



# Update on Accelerating Systems Integration Standards (ACCEL) Revisions to IEEE 1547/IEEE 1547.1/UL 1741

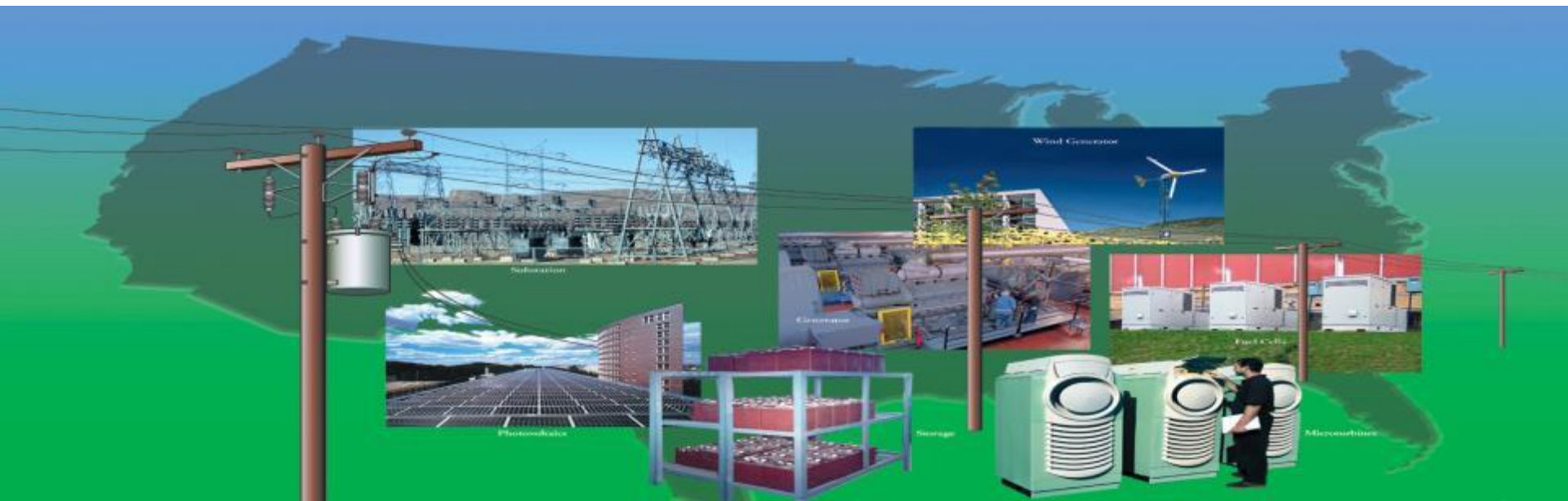
Bri-Mathias Hodge for Dave Narang

SunShot National Laboratory Multiyear Partnership (SuNLaMP) Workshop  
Argonne National Laboratory, Chicago  
July 21, 2017

# Disclaimer

*This presentation and discussion here on IEEE P1547 are the individual's views and are not the formal position, explanation or position of the IEEE.*

- Energy Policy Act (2005) Cites and requires consideration of IEEE 1547 Standards and Best Practices for Interconnection; all states use or cite 1547.
- Energy Independence and Security Act (2007) IEEE cited as a standards development organization partner to NIST as Lead to coordinate framework and roadmap for Smart Grid Interoperability standards and protocols {IEEE 1547 & 2030 series being expanded};
- Federal ARRA (2009) Smart Grid & High Penetration DER projects {*use IEEE stds*}.

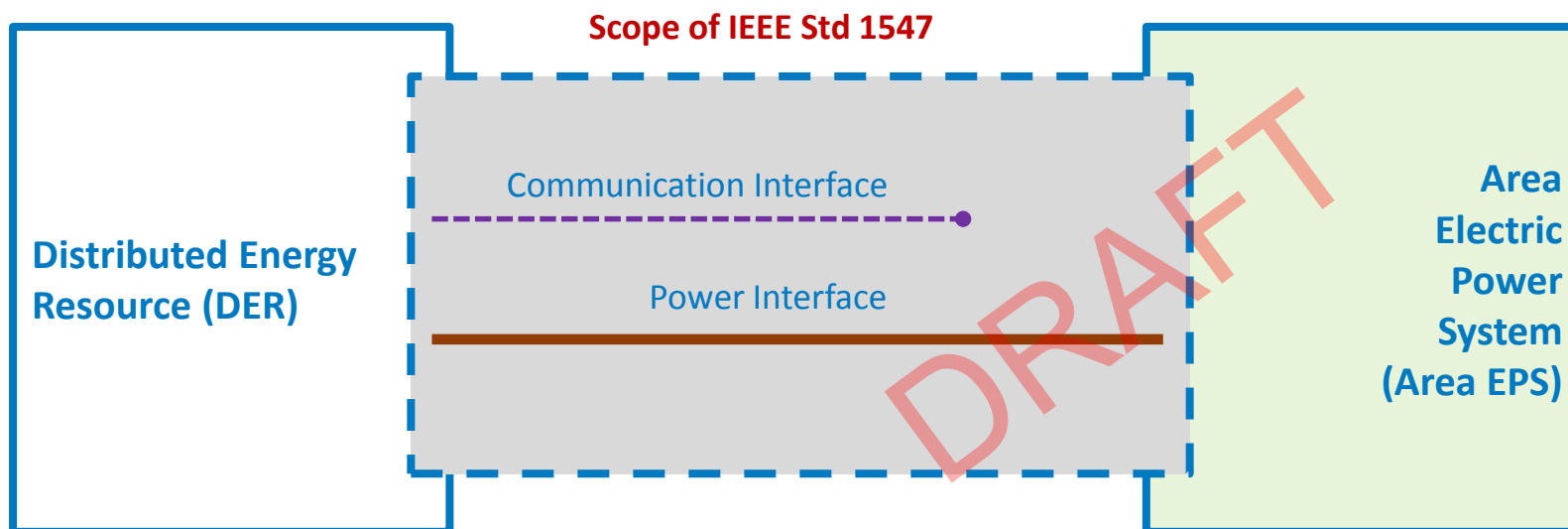


# IEEE 1547: Interconnection is the Focus

## IEEE Std 1547 covers:

- INTERCONNECTION TECHNICAL SPECIFICATIONS & REQUIREMENTS
- INTERCONNECTION TEST SPECIFICATIONS & REQUIREMENTS

## Interconnection System



**Note: P1547 full revision started in year 2015 is also addressing interoperability and interfaces**

**interconnection system:** The collection of all interconnection equipment and functions, taken as a group, used to interconnect DER to an Area EPS.

NOTE—Besides the power interface, DER shall have a communication interface.

**interface:** A logical interconnection from one entity to another that supports one or more data flows implemented with one or more data links

**interoperability:** The capability of two or more networks, systems, devices, applications, or components to externally exchange and readily use information securely and effectively.



# IEEE 1547 Standards Example Use in USA<sup>5</sup>

## **IEEE 1547** **Interconnection System and Test Requirements**

- Voltage Regulation
- Grounding
- Disconnects
- Monitoring
- Islanding
- etc.

## **IEEE 1547.1** **Interconnection System Testing**

- O/U Voltage and Frequency
- Synchronization
- EMI
- Surge Withstand
- DC injection
- Harmonics
- Islanding
- Reconnection

## **UL 1741\*** **Interconnection Equipment**

- 1547.1 Tests
- Construction
- Protection against risks of injury to persons
- Rating, Marking
- Specific DR Tests for various technologies

## **NEC \*\***

Article 690 PV Systems;

Article 705: interconnection systems (shall be suitable per intended use per UL1741)

## **PJM Interconnection, Inc.** ***Small Generator Interconnection Standards*** **FERC approved**

*(0-to<10MW and 10-to-20 MW;  
incorporate 1547 and 1547.1)*

\* UL 1741 supplements and is to be used in conjunction with 1547 and 1547.1

\*\* Articles: 480 Storage Batteries ;  
692 Fuel Cell Systems;  
694 Wind Electric Systems  
(NEC info. based on NEC 2011)

## IEEE 1547 IS:

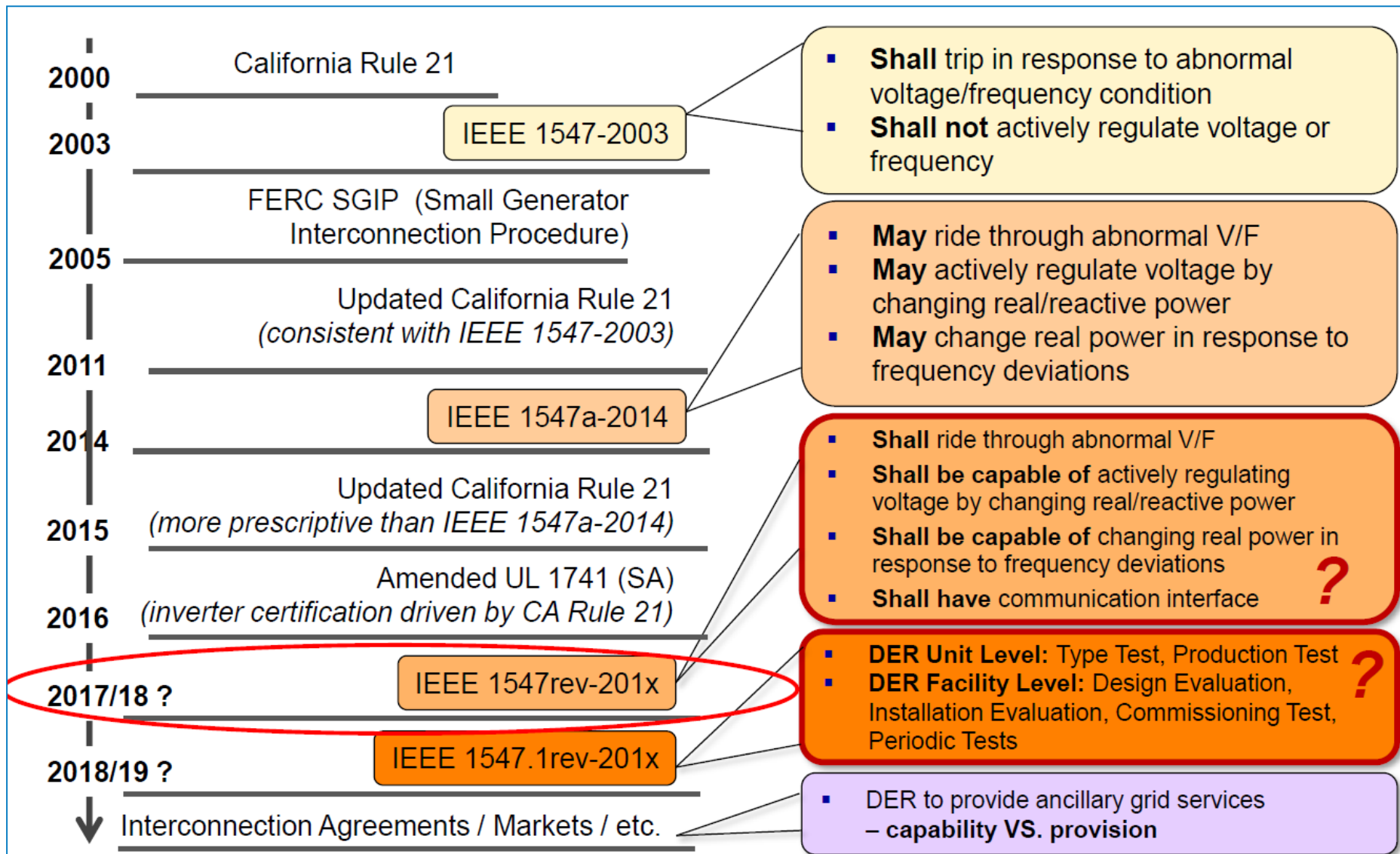
- A Technical Standard – Functional Requirements at the PCC
- Technology neutral, e.g., does not specify particular equipment nor type
- A single (whole) document of mandatory, uniform, universal, requirements that apply at the PCC.
- Should be sufficient for most installations.

## IEEE 1547 **Is NOT:**

- A design handbook
- An application guide
- An interconnection agreement
- Prescriptive, e.g., does not address DR self-protection, nor planning, designing, operating, or maintaining the Area EPS.

IEEE 1547.1 is: Test Procedures for Conformance to 1547

# IEEE 1547: Timeline of Major Changes



Graphics source: EPRI

# Timeline of P1547 Formation

May 2012	P1547 workshop, input from industry, introduce thirty six topics for consideration
March 2014	P1547 PAR approved
November 2014,	WG meeting, coalesce filtered subset of topics into 6 subgroups for action
February 2017,	WG meeting, draft revision content stable, WG vote and final refinements before balloting

Over **121 industry experts** on the working group have been meeting via phone weekly for over a year to develop consensus language and the working group has had ten face-to-face meetings. Through their dedicated efforts, we are now in the balloting stage.



**Title:** *Draft Standard for Interconnection **and Interoperability** of Distributed **Energy** Resources with **Associated** Electric Power Systems **Interfaces***

**Scope:** This standard establishes criteria and requirements for interconnection of distributed **energy** resources (DER) with electric power systems (EPS), **and associated interfaces**.

**Purpose:** This document provides a uniform standard for the interconnection **and interoperability** of distributed **energy** resources (DER) with electric power systems (EPS). It provides requirements relevant to the interconnection **and interoperability** performance, operation, and testing, and, safety, maintenance **and security considerations**.

# Organization of IEEE P1547 Working Group

Scope	Subgroup Lead, (WG Vice Chair)	Alt. Lead	Facilitator(s)
Overall Document	D. Narang, NREL, <b>WG Chair</b>	J. Boemer, EPRI	J. Boemer, EPRI
Voltage regulation	B. Enayati, National Grid <b>WG Vice Chair</b>	J. Berdner, Enphase	A. Huque, EPRI
Response to abnormal grid conditions	J. Berdner, Enphase <b>WG Vice Chair</b>	B. Enayati, National Grid	J. Boemer, EPRI R. Walling, WES
Interoperability & Communication	B. Fox, SUNSPEC <b>WG Vice Chair</b>	B. Seal, EPRI	F. Cleveland W. Stec (Distregen)
Special Interconnections, islanding, microgrids, storage, etc.	C. Vartanian, MEPPI <b>WG Secretary</b>		L. Casey, Google M. Ropp, NPPT M. Coddington, NREL D. Mungovan, ConEd R. Bravo, SCE
Interconnection/Interoperability Test Specifications and Requirements, Modeling and Simulation	M. Siira, Comrent <b>WG Vice Chair</b>	W. Stec (Distregen)	W. Stec M. Ropp, NPPT J. Piekarz, NG
Power quality, Area EPS microgrids	B. Enayati, National Grid		Chris Rowe, Enphase

# Major 1547 Revision Achievements Include

- **Performance categories**
  - Gives flexibility to accommodate different DER futures
- **More coordinated operation under normal conditions**
  - Many new details on reactive power capabilities and voltage/power control requirements (not just allowance)
- **Grid support under abnormal conditions**
  - Maintains distribution grid safety (cease to energize, trip on voltage or frequency when necessary)
  - Maintains bulk power system reliability (rides through voltage and frequency disturbances)
- **New guidance for interoperability**
  - Starts us on the path to more open communications
  - Seeks to strike a balance between varying topologies & needs
- **New guidance for intentional islands**
  - Much needed and immediate relevance
- **Testing requirements completely revised to address new capabilities**
  - Strikes a balance between needs for large and small installs

# Current Status – Initial Ballot Comment Resolution

Results of P1547 initial Sponsor Ballot		
votes	total votes	313 (80%)
	affirmative	225 (78%)
	negative with comments	63
	abstentions	21 (6%)
comments	total comments to date*	approx 1500
	editorial	~670
	technical	~620
	general	~170
	"must be satisfied"	~630
*May receive more comments in public review period		

**Initial ballot** – ended June 18 with required approval percentage – what does that mean?

- All portions of document without comments are considered “approved” as of the June 18 close date
- Recirculation is mandatory because comments need to be reviewed and addressed

Current Timeline:

[http://grouper.ieee.org/groups/scc21/1547\\_revision/docs/1547-Revision-Milestone-Schedule.pdf](http://grouper.ieee.org/groups/scc21/1547_revision/docs/1547-Revision-Milestone-Schedule.pdf)

# IEEE 1547.1 Revision Status

## **P1547.1 Working Group is drafting a revision to IEEE 1547.1-2005.**

- Content: Test procedures to **validate conformance to IEEE P1547**
- Some tests may not change substantially
  - Voltage and frequency trips, synchronization
- Some tests will be updated
  - Unintentional islanding, harmonics
- New tests will be added:
  - Transient overvoltage (TrOV; load rejection overvoltage)
  - Temporary overvoltage (TOV; ground fault overvoltage)
  - Voltage regulation (volt-var, volt-watt, etc); Frequency support (frequency-watt)
  - Voltage and frequency ride-through (VRT, FRT)
- **Major addition:** Many new DER evaluation and commissioning test procedures
- What tests/evaluations apply to a given DER depend on kVA capacity, embedded load, and whether the DER is a single unit or includes supplemental devices

***As electric grids come to depend on DERs for essential functions and services, more thorough testing and validation are needed.***

- **But must balance this need with burden of testing.**

More information:

[http://grouper.ieee.org/groups/scc21/1547.1\\_revision/1547.1\\_revision\\_index.html](http://grouper.ieee.org/groups/scc21/1547.1_revision/1547.1_revision_index.html)



# For More Information

## General information:

[http://grouper.ieee.org/groups/scc21/1547\\_revision/1547revision\\_index.html](http://grouper.ieee.org/groups/scc21/1547_revision/1547revision_index.html)

## Working Group meeting notes:

[http://grouper.ieee.org/groups/scc21/1547\\_revision/1547revision\\_logistics.html](http://grouper.ieee.org/groups/scc21/1547_revision/1547revision_logistics.html)

[http://grouper.ieee.org/groups/scc21/1547.1\\_revision/1547.1revision\\_logistics.html](http://grouper.ieee.org/groups/scc21/1547.1_revision/1547.1revision_logistics.html)

## Sign up for the P1547 email listserv:

[http://grouper.ieee.org/groups/scc21/1547\\_revision/1547revision\\_listserv.html](http://grouper.ieee.org/groups/scc21/1547_revision/1547revision_listserv.html)

P1547.1 Listserv: [http://grouper.ieee.org/groups/scc21/1547.1\\_revision/1547.1revision\\_listserv.html](http://grouper.ieee.org/groups/scc21/1547.1_revision/1547.1revision_listserv.html)

## Purchase a draft and make comments (till July 18)

<http://publicreview.standards.ieee.org/public-review-web/public-app>

## Contact Working Group Chairs:

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[Andy.Hoke@NREL.gov](mailto:Andy.Hoke@NREL.gov) (P1547.1)

[www.nrel.gov](http://www.nrel.gov)

