

IEEE P2800.2 2nd Working Group Meeting

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February 17, 2022

Some content derived from IEEE P2800 WG and Jens Boemer, P2800 WG Chair

Please record your attendance

- Please record your attendance at:
<https://imat.ieee.org/wg500900043/attendance-log?p=3804300005&t=500900043>
- **Meeting attendance determines eligibility for WG voting membership**
- In lieu of verbal roll call, **please type your name and affiliation in the chat window**
 - IEEE affiliation FAQs: <http://standards.ieee.org/faqs/affiliation.html>

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- 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 and P2800.2 are unapproved drafts of proposed IEEE Standards. As such, the documents are 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.

Status of IEEE 2800-2022 – Jens Boemer, Chair

- Officially approved by IEEE-SA Standards Board Feb 9, 2022. 94% ballot approval. Undergoing final steps before publication.
- Harmonizes interconnection requirements for large solar, wind, and storage plants (and other inverter-based resources)
- A consensus-based standard developed by over ~175 Working Group participants from utilities, system operators, transmission planners, & OEMs over 2+ years

P2800/D6.3, December 2021
Draft Standard for Interconnection and Interoperability of Inverter-Based Resources Interconnecting with Associated Transmission Systems

1 P2800™/D6.3 (December 2021)
2 Draft Standard for Interconnection and
3 Interoperability of Inverter-Based
4 Resources Interconnecting with
5 Associated Transmission Systems

6 Developed by the
7 Wind and Solar Plant Interconnection Performance Working Group (WSP-IP) – [pubsite](#)
8 of the
9 Energy Development and Power Generation Committee, the Electric Machinery
10 Committee, and the Power System Relaying Committee
11 of the
12 IEEE Power and Energy Society
13

Version	Date	Editors	Comments
Draft 6.3	12/2/2021 and 12/14/2021	Jens C. Boemer (Chair) Manish Patel (Vice-Chair) With contributions from other Vice-Chairs and SG-Leads	Draft 6.3 for IEEE SA 3rd and 4th Recirculation. 3rd Recirculation Results: • Approvals: 373 (94%) • Disapprovals: 20 (5%) • Disapprovals without MBS Comments: 3 • Abstentions: 24 (5%) • Return Ballots: 420 (90%) Total Comments: 20 Total Ballots: 466
Draft 6.2	10/21/2021	Jens C. Boemer (Chair) Manish Patel (Vice-Chair) With contributions from other Vice-Chairs and SG-Leads	Draft 6.2 for IEEE SA 2nd Recirculation. 2nd Recirculation Results: • Approvals: 369 (94%) • Disapprovals: 23 (5%) • Disapprovals without MBS Comments: 3 • Abstentions: 24 (5%) • Return Ballots: 419 (89%) Total Comments: 110 Total Ballots: 466

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Available from IEEE at <https://standards.ieee.org/project/2800.html>

More Info at <https://sagroups.ieee.org/2800/>



Agenda (per meeting invitation)

- Call to order and welcome; Roll call and declaration of affiliation
- IEEE 2800-2022 update
- **Approval of agenda and past minutes**
- IEEE disclaimers and legal notices, Privacy Policy, eTools
- P2800.2 membership update
- General vision and key topics of P2800.2
- Introduction of subgroup scopes and key questions
- Introduction of PQ task force
- Draft outline
- How to get involved in subgroups and task force
- Wrap up and next steps

IEEE Privacy Policy and eTools

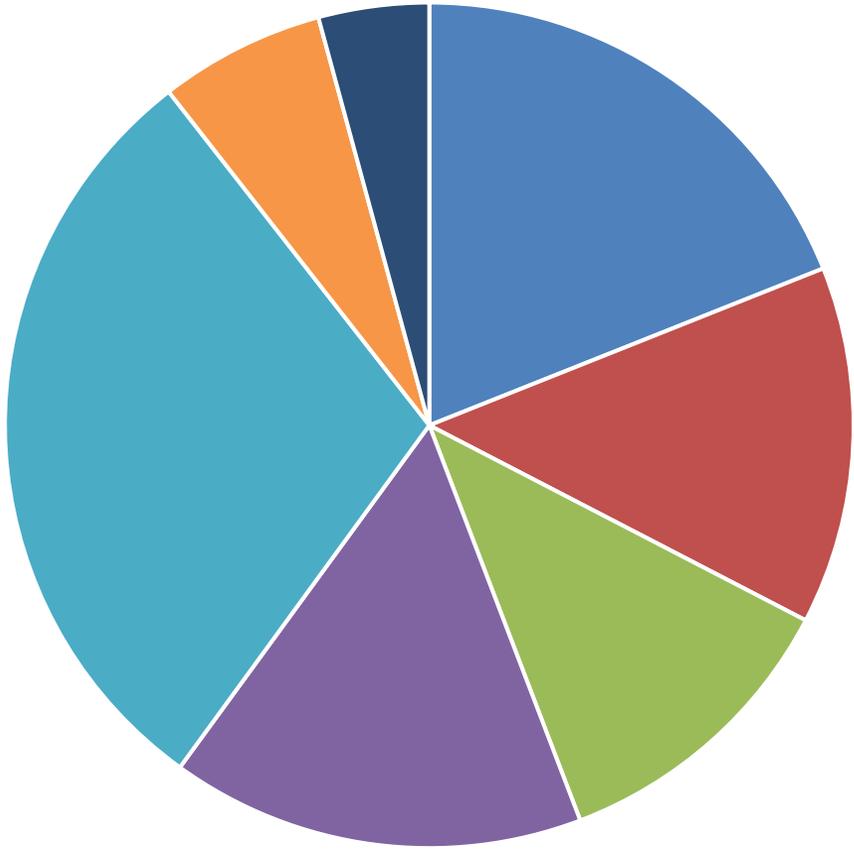
- IEEE Privacy Policy - <https://www.ieee.org/security-privacy.html>
- Electronic tools to be used by the WG:
 - myProject: IEEE-SA website for general standards participation
 - Listservs: Email reflectors for WG and subgroup meeting notices etc. (*See slide near end to sign up*)
 - *Each subgroup will also have its own listserv*
 - iMeet Central: Online collaboration site for WG members. <https://ieee-sa.imeetcentral.com/p2800-2/home>
 - iMat attendance tool
 - WordPress: <https://sagroups.ieee.org/2800-2/>
 - MS Teams (and potentially other online meeting apps)

IEEE patent policy and legal notices

- IEEE Patent Policy
 - <https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.pdf>
 - Call for potentially essential patents
- IEEE Copyright Policy:
 - <https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/copyright-policy-WG-meetings.potx>
- IEEE Participant Behavior:
 - See slides posted alongside this presentation

P2800.2 Working Group Membership

Total 95 WG Members



- Acad, Nat Labs, R&D
- Consultants
- Plant Developers
- OEMs
- Utilities/ISOs
- Regulators
- Others

- Large, well-balanced WG
- More are welcome

P2800.2 Overview (from PAR)

- Title:
 - Recommended Practice for Test and Verification Procedures for Inverter-based Resources (IBRs) Interconnecting with Bulk Power Systems
- Scope:
 - Define **recommended practices** for test and **verification procedures to confirm plant-level conformance** of IBRs interconnecting with bulk power systems in compliance with IEEE Std 2800
 - Applies to IBRs in transmission and sub-transmission systems
 - May also apply to isolated IBRs interconnected to an AC transmission system via dedicated voltage source converter high-voltage direct current (VSC-HVDC) transmission facilities, e.g., offshore wind farms
 - Specifications for the equipment, conditions, tests, modeling methods, and other verification procedures that should be used to demonstrate conformance with IEEE P2800
- Includes:
 - Type tests (unit level, not full compliance)
 - Design evaluation, including modeling
 - As-built evaluation and commissioning tests
 - Post-commissioning model validation, monitoring, periodic tests, and periodic verifications
- Recommended practice: Uses “should” language, not “shall” language.
 - In recognition that prescribing uniform procedures across all IBR types and utility locations would be very challenging

IEEE P2800.2 Scope

- 2800-2022 contains performance requirements for IBRs, and a table of methods to verify each requirement
 - Details of verification methods not included
- P2800.2 will recommend details of verification methods

- Include procedure for each “R”
- Likely for each “D” as well
- If an appropriate procedure exists elsewhere, can refer to that

Requirement	RPA at which requirement applies	<i>IBR unit-level tests (at the POC)</i>	<i>IBR plant-level verifications (at the RPA)</i>						
		Type tests ¹⁵⁷	Design evaluation (including modeling)	As-built installation evaluation	Commissioning tests	Post-commissioning model validation	Post-commissioning monitoring	Periodic tests	Periodic Verification
		Responsible Entity							
		IBR Manufacturer	Developer /TS owner/TS operator	Developer /TS owner/TS operator	Developer /TS owner/TS operator	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
6.1 Primary Frequency Response (PFR)	POC & POM	NR ¹⁵⁸	R	R	R	R	D	D	D
6.2 Fast Frequency Response (FFR)	POC & POM	R ¹⁵⁹	R	R	R	R	D	D	D
<i>Clause 7 Response to TS abnormal conditions</i>									
7.2.2 Voltage disturbance ride-through requirements	POC ¹⁶⁰ & POM ¹⁶¹	R	R	R	NR	R	R	D	D
7.2.3 Transient overvoltage ride-through requirements	POM	R	R	R	NR	R	R	D	D
7.3.2 Frequency disturbance ride-through requirements	POM	R	R	R	NR	R	R	D	D
7.4 Return to service after IBR plant trip	POM	refer to line entries for 4.10 (Enter service)							

P2800.2 Key Questions

- How specific should procedures be? How prescriptive?
 - Keep in mind “should”, not “shall”
- Will procedures include quantitative pass-fail criteria? Or rely on expert judgement? A combination?
 - Subgroups to propose
- Can one test procedure cover multiple requirements?
 - Yes. Subgroups to consider
- What other standards do we need to consider?
 - Subgroup leads and WG leadership beginning to compile list of related standards
- For some requirements, will we offer multiple different verification methods?
 - Probably yes. Which ones? (Subgroups to propose)
- Many other subgroup-specific questions

P2800.2 – Paradigm shift?

- Note that key interconnection requirements conformity assessment steps occur *before* commissioning
- Is that a change from your current process?
- Why?
 - Once an IBR is commissioned, it can be costly to fix any issues. Power system changing fast.
- Is this going to be easy?
 - Probably not
- But if we do a good job, P2800.2 (along with other ongoing industry efforts) can:
 - Offer a standardized industry-wide practice for IBR conformance assessment
 - Minimize future need for costly retrofits
 - Help ensure the near-future, highly renewable grid is at least as reliable as today's. (I.e., avoid incidents like Odessa disturbance and Blue Cut event, but much bigger)

IEEE P2800.2 Subgroup Scopes

SG 1
Overall document and general requirements

- Question from 1st WG meeting: Should subgroups be organized by requirement (horizontally) instead of by verification method (vertically)?
- Officers considered and decided to maintain vertical SGs because most SMEs align this way
- Also adding a Power Quality Task Force (horizontal) to provide input to subgroups

Excerpt of 2800 Table 20:
Verification Methods Matrix

PQ Task Force

Requirement	RPA at which requirement applies	SG 2	SG 3	SG 4		SG 5				
		IBR unit-level tests (at the POC)	Design evaluation (including modeling for most requirements)	As-built installation evaluation	Commissioning tests	IBR plant-level verifications (at the RPA)				
		Type tests ¹⁵²				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	

IEEE P2800.2 Initial Structure and Leaders

Subgroup	Vice Chair	Subgroup Chair(s)
2: Type tests	Steve Wurmlinger Stephen.Wurmlinger@sm-a-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 will occur in the subgroups via periodic calls

Chair	Andy Hoke Andy.Hoke@nrel.gov
Secretary	Manish Patel mpatel@southernco.com
Vice Chair	Bob Cummings
Vice Chair	Mahesh Morjaria

Lead overall WG

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

Power Quality Task Force	
Co-Lead	Harish Sharma
Co-Lead	Eugen Starschich

Provide input to subgroups on PQ requirements verification

Subgroup 1 – Overall document: Scope

- Scope
 - Normative and informative references
 - Definitions and acronyms
 - Introductory material
 - General requirements
 - Any other items that do not fall under other subgroups
- Items not in scope
 - Topics not related to 2800 requirements verification

Subgroup 1 – Overall document: Key questions

- When evaluating whether an IBR complies with 2800, are there any overarching tolerance on criteria? (e.g. +/- xx%)
- Overall guidance on how to apply P2800.2 procedures. (E.g. in what order? How do the different steps feed into each other?)
- What other standards are applicable (e.g. IEC)? (Also applies to each subgroup)
- How can we ensure IBRs comply with 2800 while minimizing the burden on all involved?

Subgroup 1 – Overall document: Logistics

- Plan
 - Biweekly meetings, 1.5-2 hours
 - Time TBD
- Leads
 - Andy Hoke (andy.hoke@nrel.gov)
 - Manish Patel (mpatel@southernco.com)
- How to get involved
 - Join listserv (see slide 31)

Subgroups 2 through 5

- Presented by subgroup leads:
 - Scope
 - Key questions
 - Plan

Introducing Power Quality Task Force

- Scope: provide input to each subgroup on PQ requirements verification
- Leads:
 - Harish Sharma
 - Eugen Starschich

Draft outline

- Manish to share initial draft of P2800.2 outline

Next steps

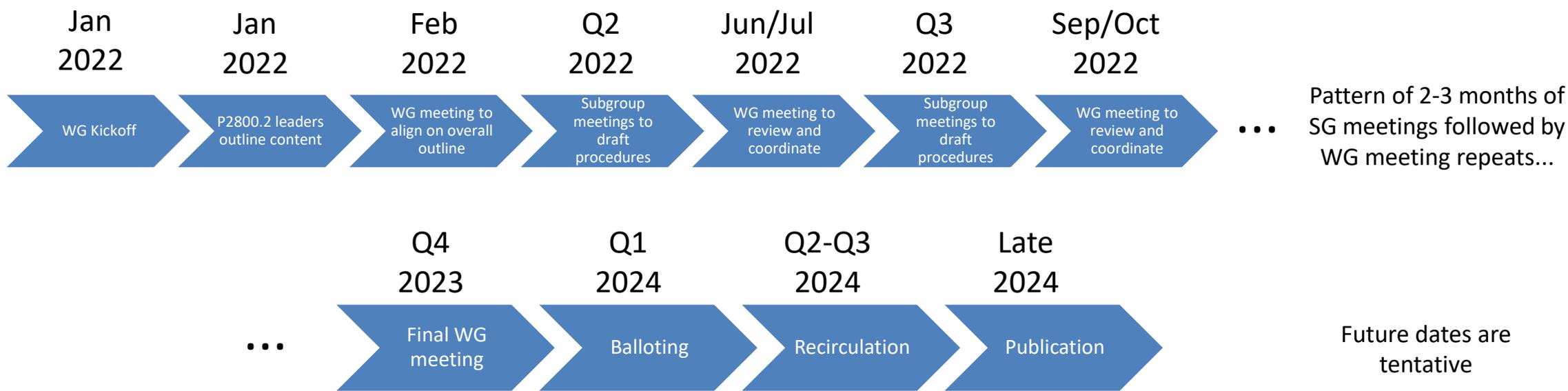
- Reminder to record attendance
- Join overall listserv
- Sign up for any subgroup(s) you're interested in
- Subgroups begin internal discussions
- Officers to schedule next WG meeting

IEEE P2800.2 Email Listservs

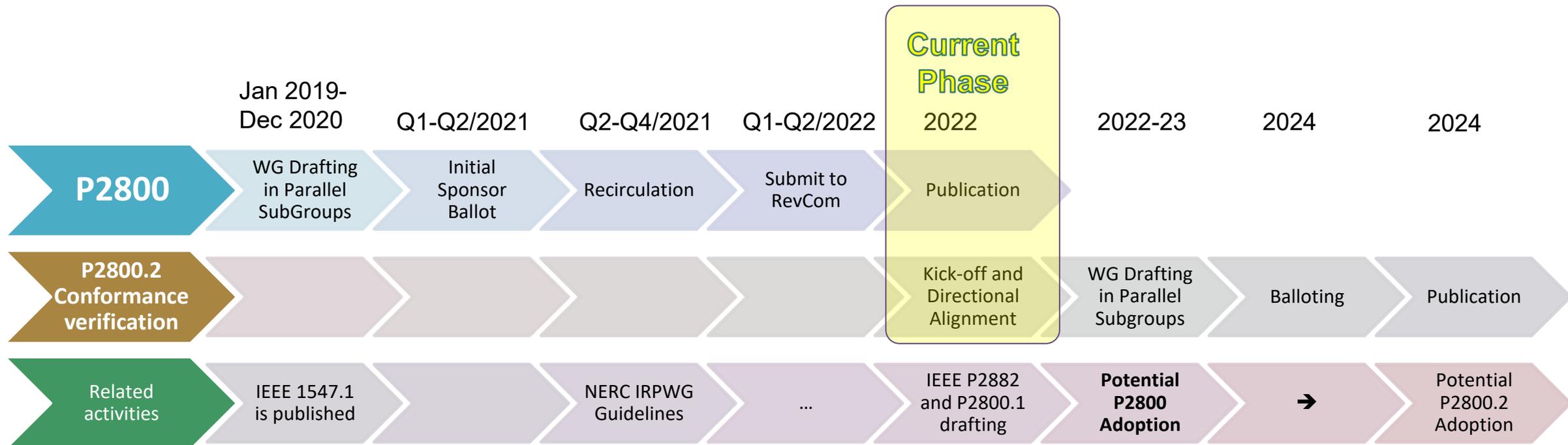
- Overall listserv “P2800-2” will be used to communicate meeting dates, agendas, etc.
- **Each subgroup and PQ task force now has a listserv – sign up to get involved in that group:**
 - Subgroup 1 (overall document): STDS-P2800-2-SG1
 - Subgroup 2 (type tests): STDS-P2800-2-SG2
 - Subgroup 3 (design evaluation): STDS-P2800-2-SG3
 - Subgroup 4 (commissioning and as-built): STDS-P2800-2-SG4
 - Subgroup 5 (post-commissioning): STDS-P2800-2-SG5
 - Power quality task force: STDS-P2800-2-PQTF
- To join a listserv, send an email message to listserv@listserv.ieee.org
 - In first line of email body, write: **SUBSCRIBE <list name> <Your Name>**
 - For example, “**SUBSCRIBE STDS-P2800-2-SG1 Andy Hoke**”

Future P2800 meetings

- 3-4 per year
- Initially online only
- Will consider in-person meetings with remote option if conditions allow
 - Anyone want to host at their organization? Need meeting room for ~100 people



Anticipated Timeline



Related standards:

- IEC 61400 – WTG engineering verification; significant overlap, coordination needed.
- IEEE P2988 – Virtual synchronous machines.
- P2882 – Guide for model validation for all generation types. Little info/progress so far.

To get involved in IEEE P2800.2:

- To join Working Group:
 - If you attended 1/18/2022 kickoff meeting, email Manish Patel: Mpatel@southernco.com; CC Andy.Hoke@nrel.gov
 - If not, attend any two meetings and request membership
- Join listserv for any subgroup or task force of interest (slide 23)
- WG member iMeet site: <https://ieeesa.imeetcentral.com/p2800-2/home>
- Public website: <https://sagroups.ieee.org/2800-2/>