IEEE* American National Standards

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

Solar America Board for Codes and Standards
National and International Standards Panel
October 17, 2008

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* Institute of Electrical and Electronic Engineers (IEEE) Standards Coordinating Committee 21 (SCC21)

** National Renewable Energy Laboratory (NREL) - T. Basso:

- Solar Codes and Standards: NREL DOE Market Transformation;
- Interconnection, Impacts, and Smart Grid Standards: NREL OE (R. DeBlasio NREL program manager for DOE Office of Electricity Delivery and Energy Reliability; and, R. DeBlasio IEEE Smart Grid contact).

IEEE American National Standards Update

IEEE SCC21: *Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage (e.g., 1547 interconnection, PV, etc.):*

- Impacts of grid interconnected distributed resources;
- Photovoltaics (PV) new or expanded standards, e.g., PV system storage-grid-interconnected/etc.
- Power electronics/inverters/etc.

IEEE Smart Grid Interoperability Framework 2007 EISA section 1305: IEEE Standards Board point of contact R. DeBlasio (NREL), e.g., IEEE group formed (Chair DeBlasio).

IEEE Green Standards - Projects Or Proposed (SCC21; EV; SmartGrid):

- PHEV (V2G): Plug-in Hybrid Electric Vehicles (vehicle to grid);
- Industrial eneergy efficiency;

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

IEEE American National Standards in Green Technology

- **Energy - renewables/greener, clean technologies**
  - Published 1547 series for Distributed Resources
  - P1547 ongoing projects, e.g., impacts
  - Published 1680 for Electronic Product Environmental Assessment (EPEAT)
- **New Potential Project Areas**
  - PHEV (plug-in hybrid electric vehicles)
    - Grid interface (SCC21)
    - Batteries
  - Smart Grid
  - Future wind, solar, geothermal, hydro
  - GHG emissions calculations
  - Industrial Energy Efficiency

Smart Grid Interoperability Framework of Standards and Protocols

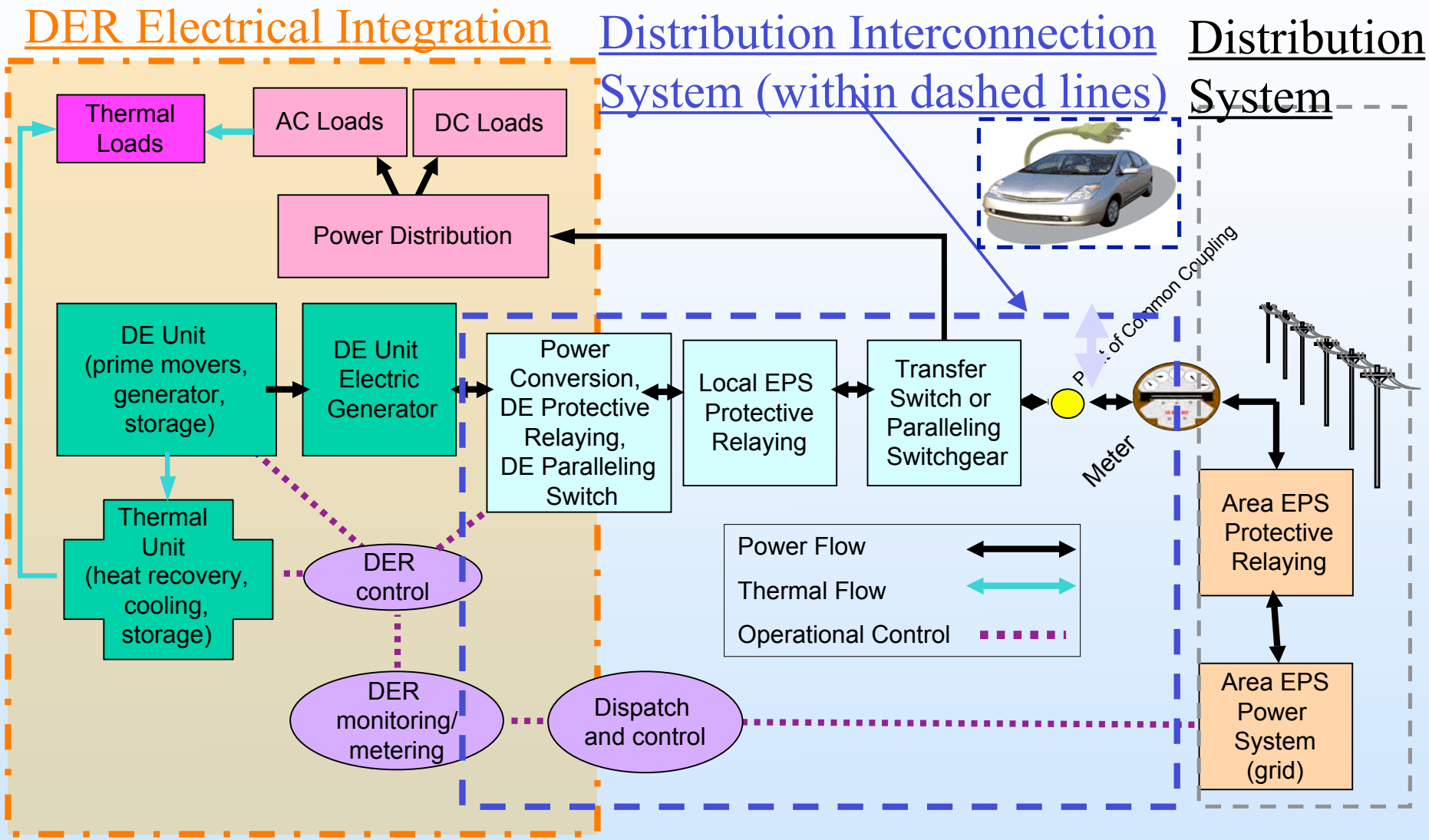
- Energy and Security Independence Act of 2007
- NIST Domain Expert Working Groups (DEWGs)

  to identify use cases, key standards, standards gaps, for inclusion in the future Smart Grid Standards Interoperability Roadmap:

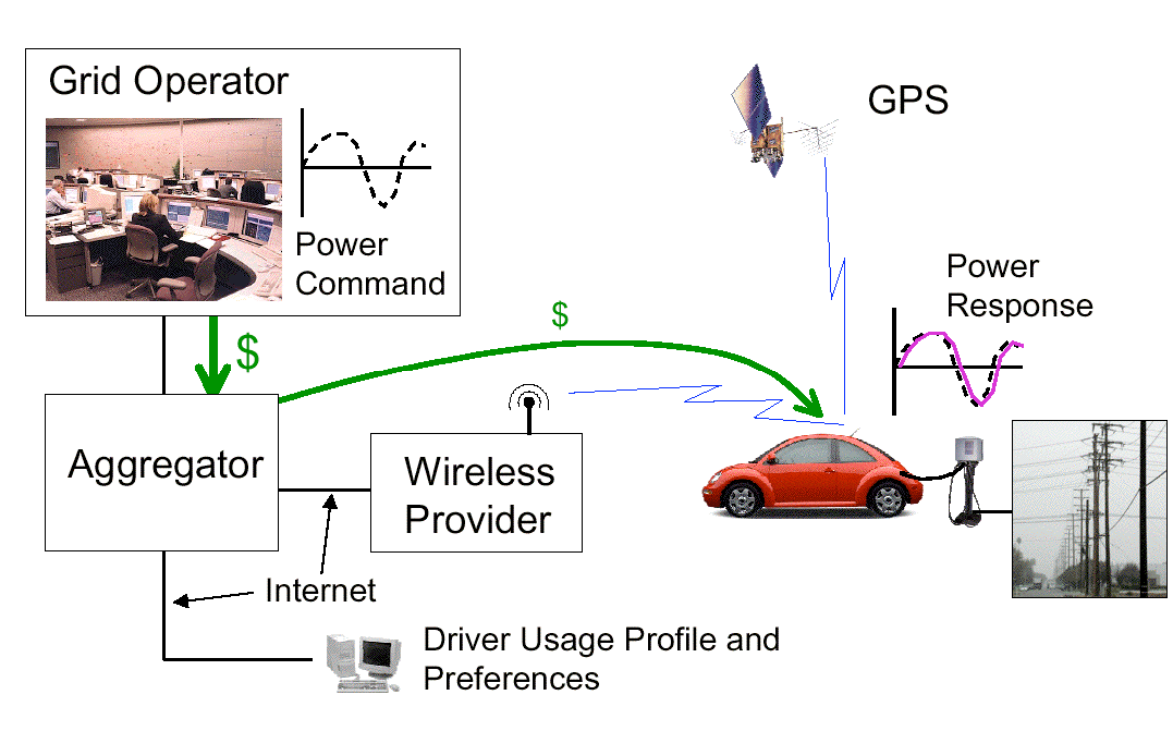
  - Building-to-Grid (B2G)
  - Industrial-to-Grid (I2G)
  - Home-to-Grid (H2G)
  - Transmission and Distribution (T&D)
  - Vehicle to Grid (V2G) - new

Source - NIST EISA Smart Grid Coordination Plan 6/2/08 at http://www.nist.gov/smartgrid/

Interconnectivity – Distributed Generation



PHEV (or V2G – Vehicle to Grid)



What needs to be done in this area:

- Business Cases
- Hardware Requirements
- Communications/ Metering/Billing
- Utility Contracts

Key Enabler: Interconnection Standards

Proposed IEEE PHEV (V2G) standards projects

Potential IEEE and IEEE SCC21 Standards projects for EV Interconnection with the electric grid based on IEEE 1547 as follows:

- **Guide for EV Interconnectivity to the Electric Grid- IEEE P1547.xx**
- **Standard for EV Interconnectivity to the Electric Grid - Functional Requirements - IEEE P1547.xx**
- **Standard for EV Interconnectivity to the Electric Grid - Validation Tests of Functional Requirements - IEEE P1547.xx**

IEEE SCC21 Contact Information (expanded slides follow)

- **Dick DeBlasio* Technology Manager**
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* **NREL** http://www.nrel.gov
1617 Cole Blvd. MS-1614 Golden, CO 80401-3393

- **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 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 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).
- **IEEE Smart Grid** Interoperability Framework (2007 EISA section 1305) point of contact R. DeBlasio.
- **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 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:
William (Bill) Ash 732 465 5828 w.ash@ieee.org

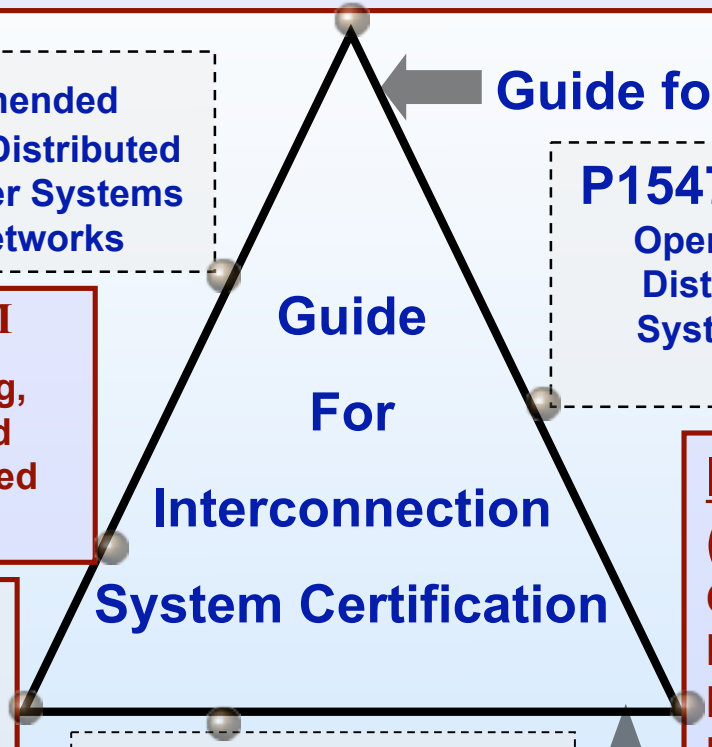
IEEE SCC21 Photovoltaic (PV) Standards

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

- IEEE 1526 reaffirmation due fall 2008 Recommended Practice For Testing the Performance of Stand Alone Photovoltaic Systems
- IEEE 1361 reaffirmation due fall 2008 Guide for Selection, Charging, Test & Eval. of Lead-Acid Batteries Used in Stand-Alone PV 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 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

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

IEEE Std 1547.2™ (2009) Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

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

Guide for Impacts – 2009 start

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

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)

IEEE SCC21 PV Withdrawn Standards

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

- IEEE 928 Recommended Criteria for Terrestrial PV Power Systems
- IEEE 929 Recommended Practice for Utility Interface of PV Systems
- IEEE 1144 Recommended Practice for Sizing Nickel/Cadmium Batteries for Photovoltaic Systems
- IEEE 1145 Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for PV Systems
- IEEE 1262 Recommended Practice for Qualification of PV Modules
- IEEE 1374 Guide for Terrestrial Photovoltaic Power System Safety
- IEEE 1513 Recommended Practice for Qualification of Concentrator PV Receiver Sections and Modules

IEEE SCC21 PV Withdrawn Projects

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

- IEEE P926 Draft Standard for Terrestrial Photovoltaic Systems Power Test and Power-Energy Performance Ratings
- IEEE P927 Interim Recommended Practice for Terrestrial Photovoltaic Systems Electrical Power/Energy Performance Calculations
- IEEE P1146 Draft Recommended Practice on Grounding of Batteries and Battery Subsystems in PV Systems
- IEEE P1479 Draft Recommended Practice for the Evaluation of Photovoltaic Module Energy Production
- IEEE P1611 Draft Recommended Practice for Characterizing Solar Tracker Controllers Used for Solar Electric Systems

IEEE SCC21 Wind Energy Withdrawn Stds

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

- IEEE 1021 Recommended Practice for the Utility Interconnection of Small Wind Energy Conversion Systems - Withdrawn 5/96
- IEEE 1035 Recommended Practice: Test Procedure for Utility-Interconnected Static Power Converters - Withdrawn 5/95
- IEEE 1094 Recommended Practice for the Electrical Design and Operation of Wind-farm Generating Stations - Withdrawn 1/97

IEEE SCC21 Dispersed Energy and Generation Facilities Withdrawn Standard

- IEEE 1001 IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems - Withdrawn 5/96