



**Electricity, Resources,  
& Building Systems  
Integration**

# Update on IEEE Interconnection Standards and Procedures Development



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**UWIG Solar Users  
Group Workshop**

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NREL is a national laboratory of the U. S. Department of Energy,  
Office of Energy Efficiency and Renewable Energy, operated by  
the Alliance for Sustainable Energy, LLC.

# IEEE SCC21 (Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage)

## Published Standards in 2011

IEEE 1547.4 – Planned Island Systems

IEEE 1547.6 – Secondary Network Distribution Systems

IEEE 2030 – Smart Grid Interoperability

## Standards Under Development

IEEE P1547.7 - Impact Studies

IEEE P1547.8 – Expanded Use of IEEE 1547

# IEEE 1547.4

## Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

Purpose “...The document is intended to provide an introduction, overview and address engineering concerns of DR island systems. It is relevant to the design, operation, and integration of DR island systems...”



Published 2011

# IEEE 1547.6

Draft Recommended Practice For Interconnecting  
Distributed Resources With Electric Power Systems  
Distribution Secondary Networks

## Purpose

“This standard focuses on the technical issues associated with the interconnection of Area EPS distribution secondary networks with a Local EPS having DR generation. The standard provides recommendations relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection....”

Published 2011

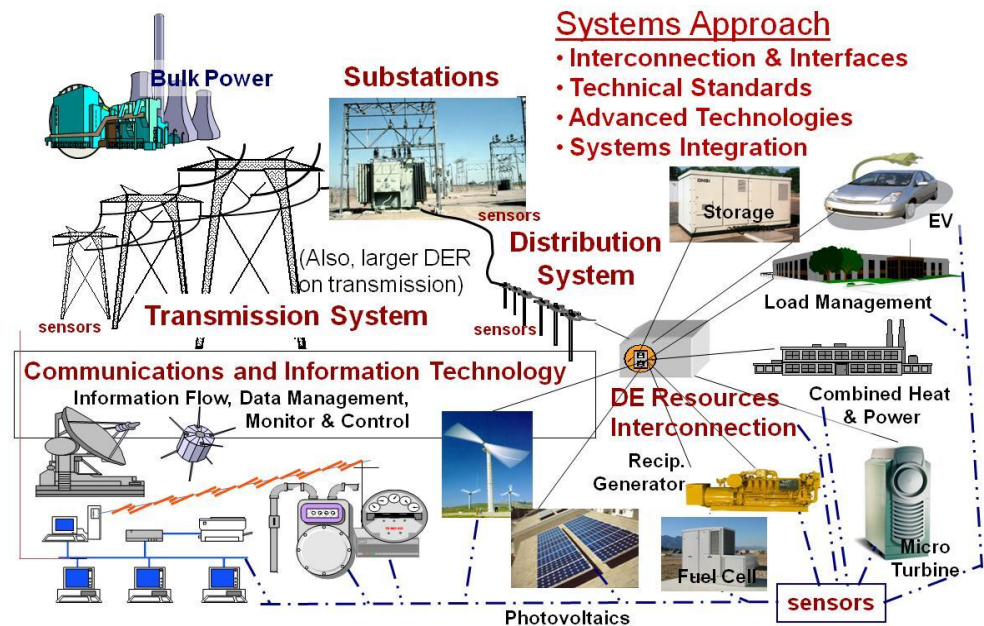
# IEEE 2030

## Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads

### Purpose

“This standard provides guidelines in understanding and defining smart grid interoperability of the electric power system with end-use applications and loads. ...”

Published 2011



# IEEE P1547.7

## Draft Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection

### Purpose

“..... a described methodology for when distribution system impact studies are appropriate, what data is required, how they are performed, and how the study results are evaluated. In the absence of such guidelines, the necessity and extent of DR interconnection impact studies has been widely and inconsistently defined and applied.”

Going to Ballot 2012?

# Major Study Types

- Power Flow
- Short Circuit
- Power Quality
  - Harmonic Analysis, Flicker, Ferroresonance
- Quasi-Static
- Dynamic Stability
- Transient Stability

# IEEE P1547.7 - Impact Studies Focus

- Voltage Regulation Schemes
- Unintentional Islanding Prevention
- False Inverter Trips Due to Utility Line Transients
- Reactive Power (VAr) Control Schemes for Multiple Inverters
- Fault Contribution from PV Systems (inverters)
- Coordinated Protection and Operations of Protection Equipment
- Effects of Variable Cloud Cover on System Stability
- Use of Balancing Resources – Demand Response
- Reverse Power Flow in Secondary Networks

# IEEE P1547.8

“Recommended Practice to Expand The Usefulness And Utilization Of IEEE Std 1547”

## Overview of P1547.8

- Guide will reflect IEEE 1547 clauses
- Focus on High Penetration PV (and other DG)
- Intent is to make DG systems “Utility Friendly”
- Solutions should incorporate advanced functionality inverters

# Topics of Focus for P1547.8

- Voltage Regulation
- Monitoring & Communications
- Response to Area EPS Abnormal Conditions
- Power Quality
- Coordination with NEC and UL 1741
- Optimizing Group Behavior of DG
- DR Requirements to “See” Fault Conditions
- Additional Data Requirements
- DG Greater than 10 MW (< 20MW)

# New Challenges for PV Interconnection

- There has been a large increase in the number of PV interconnection requests to utilities
- Utilities need to be able to screen out systems that will not have an impact on grid operations
- A more rigorous screening method is needed that produces an expedited interconnection process

Higher penetrations, higher volume

# Revised Screening Metrics Need a Technical Focus

- **Equipment Ratings** – new DG cannot exceed voltage or current ratings of existing equipment
- **Voltage Regulation** - impact on current voltage regulation scheme and abilities of DG
- **Fault Currents and Protection** – impact on existing protection scheme
- **Overvoltages** – DG does not cause overvoltages for faults and/or disconnects
- **Islanding** – needs to protect from unintentional islanding

# NREL/SNL/EPRI's Joint Whitepaper

Tentative proposal:

- Short term – Are current screening penetration limits technically justified?
- Medium term – Develop new metrics to identify PV interconnections that will not impact the distribution system
- Long term – IEEE 1547.8 certified equipment, grid interactive inverters, etc.

Current Hi-Pen Projects



# Timeline for Interconnection Improvements

2010

- Current Rule 21 and WDAT Process

2011

- Updated screening methodology allows current technology

2013

- IEEE 1547.8 certified equipment – advanced functionality to ease interconnections

201?

- Inverters communicate to utility upon interconnection and operate in a planned manner

Thank you for your attention.



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