

IEEE P2800.2 Kickoff Meeting

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January 18, 2022

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

To get involved in IEEE P2800.2:

- Sign up for listserv to receive future meeting notices by sending an email to listserv@listserv.ieee.org
 - In first line of email body, write: **SUBSCRIBE p2800-2 Your Name**
 - For example, "SUBSCRIBE P2800-2 Andy Hoke"
- In addition, each subgroup will have a Listserv to announce its meetings
 - Details to be announced
- 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 two future meeting and request membership
- Public website (to be populated with more information soon)
 - <https://sagroups.ieee.org/2800-2/>

Introductory material

- Motivation for IEEE P2800 and P2800.2 – Ryan Quint
- Status of IEEE P2800 – Jens Boemer

Summary of IEEE P2800

- The draft standard harmonizes Interconnection Requirements for Large Solar, Wind, and Storage Plants
- It is a consensus-based draft developed by over ~175 Working Group participants from utilities, system operators, transmission planners, & OEMs over 2+ years
- Currently at 94% ballot approval and undergoing final steps before publication

P2800D6.3, November 2021
Draft Standard for Interconnection and Interoperability of Inverter-Based Resources Interconnecting with Associated Transmission Systems

1 **P2800™/D6.3 (November 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 (WSPI-P) – [website](#)
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	11/14/2021	Jens C. Boemer (Chair) Manish Patel (Vice-Chair) With contributions from other Vice-Chairs and SG-Leads	Draft 6.3 for IEEE SA 3rd Recirculation. PLEASE REFER IN YOUR COMMENTS TO PAGE AND LINE NUMBERS FROM THIS REDLINE VERSION.

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

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 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.

Please record your attendance

- To be eligible to join the Working Group, record your attendance at:
<https://imat.ieee.org/attendance>
- **To join IEEE P2800.2 Working Group:** After attending this meeting, contact WG Secretary Manish Patel and request to join:
MPATEL@southernco.com; CC Andy.Hoke@nrel.gov
- 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>

Working Group Policies and Procedures

- We plan to use the same P&Ps as the P2800 WG, as previously approved by the sponsor, available here:
https://sagroups.ieee.org/2800/wp-content/uploads/sites/336/2020/08/EDPGC-Sponsored-WG-P-and-PV2Jan2020_IEEE-P2800-WG.pdf
 - Malia Zaman, IEEE liaison to P2800.2, to introduce this and subsequent items

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
 - Listserv: Email reflector for meeting notices etc. *(See slide near end to sign up)*
 - *Listservs also to be developed by for subgroups*
 - iMeet Central: Online collaboration site for WG members. *(To appear)*
 - iMat.IEEE.org: Attendance tool
 - WordPress: Public website
 - MS Teams (and potentially other online meeting apps)

Agenda (as emailed to invitees 1/10/2022)

- Call to order and welcome
- Motivation and background
- Roll call and declaration of affiliation
- Review: WG Policies and Procedures, Privacy Policy, eTools
- Approval of agenda
- IEEE disclaimers and legal notices
- Discussion of goals, intent and structure of P2800.2
- Introduction of initial leadership team and subgroups
- Wrap up and next steps

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>

What's next after IEEE P2800?

- IEEE P2800 has the potential to become fundamental to the reliability of the near-future, high-IBR power system
 - Robust disturbance ride-through requirements
 - Detailed grid support capability requirements
 - Extensive monitoring and data collection requirements
 - Etc.
- To realize its potential, P2800 needs to be properly implemented and **compliance needs to be verified**

IEEE P2800.2 Objective: Filling Gaps in North American Interconnection Standards for Inverter-Based Resources

		Performance	Test & Verification & Model Validation
BES¹ BPS³ Transmission Sub-Transmission		<ul style="list-style-type: none"> • FERC Orders • NERC Reliability Standards & Guidelines 	<ul style="list-style-type: none"> • NERC compliance monitoring & enforcement
		<ul style="list-style-type: none"> • IEEE P2800 (✓) 	<ul style="list-style-type: none"> • Not available
DER²		<ul style="list-style-type: none"> • IEEE Std 1547-2018 (✓) 	<ul style="list-style-type: none"> • IEEE 1547.1-2020 (✓) • UL 1741 (SB) • IEEE ICAP

IEEE P2800.2, P2800.1

IEEE standards are voluntary industry standards and must be adopted by the appropriate authority to become mandatory (e.g., Transmission Owners, NERC, FERC).

¹ NERC definition of Bulk Electric System: ≥ 100 kV with gross individual / aggregate nameplate rating greater than 20 MVA / 75 MVA

² DER connected at typical (radial) primary and secondary voltage levels

³ transmission and meshed sub-transmission

Slide modified from Jens Boemer, EPRI

P2800.2 relative to other standards

- P2800.2 is to P2800 as 1547.1 is to 1547, but...
- P2800.2 will be different from 1547.1 in some key ways:
 - P2800.2 will be more **focused on plant-level conformance**, less focused on device-level type tests
 - P2800.2 will be **less prescriptive** (“should”, not “shall”)
 - P2800/2800.2 apply only to **inverter/converter-based resources** (whereas 1547/1547.1 apply to all DERs)
- 1547 compliance was not generally required until 1547.1 was available. In contrast, **P2800 can be adopted before P2800.2 is published** using existing verification methods.
 - Appropriate entities can begin discussions/processes to adopt P2800 now

P2800.2 PAR Summary

- 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

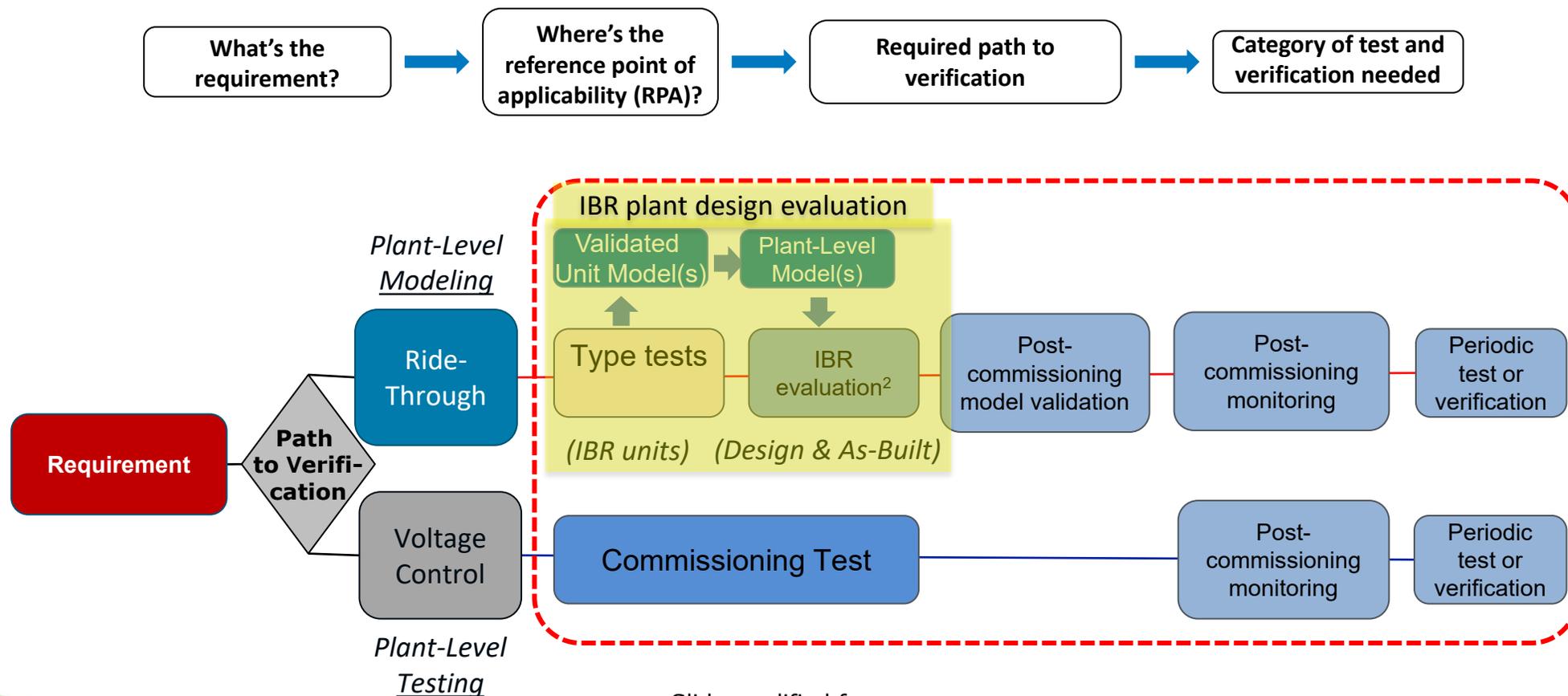
IEEE P2800.2 Motivation

- P2800 contains performance requirements for IBRs, and a table of methods to verify each requirement
 - Details of verification methods not included
- P2800.1 may contain those details, but P2800.1 is developed under the “Entity Method” where voting requires IEEE-SA Advanced Corporate Membership

- **P2800.2** will develop details through IEEE “individual standard” process (like P2800, 1547, 1547.1, etc)

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 requirements verification framework: Examples



Slide modified from
Jens Boemer, EPRI

IEEE P2800.2 Subgroup Scopes

SG 1
Overall document and general requirements

Excerpt of P2800 Table 20: Verification Methods Matrix

Requirement	RPA at which requirement applies	SG 2	SG 3	SG 4		SG 5				
		<i>IBR unit-level tests (at the POC)</i>	Design evaluation (including modeling for most requirements)	As-built installation evaluation	Commissioning tests	<i>IBR plant-level verifications (at the RPA)</i>				
		<i>Type tests</i> ¹⁵²				Post-commissioning model validation	Post-commissioning monitoring	Periodic tests	Periodic verification	
				Responsible Entity						
		<i>IBR unit or supplemental IBR device manufacturer</i>	<i>IBR developer / TS owner / TS operator</i>	<i>IBR developer / TS owner / TS operator</i>	<i>IBR developer / TS owner / TS operator</i>	<i>IBR developer / IBR operator / TS owner / TS operator</i>	<i>IBR operator / TS owner / TS operator</i>	<i>IBR operator / TS owner / TS operator</i>	<i>IBR operator / TS owner / TS operator</i>	
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	

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

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

Lead overall WG

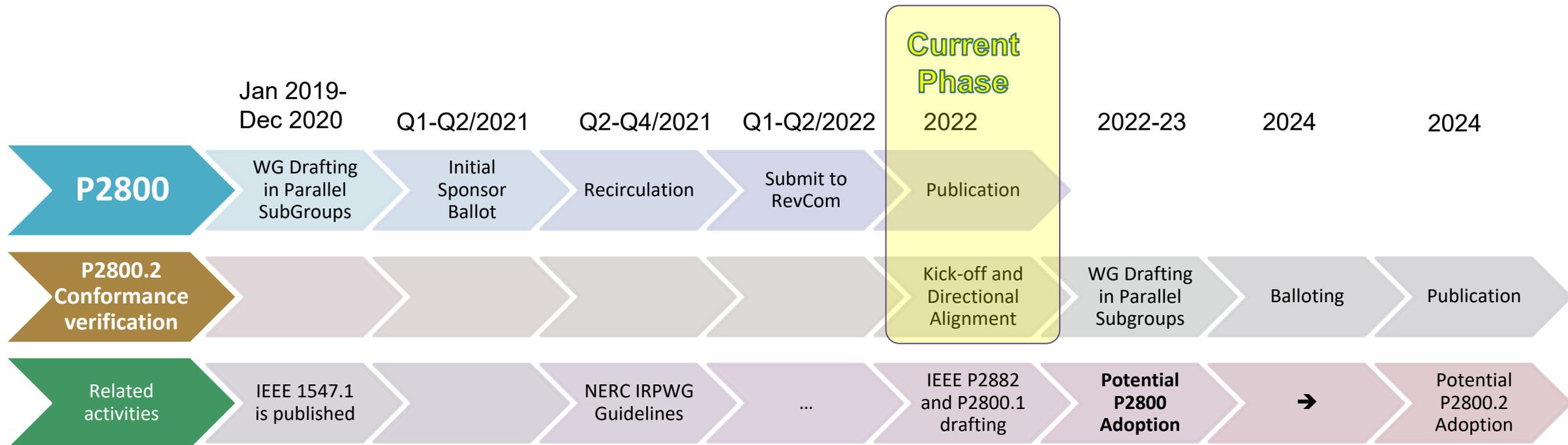
Compile drafts; Lead Subgroup 1 (overall document and general requirements)

- Most of the detailed work will occur in the subgroups via periodic calls
- Contact subgroup leads shown here to express interest
- Instructions to sign up for subgroup listservs will be sent soon

Questions

- Some IBR types have existing methods of verifying interconnection requirements. How will P2800.2 treat these existing methods?
 - We do not need to reinvent the wheel. Existing methods and procedures from other documents can be leveraged.
 - Subgroups and WG should consider existing methods. Incorporate by reference? Leverage concepts? Adapt?
 - Example: IEC 61400 may contain content that can be leveraged, at least for WTGs, maybe for others
 - Need to consider whether existing methods meet our needs
- How detailed should verification procedures be? How prescriptive?
 - This is up to the subgroups and WG. May vary by procedure
- Can we recommend different procedures for different technologies?
 - Yes, if the subgroup and WG decide to
- What if we find something in P2800 we think needs to be fixed?
 - We can't edit P2800 in this WG, but we should keep a list for future revisions/amendments
- What else?

Anticipated Timeline

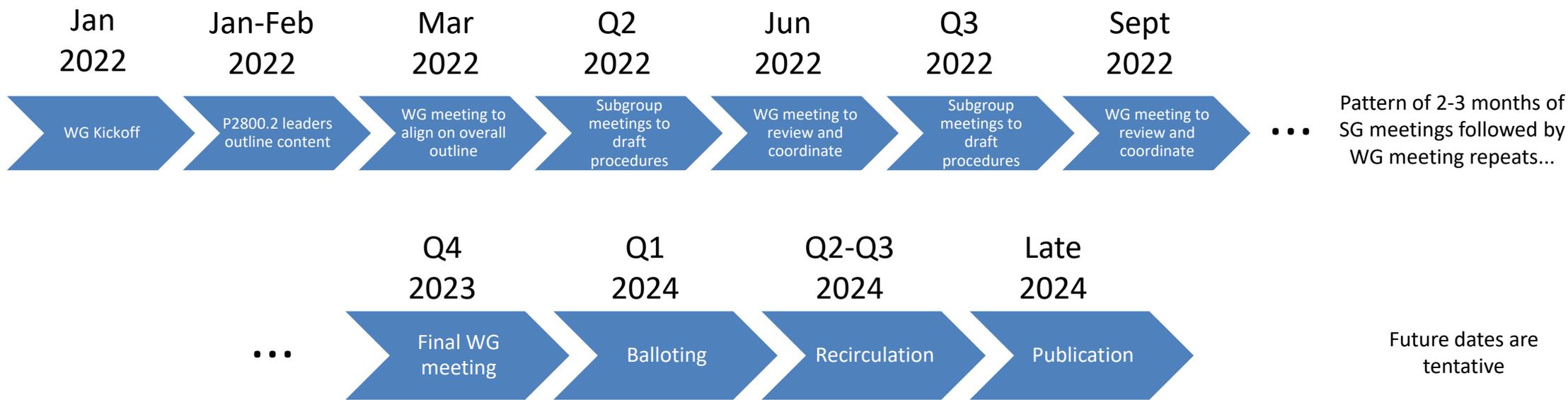


Related standards:

- 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.

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 ~50-100 people



P2800.2 Call for Participation

- Recruiting participation from P2800 WG and industry in general
- Especially need those with knowledge of best practices in designing, studying, interconnecting, commissioning, and operating large IBRs
- Utilities, project developers, consultants, manufacturers, labs, etc.

IEEE P2800.2 Email Listserv

- The listserv will be used to communicate meeting dates, agendas, etc
- To join:
- Send an email message to listserv@listserv.ieee.org
 - In first line of email body, write: **SUBSCRIBE p2800-2 Your Name**
 - For example, "SUBSCRIBE P2800-2 Andy Hoke"
- In addition, each subgroup will have a Listserv to announce its meetings
 - Details to be announced