and Directional Alignment	WG Drafting in Parallel Subgroups	WG Drafting in Parallel Subgroups	WG Drafting in Parallel Subgroups	Complete WG draft IEEE-SA Balloting	Publication
Related activities	IEEE 1547.1 is published	NERC IRPWG Guidelines		FERC GI NOPR IEEE 1547 Revision Kickoff	Potential 2800 Adoption, FERC 901 and 2023, NERC Stds	Potential 2800 Adoption	Potential 2800 Adoption	Potential P2800.2 Adoption

To get involved in IEEE P2800.2:

- To join Working Group:
  - If you have attended two WG meetings and want to be a WG voting member, email Manish Patel: Manish.P@ieee.org; CC Andy.Hoke@nrel.gov
  - If not, attend two meetings and request membership
- Join listserv for any subgroup or task force of interest
- WG member iMeet site: https://ieee-sa.imeetcentral.com/p2800-2/home
  - Contains draft documents, subgroup documents, references, etc.
- Public website: https://sagroups.ieee.org/2800-2/