IEEE SCC21* Standards

M. Coddington, NREL; **P. McNutt**, NREL;
T. Basso, NREL** and IEEE SCC21 Secretary; and
R. DeBlasio, NREL and IEEE SCC 21 Chair

Solar America Board for Codes and Standards
National and International Standards Panel
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* Institute of Electrical and Electronic Engineers (IEEE) Standards Coordinating Committee 21 (SCC21)

** National Renewable Energy Laboratory (NREL):

- Field Lead for Solar Codes and Standards - DOE Market Transformation;
- Interconnection Engineering and Standards for NREL Distributed Energy and Electricity Reliability (DEER) Program under DOE Office of Electricity Delivery and Energy Reliability.

IEEE Standards Coordinating Committee 21

SCC21 *Fuel Cells, Photovoltaics, Dispersed Generation, & Energy Storage*

Scope. SCC21 Oversees the development of standards in the areas of Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage, and coordinates efforts in these fields among the various IEEE Societies and other affected organizations to ensure that all standards are consistent and properly reflect the views of all applicable disciplines.

Purpose. SCC21 reviews all proposed IEEE standards in these fields before their submission to the IEEE-SA Standards Board for approval and coordinates submission to other organizations.

IEEE SCC21 Standards Development

- **IEEE American National Standards (IEEE/ANSI)** -- national consensus standards established via industry driven partnerships; balanced stakeholder participation.
- **IEEE SCC21** – sponsors and develops standards: Chair - R. DeBlasio (also IEEE Standards Board Liaison to DOE).
- **Harmonization of IEEE SCC21 national** and international standards; International Electro-technical Commission **IEC/IEEE dual logo arrangement** for IEC to adopt IEEE standards, **e.g**., discussion on IEEE 1547 as dual logo with **IEC TC 8 *System Aspects of Electrical Energy Supply***: TC8 facilitates functioning of electricity supply systems – encompasses T&D including interfaces with users (US/TAG/TC8 and Co-Technical Advisors -- J. Koepfinger and T. Basso).

IEEE SCC21 Photovoltaic (PV) Standards

http://grouper.ieee.org/groups/scc21/pv/index.html

- IEEE 1526 (2003) Recommended Practice For Testing the Performance of Stand Alone Photovoltaic Systems
- IEEE 937 (2007r) Recommended Practice for the Sizing of Lead-Acid Batteries for Photovoltaic (PV) Applications
- IEEE 1013 (2007r) Recommended Practice for the Installation and Maintenance of Lead-Acid Batteries in PV Applications
- IEEE 1361 (2003) Guide for Selection, Charging, Test and Evaluation of Lead-Acid Batteries Used in Stand-Alone PV Systems
- IEEE 1561 (2007r) Guide for Optimizing the Performance and Life of Lead-Acid Batteries in Remote Hybrid Power Systems
- IEEE 1562 (2007r) Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems
- IEEE 1661 (2007r) Guide for Test and Evaluation of Lead-Acid Batteries Used in PV Hybrid Power Systems

IEEE SCC21 1547 Series of Interconnection Standards

IEEE Std 1547™ (2003) Standard for Interconnecting Distributed Resources with Electric Power Systems

P1547.6 Draft Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks

Guide for Impacts

P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

IEEE Std 1547.3™ (2007) Guide for Monitoring, Information Exchange and Control of DR Interconnected with EPS

Guide For Interconnection System Certification

P1547.2 Draft Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE Std 1547.1™ (2005) Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

P1547.5 Draft Technical Guidelines for Interconnection of Electric Power Sources Greater Than 10 MVA to the Power Transmission Grid

DP Specifications & Performance (includes modeling)

(publication year in parentheses; P1547.X are under development; other topics are under consideration by SCC21 work group members)

EPACT 2005 Cites & Requires IEEE Stds 1547
And Best Practices for Interconnection Implementation
IEEE 1547 Developed By National Team of 444 Professionals

UL 1741: UL Standard for Safety for *Inverters, Converters, Controllers and Interconnection Equipment for Use With Distributed Energy Resources*.

- NREL contracted UL to update 1741 (2005) to include all DR interconnections.
- For utility interactive equipment, **UL 1741** supplements and is to be used in conjunction with **IEEE 1547** and **IEEE 1547.1**;
  - Construction, Materials, wiring, component spacing, etc.
  - Protection against risks of injury to persons
  - Output Characteristics and utility compatibility

    (This section includes requirements from IEEE 1547)
  - Rating, Marking
  - Specific DR Tests for various technologies

    (PV, Wind, Microturbine, Fuel Cell, Engine)

What are Today's Interconnection Standards? (at the distribution level)

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 - UL1741)

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

Renewable Systems Interconnection Reports

http://www1.eere.energy.gov/solar/solar_america/rsi.html

- Distributed PV Systems Design & Technology Requirements
- Advanced Grid Planning and Operation
- Utility Models, Analysis, and Simulation Tools
- Cyber Security Analysis
- Power System Planning: Emerging Practices (Evaluating Impact of High-Penetration Photovoltaics)
- Distribution System Voltage Performance Analysis for High-Penetration Photovoltaics
- Enhanced Reliability of PV Systems with Energy Storage and Controls
- Transmission System Performance Analysis for High-Penetration PV
- Solar Resource Assessment
- Test and Demonstration Program Definition
- Photovoltaics Value Analysis
- Photovoltaics Business Models

RSI Study C&S Recommendations

- Enable coordinated operation of all equipment on the distribution feeder. (The same infrastructure then enables demand-side management, implements flexible metering tariffs, and enhances distribution system management.)
- Establish recommended practices for modeling high penetration, intermittent renewable energy power sources and energy storage systems embedded in the distribution system.
- Develop consensus best practices that facilitate T&D system planning and operation for grid modernization, which includes provision for greater deployment of renewable energy systems.
- Develop recommendations for consideration by electricity regulators on net metering and rate structures, microgrids, and impact study requirements.
- Improve methods and agreements for local siting, permitting, and inspection of PV systems.

Approach to Meeting C&S Concerns and Needs

Codes & Standards: consider the RSI technical concerns and solutions to establish C&S universal requirements to facilitate high penetration PV deployment. For example pursue C&S related to:

- Interoperability;
- Modeling and Simulation;
- System Impact;
- System Protection and Coordination;
- Voltage Regulation;
- Grid Planning;
- Operations;
- Reliability
- etc.

Energy Independence and Security Act 2007

SEC. 1305. Smart Grid Interoperability Framework.

(a) Interoperability Framework - The Director of the National Institute of Standards and Technology shall have primary responsibility to coordinate the development of a framework that includes **protocols and model standards** for information management **to achieve interoperability** of smart grid devices and systems. Such protocols and standards shall further align policy, business, and technology approaches in a manner that would enable all electric resources, including demand-side resources, to contribute to an efficient, reliable electricity network. In developing such protocols and standards--

(1) the Director shall seek input and cooperation from the Commission, **OEDER** and its Smart Grid Task Force, the Smart Grid Advisory Committee, **other relevant Federal and State agencies**; and

(2) the Director shall also solicit input and cooperation from private entities interested in such protocols and standards, including but not limited to the Gridwise Architecture Council, the **Institute of Electrical and Electronics Engineers**, the National Electric Reliability Commission recognized by the Federal Energy Regulatory Commission, and National Electrical Manufacturer's Association.

IEEE Point of Contact for Smart Grid

IEEE Standards Board appointed Mr. Richard DeBlasio as point of contact for IEEE standards for NIST Team developing interoperability framework.

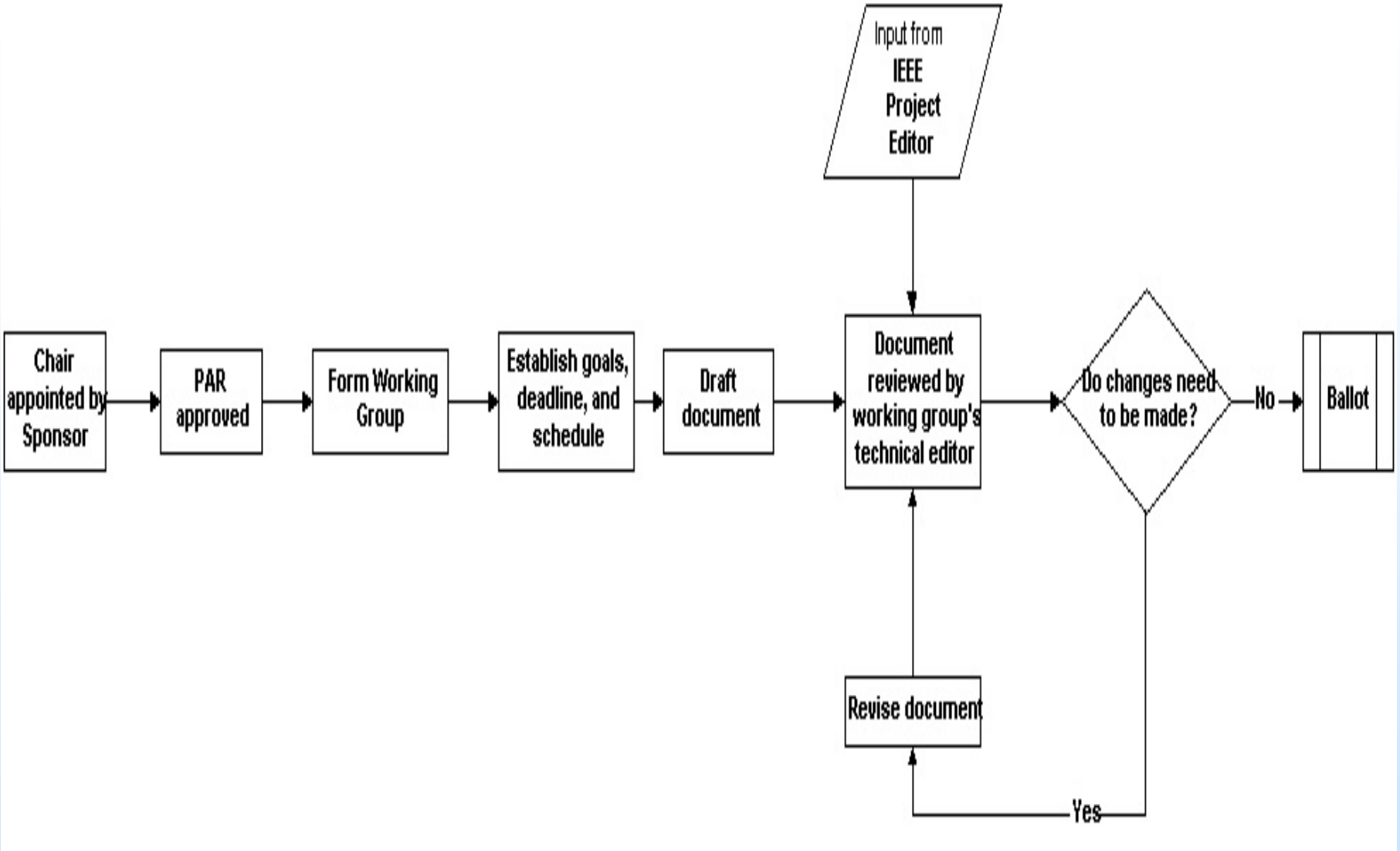
Mr. DeBlasio will lead IEEE interactions on behalf of IEEE Standards Association and, will coordinate with all IEEE groups developing standards and with the IEEE Standards Board.

Additionally, Mr. DeBlasio is the IEEE Standards Association Standards Board Member serving as the U.S. DOE Liaison and he is also the SCC21 Chair.

SCC21 Current Activities and Projects

- IEEE P1547.2 Draft Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems
- IEEE P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems With Electric Power Systems
- IEEE P1547.5 Draft Technical Guidelines for Interconnection of Electric Power Sources Greater than 10MVA to the Power Transmission Grid
- IEEE P1547.6 Draft Recommended Practice For Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks

Development of the Draft Standard



IEEE Standards Coordinating Committee 21

Participate in SCC21 standards development:

- Attend standards working group meetings (SCC21 URL),
- Start an SCC21 standards project (e.g., consider a draft title, scope, and purpose) -- contact SCC21 Secretary

SCC21 information:

http://grouper.ieee.org/groups/scc21/index.html

IEEE standards development (e.g., FAQs, etc.):

http://standards.ieee.org/stdsdev/getinvolved.html
http://standards.ieee.org/stdsdev/index.html Tools & Resources
http://www.ieee.org/web/standards/home/index.html
Questions - contact IEEE liaison to SCC21:
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IEEE SCC21 Contact Information

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- **IEEE SCC21 -- IEEE Standards Coordinating Committee 21** on Fuel Cells, Photovoltaics, Dispersed Generation, & Energy Storage
  http://grouper.ieee.org/groups/scc21/
- **IEEE SCC21 PV Battery/Energy Storage Standards –**

http://grouper.ieee.org/groups/scc21/pv/index.html

IEEE Std 1547 Series of Interconnection Standards --
http://grouper.ieee.org/groups/scc21/dr_shared/

IEEE SCC21 PV Standards

Standards Coordinating Committee on Fuel Cells, PV, DG, & Energy Storage

Last WG meeting held August 2007 in Las Vegas

Approximately 10-15 members attend WG meetings.

Regular attendees/contributors include:

Manufacturers: Chuck Finin, Haissam Nasrat, Mike Nispel, Carl Parker, Rob Rallo, Ken Sanders, Steve Vechy

Government: Howard Barikmo, Jay Chamberlin, Tom Hund, Peter McNutt, John Wiles

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Documents Up For Renewal

•IEEE 1361 (2003) Guide for Selection, Charging, Test & Evaluation of Lead-Acid Batteries Used in Stand-Alone PV Systems

beginning to update

•IEEE 1526 (2003) Recommended Practice For Testing the Performance of Stand-Alone PV Systems

IEEE SCC21 PV Standards

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New Documents

•IEEE 1561 (2007) Guide for Optimizing the Performance & Life of Lead-Acid Batteries in Remote Hybrid Power Systems

•IEEE 1562 (2007) Guide for Array & Battery Sizing in Stand-Alone PV Systems

•IEEE 1661 (2007) Guide for Test & Evaluation of Lead-Acid Batteries Used in PV Hybrid Power Systems

IEEE SCC21 PV Standards

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Renewed Documents

•IEEE 937 (2007) Recommended Practice for the Sizing of Lead-Acid Batteries for PV Applications

•IEEE 1013 (2007) Recommended Practice for the Installation & Maintenance of Lead-Acid Batteries in PV Applications

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New Work

Sizing & siting PV arrays for residential grid-tied inverters

- Selecting correct number of modules for inverter
- Derating array for less-than-optimal air flow, tilt & azimuth angles

Design of small, off-grid wind systems (Southwest Wind)