IEEE STANDARDS ASSOCIATION

SAND2019-14684C

IEEE P2800 Update
Solar Energy Systems Conference
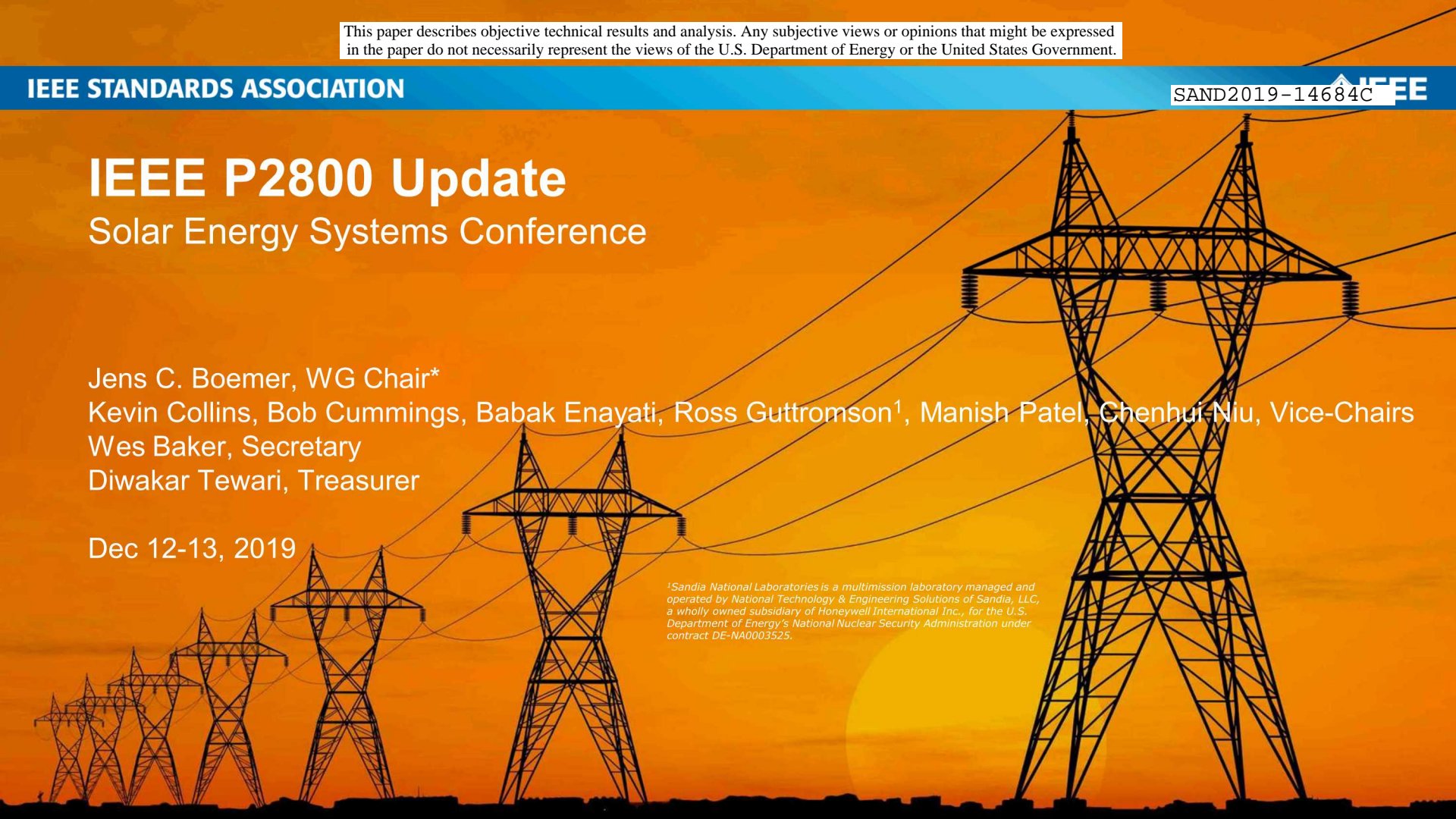
Jens C. Boemer, WG Chair*
Kevin Collins, Bob Cummings, Babak Enayati, Ross Guttromson[1], Manish Patel, Chenhui Niu, Vice-Chairs
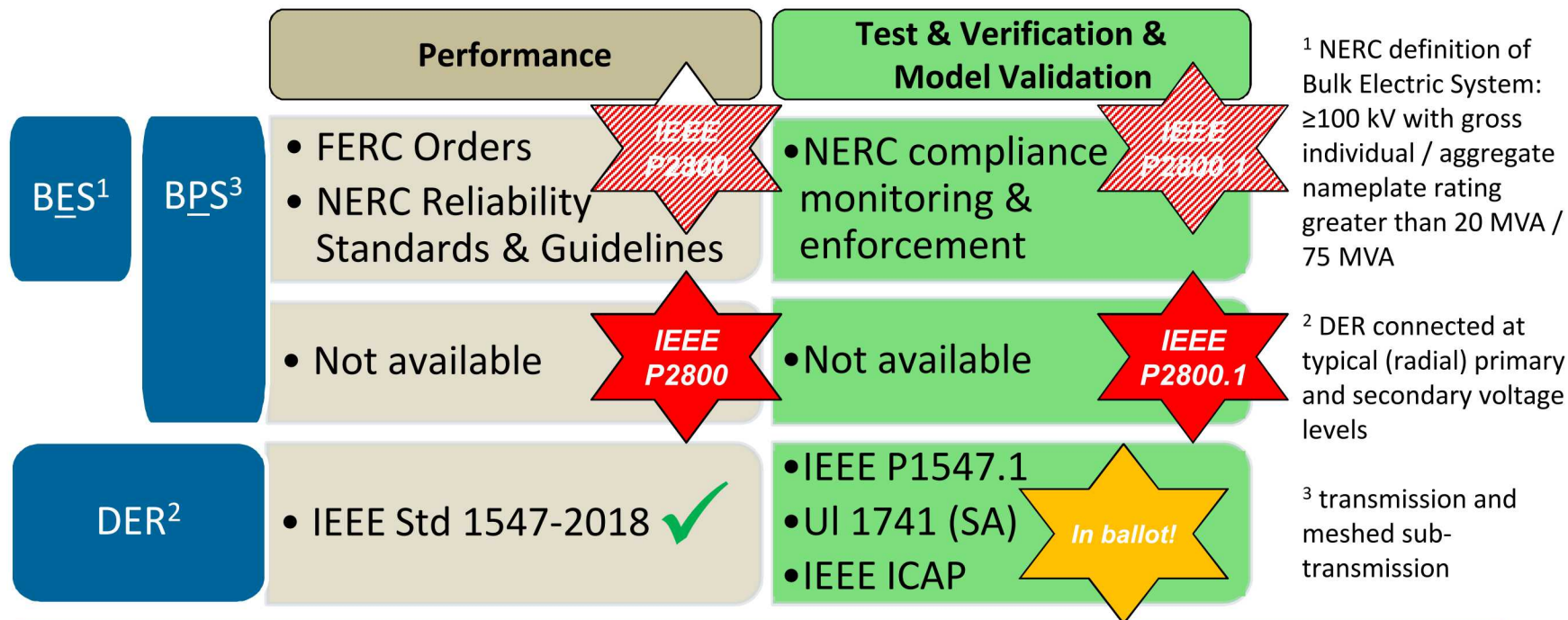Wes Baker, Secretary
Diwakar Tewari, Treasurer

Dec 12-13, 2019

Filling the Gaps in North American Standards for Inverter-Based Generating Resources

		Performance	Test & Verification & Model Validation
BES[1]	BPS[3]	• FERC Orders • NERC Reliability Standards & Guidelines	• NERC compliance monitoring & enforcement
		IEEE P2800	*IEEE P2800.1*
		• Not available	• Not available
		IEEE P2800	*IEEE P2800.1*
DER[2]		• IEEE Std 1547-2018 ✔	• IEEE P1547.1 • Ul 1741 (SA) • IEEE ICAP
			In ballot!

[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

IEEE standards are voluntary industry standards and must be adopted by the appropriate authority to become mandatory.

Approximately 300 Interested Parties

- Most of the inverter-based resource vendors

- Many Transmission Planners

- Many Service Providers & Consultants

- Several Regulatory Bodies

- Supported by Academics & Researchers

Which of the following balloter classifications do you belong to?

Classification	Percentage
Users, Industrial, e.g. IBR developers, owners, operators, IPPs	5%
Producer – Components, Software, Systems, e.g., IBR equipment & system manufacturers	9%
Academic/Research	12%
Regulatory and Governmental Bodies	17%
Utility, Transmission, e.g., planning, protection & operation engineers	31%
Service Provider/ Consulting, e.g., consultants, NRTLs, certification providers	26%
Other Groups	

0% 5% 10% 15% 20% 25% 30%

Responses: 65

Total Results: 65

IEEE Standards Classification & Language

**IEEE P2800**

IEEE Std 1547

IEEE Std 1547.1

Standards
documents specifying mandatory requirements (*shall*)
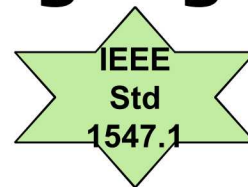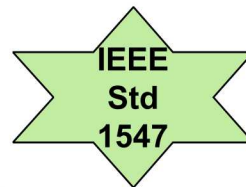
Recommended Practices
documents in which procedures and positions preferred by the IEEE are presented (*should*)

IEEE P2800.1

Guides
documents that furnish information – e.g., provide alternative approaches for good practice, suggestions stated but no clear-cut recommendations are made (*may*)

IEEE P1547.2

IEEE P1547.3

IEEE P1547.9
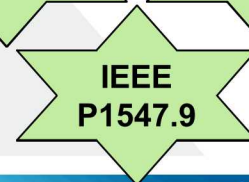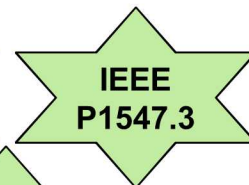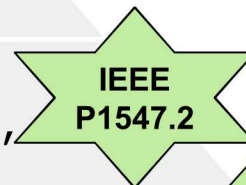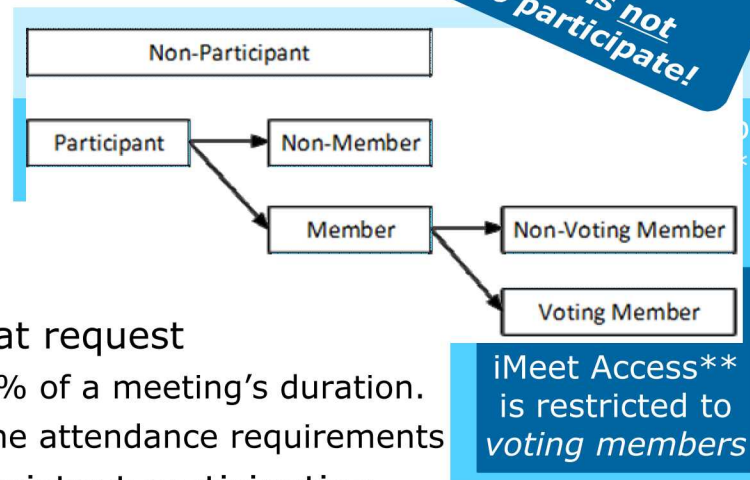
IEEE SA Balloting Rules

Consensus =

- ≥75% Quorum

- ≥75% Approval

  - *WG Chair's goal is ≥90%!*

WG membership criteria

- **PnP's: Clause 4.0 Working Group Membership**
  - Working Group membership is by individual
  - Membership was granted automatically to those attending the kick-off meeting
  - Membership shall be ***granted after attending two consecutive WG meetings or WG calls***, at request
    - Attendance credit is granted to those who attend ≥50% of a meeting's duration.
    - Attendance via teleconferencing shall count towards the attendance requirements
  - Voting member status is maintained through consistent participation at meetings and through Working Group votes
    - may be revoked if a Working Group member misses two consecutive meetings
    - A member who lost voting privileges shall have them reinstated by attendance at two consecutive meetings of the Working Group and upon request for member status
    - Working Group Chair can decide in cases of personal hardship
  - Roster / <u>public list</u> includes <u>name</u>, email address, <u>affiliation</u>, and membership status

Non-Participant

Participant → Non-Member

Member → Non-Voting Member

Member → Voting Member

*iMeet Access** is restricted to voting members*

* Log WG Mtg attendance via iMAT (imat.ieee.org)
** Available at https://ieee-sa.imeetcentral.com/p280 0-wspi-p
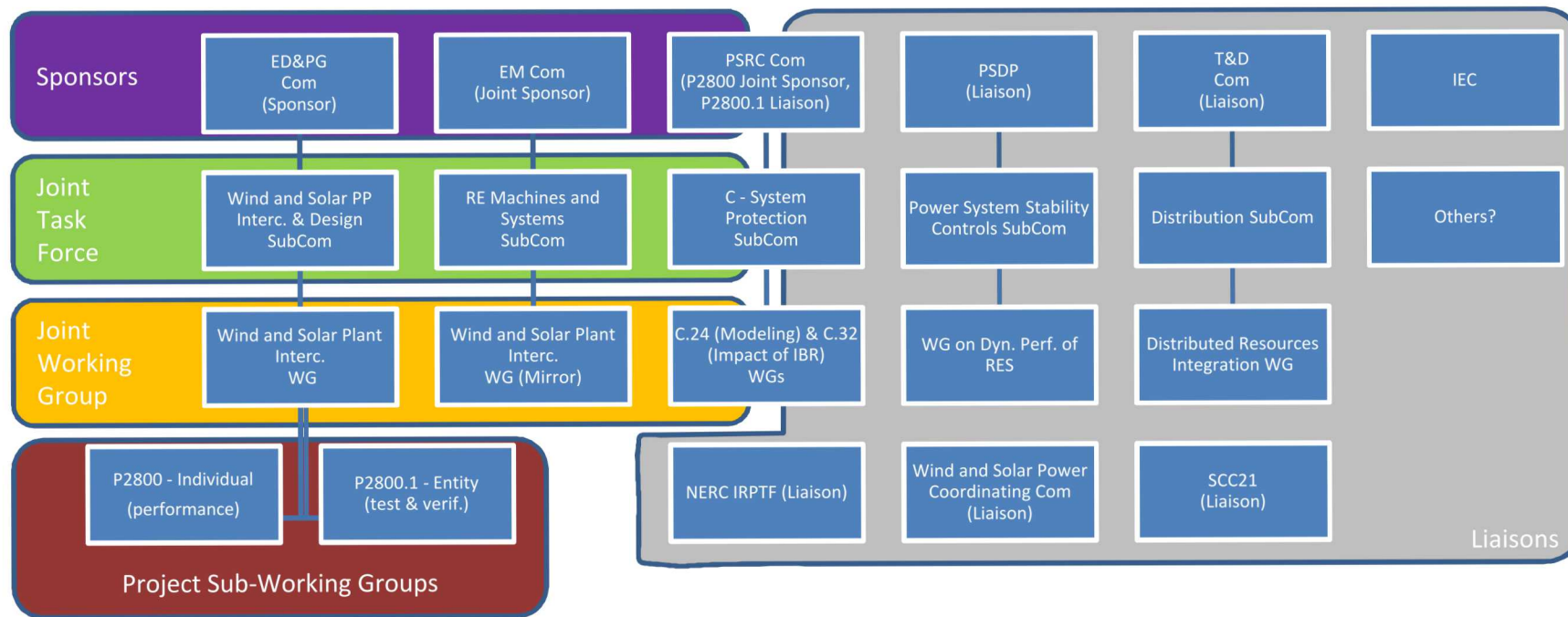
What to expect from IEEE P2800?

- Specify performance and functional *capabilities.*

- Specify functional *default settings.*

- Specify functional *ranges of allowable settings.*

- Specify modeling data, and measurement data for performance monitoring and validation.

- Specify required tests and verifications, but not their detailed procedures (➔ P2800.1)

Clarifications of the Scope

- Voluntary standard, requires reference by responsible parties', e.g., interconnection requirements / agreements
  - Candidate parties are transmission owners, state regulators, NERC, and FERC

- Technical minimum requirements, intention is that responsible parties can specify additional requirements
  - Some participants see a risk that it may be regarded as exhaustive requirements
  - Strive for balance between the common denominator and exhaustive requirements
  - May want to consider tiered requirements by use of "performance categories"

- Only "inverter-based" resources, e.g., wind power, solar photovoltaic, energy storage
  - Some participants suggested renaming to "inverter-coupled"
  - "Type 3" wind turbines (doubly-fed induction generators) are in scope

- Applicable to transmission and meshed sub-transmission grids (broad BPS definition)
  - May need different set of requirements for transmission and sub-transmission

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Coordination Approach

Sponsors
- ED&PG Com (Sponsor)
- EM Com (Joint Sponsor)
- PSRC Com (P2800 Joint Sponsor, P2800.1 Liaison)
- PSDP (Liaison)
- T&D Com (Liaison)
- IEC

Joint Task Force
- Wind and Solar PP Interc. & Design SubCom
- RE Machines and Systems SubCom
- C - System Protection SubCom
- Power System Stability Controls SubCom
- Distribution SubCom
- Others?

Joint Working Group
- Wind and Solar Plant Interc. WG
- Wind and Solar Plant Interc. WG (Mirror)
- C.24 (Modeling) & C.32 (Impact of IBR) WGs
- WG on Dyn. Perf. of RES
- Distributed Resources Integration WG

Project Sub-Working Groups
- P2800 - Individual (performance)
- P2800.1 - Entity (test & verif.)

- NERC IRPTF (Liaison)
- Wind and Solar Power Coordinating Com (Liaison)
- SCC21 (Liaison)

Liaisons

IEEE P2800 Leadership Team

Role	Name	Affiliation	Stakeholder Group	Liaison
Chair	Jens C. Boemer	EPRI	Academic/Research	EDP&G, SCC21
Secretary	Wesley Baker	Power Grid Eng.	Service Provider/ Consulting	EMC, IRPTF
Vice-Chair	Bob Cummings	NERC	Regulatory and Governmental Bodies	NERC IRPTF
Vice-Chair	Kevin Collins	FirstSolar	Users, Industrial	NERC IRPTF
Vice-Chair	Babak Enayati	NationalGrid	Stakeholders represented in IEEE Power & Energy Society	T&D, SCC21, PES GovBrd
Vice-Chair	Ross Guttromson	SANDIA National Lab	Academic/Research	DOE
Vice-Chair	Chenhui Niu	State Grid Corporation of China	Stakeholders represented in IEEE P2800.1 Working Group	IEEE P2800.1, IEC SC8A
Vice-Chair	Manish Patel	Southern Company	Utility, Transmission	PSRC, IRPTF
Treasurer	Diwakar Tewari	Leidos	Service Provider/ Consulting	EDP&G

| IEEE P2800 Working Group | Mailing List | stds-p2800@listserv.ieee.org |
| | Collaborative Workspace for WG Members (only) | https://ieee-sa.imeetcentral.com/p2800-wspi-p/ |

IEEE P2800 SubGroup	Lead (=Officer)	Mailing List
I. Overall Document	Jens C Boemer	stds-p2800-sg1@listserv.ieee.org
II. General Requirements	Bob Cummings	stds-p2800-sg2@listserv.ieee.org
III. Active Power – Frequency Control	Kevin Collins	stds-p2800-sg3@listserv.ieee.org
IV. Reactive Power – Voltage Control	Wes Baker	stds-p2800-sg4@listserv.ieee.org
V. Low Short-Circuit Power	Ross Guttromson	stds-p2800-sg5@listserv.ieee.org
VI. Power Quality	Ross Guttromson	stds-p2800-sg6@listserv.ieee.org
VII. Ride-Through *Capability* Requirements	Bob Cummings	stds-p2800-sg7@listserv.ieee.org
VIII. Ride-Through *Performance* Requirements	Manish Patel	stds-p2800-sg8@listserv.ieee.org
IX. IBR Protection	Babak Enayati	stds-p2800-sg9@listserv.ieee.org
X. Modeling & Validation, Measurement Data, and Performance Monitoring	Manish Patel	stds-p2800-sg10@listserv.ieee.org
XI. Tests and verification requirements	Chenhui Niu	stds-p2800-sg11@listserv.ieee.org

➢ Mailing lists are open to all Interested Parties ("Participants"), not only to WG Members.

Instructions for Mailing Lists

IEEE P2800 Working Group and Sub-WGs Listservs – Public Reflector Information

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NOTE: The IEEE P2800 Working Group public reflector is provided for the benefit of moving the work of the Working Group forward. Use of this reflectors is subject to the *IEEE E-mail Acceptable Use Practices.*

Subscribing to the Reflectors

To subscribe to the P2800 listservs, send an e-mail to listserv@listserv.ieee.org with the following command in the body of the e-mail:

> Subscribe stds-p2800 lastname, firstname   ← replace red part with the name of any of the Sub-WGs mailing lists
> End

Subscribe Note 1: Use of the e-mail subscribe instruction requires that you supply your Last Name followed by your First Name and will subscribe the e-mail address from which the e-mail is sourced from. The e-mail subscribe instruction does not support an e-mail address field, if you try to use an e-mail address in the Name fields it will be rejected. If you wish to subscribe an e-mail address other than the one which your e-mail is sourced from, for example the IEEE e-mail alias my.name@ieee.org, you will need to use the ListServ web interface. Use of this web interface will require the creation of a login but once this login has been created it will be used for all IEEE ListServ subscriptions you wish to manage.

Subscriber Note 2: To contact the owner of the list, or if you have trouble subscribing/unsubscribing, or have questions, please send an email to stds-p2800-request@listserv.ieee.org

Unsubscribing from the Reflector

To unsubscribe from the IEEE P2800 listserv, send an e-mail to listserv@listserv.ieee.org with the following command in the body of the e-mail:

> unsubscribe stds-p2800 lastname, firstname   ← replace red part with the name of any of the Sub-WGs mailing lists
> End

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Instructions for Mailing Lists

To send a message to all of the people currently subscribed to the P2800 listserv, send an email to **stds-p2800@listserv.ieee.org**, which is called the **LIST** address. You must never try to send any command to that address, as it would be distributed to all the people who have subscribed. All commands used to manage your account must be sent to **listserv@listserv.ieee.org**, which is the **LISTSERV** address. It is important to understand the difference between the two.

Managing Your IEEE Listserv Account

To manage your IEEE listserv account, send an e-mail with the appropriate command(s) in the body of the e-mail to **listserv@listserv.ieee.org**. The END command informs listserv to stop reading commands, so if you string commands together, only include END once at the end of the string.

Note:(* = asterisk = wildcard = all lists)

To change your e-mail address on this listserv list:
    Change stds-p2800 [Your New e-mail Address]   ← replace red part with the name of any of the Sub-WGs mailing lists
    End

To change your e-mail address on all IEEE lists:
    Change * [Your New e-mail Address]
    End

To remove your e-mail address from this listserv list:
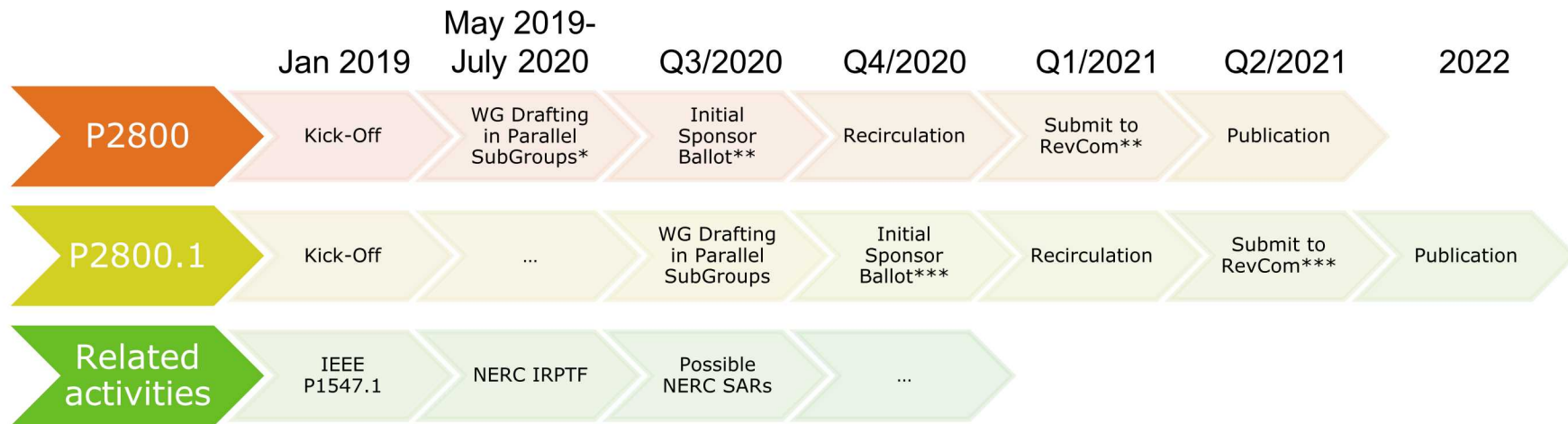   Signoff stds-p2800   ← replace red part with the name of any of the Sub-WGs mailing lists
    End

To remove your e-mail address from all IEEE lists:
    Signoff *
    End

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Updated Timeline With Strech Goals

	Jan 2019	May 2019-July 2020	Q3/2020	Q4/2020	Q1/2021	Q2/2021	2022
P2800	Kick-Off	WG Drafting in Parallel SubGroups*	Initial Sponsor Ballot**	Recirculation	Submit to RevCom**	Publication	
P2800.1	Kick-Off	...	WG Drafting in Parallel SubGroups	Initial Sponsor Ballot***	Recirculation	Submit to RevCom***	Publication
Related activities	IEEE P1547.1	NERC IRPTF	Possible NERC SARs	...			

*   Please contact the SubGroup leads and sign up for their Mailing Lists to engage.
** The P2800 PAR states June 2021 for Initial Sponsor Ballot and October 2022 for submission to RevCom.
*** The P2800.1 PAR states Dec 2021 for Initial Sponsor Ballot and October 2022 for submission to RevCom.

The ability to meet this tentative timeline may be subject to strong commitments of Working Group leadership team, i.e., support/funding.

Next Deliverables & Milestones

Deliverable	Due date for SubGroup submissions		Publication date
Draft 1.1 (Annotated)	Oct 31, 2019 (Officer Comments)		Nov 6, 2019 (Posted on iMeet)
WG ConfCall	Nov 21, 2019 – discuss & vote on important decisions, e.g., Definitions		
WG ConfCall	Dec 6, 2019 – discuss & vote on 1-2 important decisions per SubGroup		
WG ConfCall	Dec 17, 2019 – discuss & vote on 1-2 important decisions per SubGroup		
Informal WG Meeting & Voluntary SubGroup Meetings	Jan 13, 2020, 1p-5p ET @2020 IEEE JTCM, Jacksonville, FL (does not count towards WG membership)		
WG ConfCall	Feb 6, 2020* – discuss & vote on 1-2 important decisions per SubGroup		
Milestone: Draft 2 (Complete Draft)	Mar 1, 2020* (SubGroup Input)		Mar 15, 2020* (Posted on iMeet)
WG Meeting	TBD (April 7-9), 2020* (2 ½ days), FirstSolar, Tempe, AZ		
Draft 2.1	April 15, 2020* (SubGroup Posted)		May 1, 2020 (Comments in spreadsheet)
Milestone: Draft 3	June 15, 2020* (Input)		June 30, 2020* (Posted on iMeet)
WG Meeting	TBD (July 14-16), 2020*, Location TBD		
Milestone: WG Vote on Draft 3.x	TBD (July 23), 2020*		
Sponsor Coms Approve WG Draft	August 3-7, 2020 at PES General Meeting, Montreal, Canada		
Initial Ballot	Q3/2020*		
Recirculation	Q4/2020*		
Milestone: Submission to NesCom	Q1/2021*		
Milestone: Publication	Q2/2021*		

* Tentative dates

Progress To Date

✓ Mailing lists

✓ File sharing

✓ Scope documents

✓ Strawman

✓ Two Working Group Meetings

✓ SubGroup schedules

✓ Draft 1 discussed at WG Meeting in Salt Lake City, September 2019

Logistics of Bi-weekly SubGroup
P2800 Mailing List at stds-p2800@listserv.ieee.org

P2800 SubGroup	Lead	Mailing List	iMeetCentral Folder	Mon	Tues	Wed	Thurs	Fri
I. Overall Document	Jens Boemer	stds-p2800-sg1@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIIa				12 PM ET (even weeks)	
II. General Requirements	Bob Cummings	stds-p2800-sg2@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIIb					3 PM ET (odd weeks)
III. Active Power – Frequency Control	Kevin Collins	stds-p2800-sg3@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIIc				12 PM ET (odd weeks)	
IV. Reactive Power – Voltage Control	Wes Baker	stds-p2800-sg4@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIId		1 PM ET (odd weeks)			
V. Low Short-Circuit Power	Ross Guttromson	stds-p2800-sg5@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIIe		11 AM ET (odd weeks)			
VI. Power Quality	Ross Guttromson	stds-p2800-sg6@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAtIIf		11 AM ET (even weeks)			

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Logistics of Bi-weekly SubGroup
P2800 Mailing List at stds-p2800@listserv.ieee.org

P2800 SubGroup	Lead	Mailing List	iMeetCentral Folder	Mon	Tues	Wed	Thurs	Fri
VII. Ride-Through Capability Requirements	Bob Cummings	stds-p2800-sg7@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAAtIlg					3 PM ET (even weeks)
VIII. Ride-Through Performance Requirements	Manish Patel	stds-p2800-sg8@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAAtIlh			1 PM ET (even weeks)		
IX. IBR Protection	Babak Enayati	stds-p2800-sg9@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAAtIli				4 PM ET (odd weeks)	
X. Modeling & Validation, Measurement Data, and Performance Monitoring	Manish Patel	stds-p2800-sg10@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAAtIlj			1 PM ET (odd weeks)		
XI. Tests and verification requirements	Chenhui Niu	stds-p2800-sg11@listserv.ieee.org	https://ieee-sa.imeetcentral.com/p/ZgAAAAAAtIlk	Intentionally Delayed				

2019/2020 Meetings

- Coordinated with NERC IRPTF Meeting Schedule and IEEE Meetings, as appropriate

- Webex for remote participation is available & counts towards WG meeting attendance

- Striving for no registration fee, as facilities and catering may be provided in-kind

IEEE P2800	Location	Registration
May 22-23, 2019	Atlanta, GA (NERC)	via vtools
September 25-26, 2019	Salt Lake City, UT (WECC)	via 123signup
~~December 4-5, 2019~~	~~Tempe, AZ (FirstSolar)~~	~~Cancelled~~
November 21, 2019	Webex (2:00p–4:00p ET)	Webex
December 6, 2019	Webex (noon–2:00p ET)	Webex
December 17, 2019	Webex (noon–2:00p ET)	Webex
January 13, 2020, 1p-5p*	Jacksonville, FL (IEEE JTCM)	available here
TBD (April 7-9), 2020	Tempe, AZ (FirstSolar)	N/A yet
TBD (July 14-16), 2020	TBD	N/A yet

NERC IRPTF
Tue/Wed, May 21-22, 2019
Wed/Thu, September 4-5, 2019
Tue/Wed, December 3-4, 2019

*This is an informal WG Meeting with voluntary Sub-WG meetings (does not count towards WG membership)

Contacts

IEEE P2800
- Jens C Boemer,
  j.c.boemer@ieee.org

- Wes Baker,
  wbaker@powergridmail.com
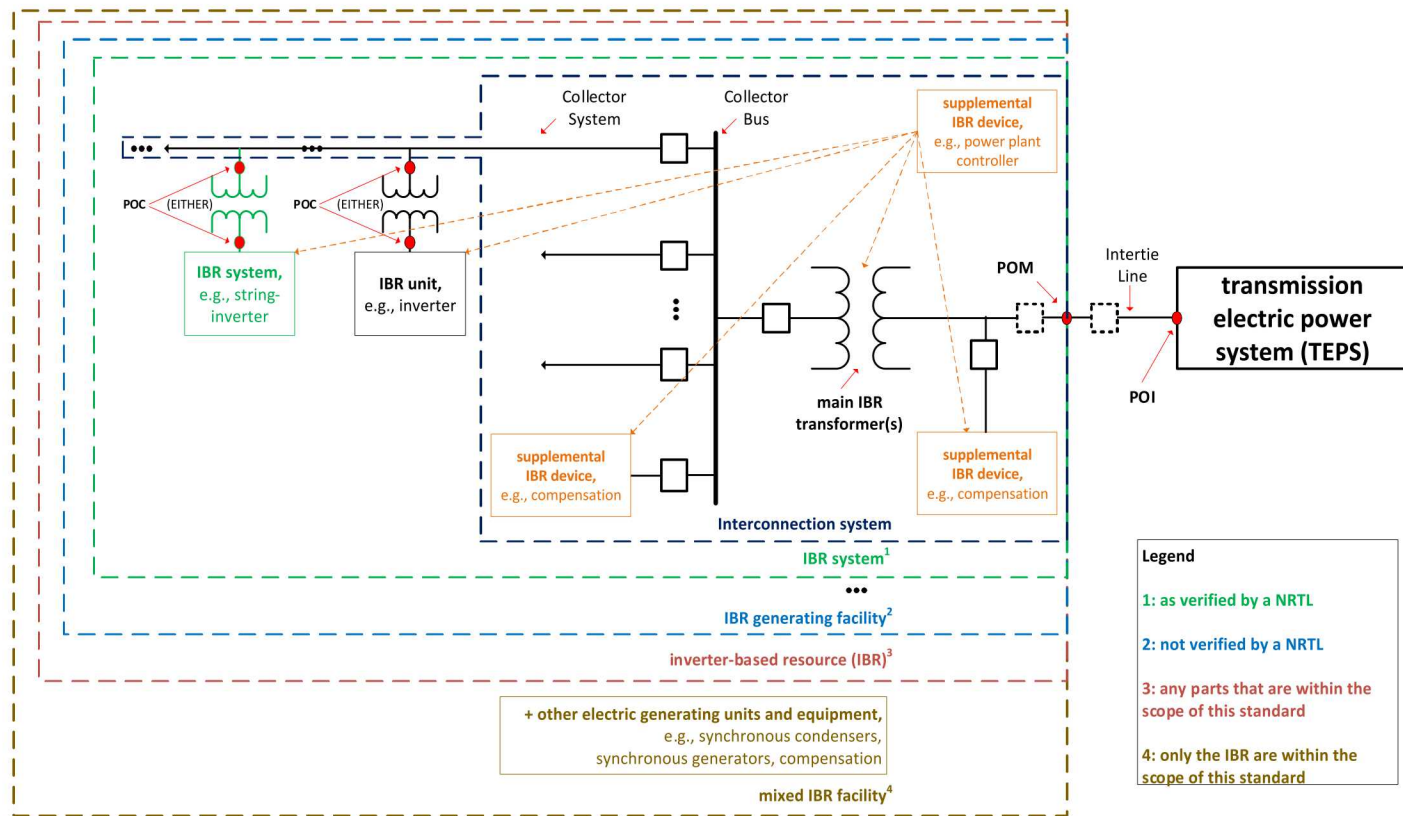
IEEE P2800.1
- Chenhui Niu,
  niuchenhui@sgepri.sgcc.com.cn

- Jens C Boemer,
  j.c.boemer@ieee.org

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Informal WG Meeting at IEEE JTCM in Jacksonville, FL on Jan 13, 2020, 1p-5p

DRAFT AGENDA - Monday, 1/13/2020: 1PM – 5PM		
1:00 PM	Welcome Facility safety and emergency procedures Opening remarks, objectives of this meeting	J. Boemer (remotely)
1:10 PM	Status Update on IEEE P2800	J. Boemer (remotely)
1:20 PM	Status Update on IEEE P2800.1	C. Niu / J. Boemer (remotely)
1:30 PM	Questions & Answers	All (on-site & remotely)
2:00 PM	Joint SubGroup Break-Out (M. Patel, B. Cummings, B. Enayati) • VII. Ride-Through Capability Requirements • VIII. Ride-Through Performance Requirements • IX. IBR Protection	SubGroup VI. Power Quality Break-Out (R. Guttromson) - tentative • VII. Ride-Through Capability Requirements • VIII. Ride-Through Performance Requirements
3:15 PM	Break	
3:45 PM	(cont.)	(cont.)
5:00 PM	Adjourn	

Presentation of definitions developed in SG1+2

- Refer to Word file on iMeet [here](#).

- *The updated has been posted to iMeet [here](#).*

Test & verification requirements in P2800 vs. P2800.1

	P2800	P2800.1
1) Any **performance requirement** that can be verified *with any of the verification methods below**	X	
2) For each performance requirements from 1), specify <u>**which**</u> **verification method*** shall be used ▪ *Current practice for BPS-resources is verification of performance by post-event analysis* ▪ *SubGroup XI. (Tests and verification requirements) to start with a structure similar to Tables 43 and 44 in IEEE 1547-2018 but need to add additional column(as) as needed. See next slide for details.*	X	
3) For each performance requirement from 1), specify guidelines for detailed **verification procedures** (step-by-step instructions) regarding <u>**how**</u> to conduct the required verification method* ▪ *SubGroup XI. (Tests and verification requirements) to start with P1547.1 Draft 9.6 (Recirc 2)*		X

*** *Potential Verification methods*
- Type Tests (NRTL, manufacturer)
- Production Tests (manufacturer)
- IBR Evaluations (IBR developer and/or TEPS operator)
  - *Need to decide whether modeling will be a "shall" or a "may" requirement in P2800.*
  - *Could specific be included as a recommended practice in an P2800 appendix?*
  - *Guidance on how to use modeling for verification purposes could be given in P2800.1.*
- Commissioning Tests
  - *May include post-interconnection measurements if a "Conditional Permission to Operate" has been issued*
- Periodic Tests (Lifecycle, Major Changes)
- *Post-Event Analysis (use of digital fault recordings, need to define what to measure)*

Examples from Clause 11 of IEEE 1547-2018

Modeling?

Requirement	Compliance at PCC achieved by:	Type tests	IBR evaluation	Commissioning tests
6.4 Voltage				
6.4.1 Mandatory voltage tripping requirements	DER System	R	Design: R[a] Installation: R[b]	D
	Composite	L	Design: R[a] Installation: R[b]	D
6.4.2.1 General requirements and exceptions	DER System	R	R	D
	Composite	L	R	D[a]
6.4.2.2 Voltage disturbances within continuous operation region	DER System	R	Design: R[a] Installation: R[b]	D
	Composite	L	R	D[a]

■ Review Tables 43 and 44 of IEEE Std 1547™-2018 as needed: **R**equired; **L**imited; **D**epends