



Implementing IEEE 1547 As A Regional Interconnection Standard

Prepared by

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NREL Contract 55152-01**

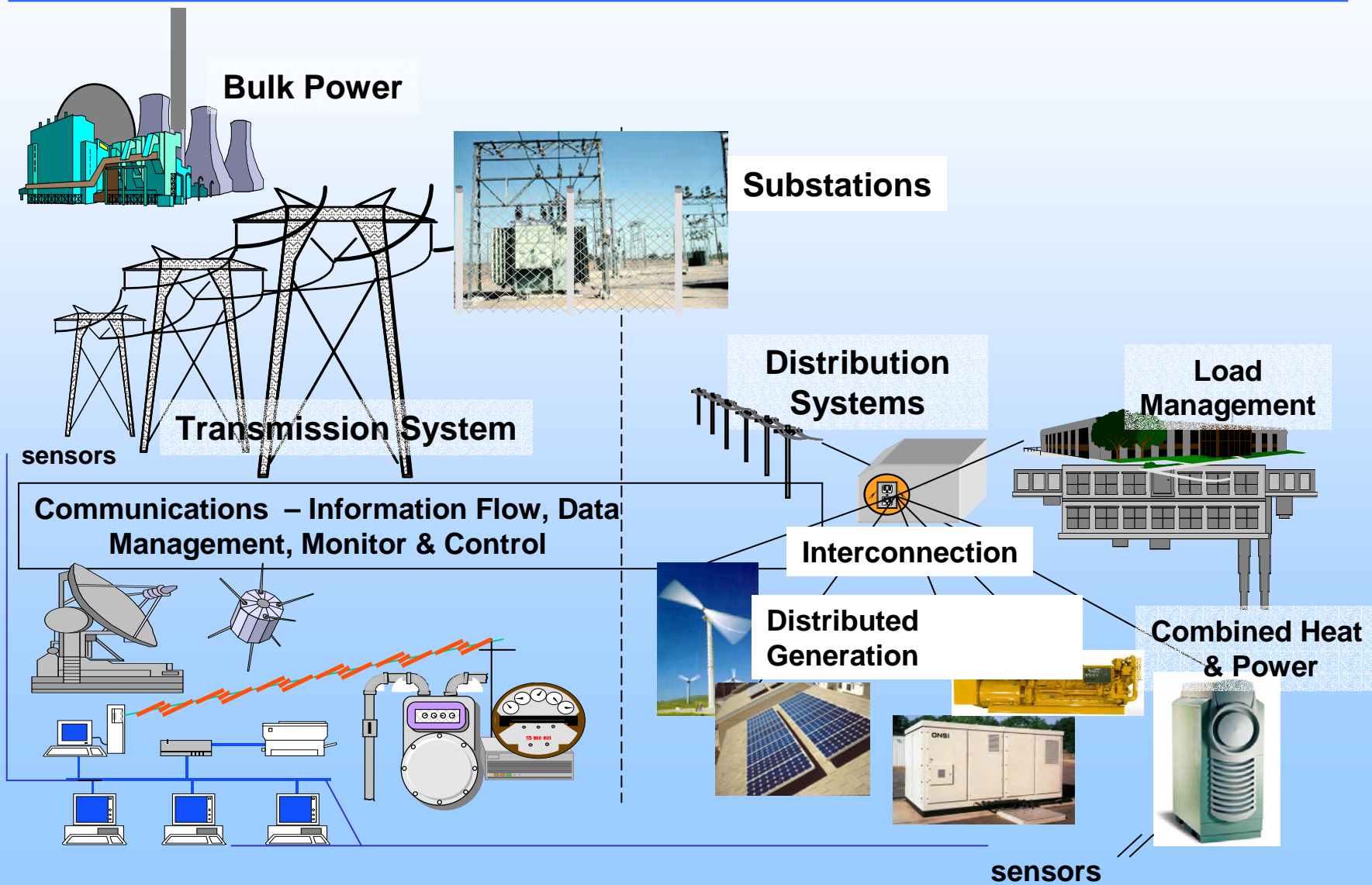
And

Tom Basso – NREL PI & Contract Technical Monitor

**Presented at US DOE Office of Electricity and Energy
Assurance (OEEA)**

**Electric Distribution R&D Program & Peer Review
April 19, 2005 Atlanta GA**

Low Cost, Safe, Interconnection is Key to Grid Modernization Using DG





Interconnection Practices Have Been a Barrier For DG

- Requirements vary from utility to utility
- Requirements not transparent
- Requirements not uniformly applied
- As a result, it has been difficult and costly for DG manufacturers and project implementers to comply

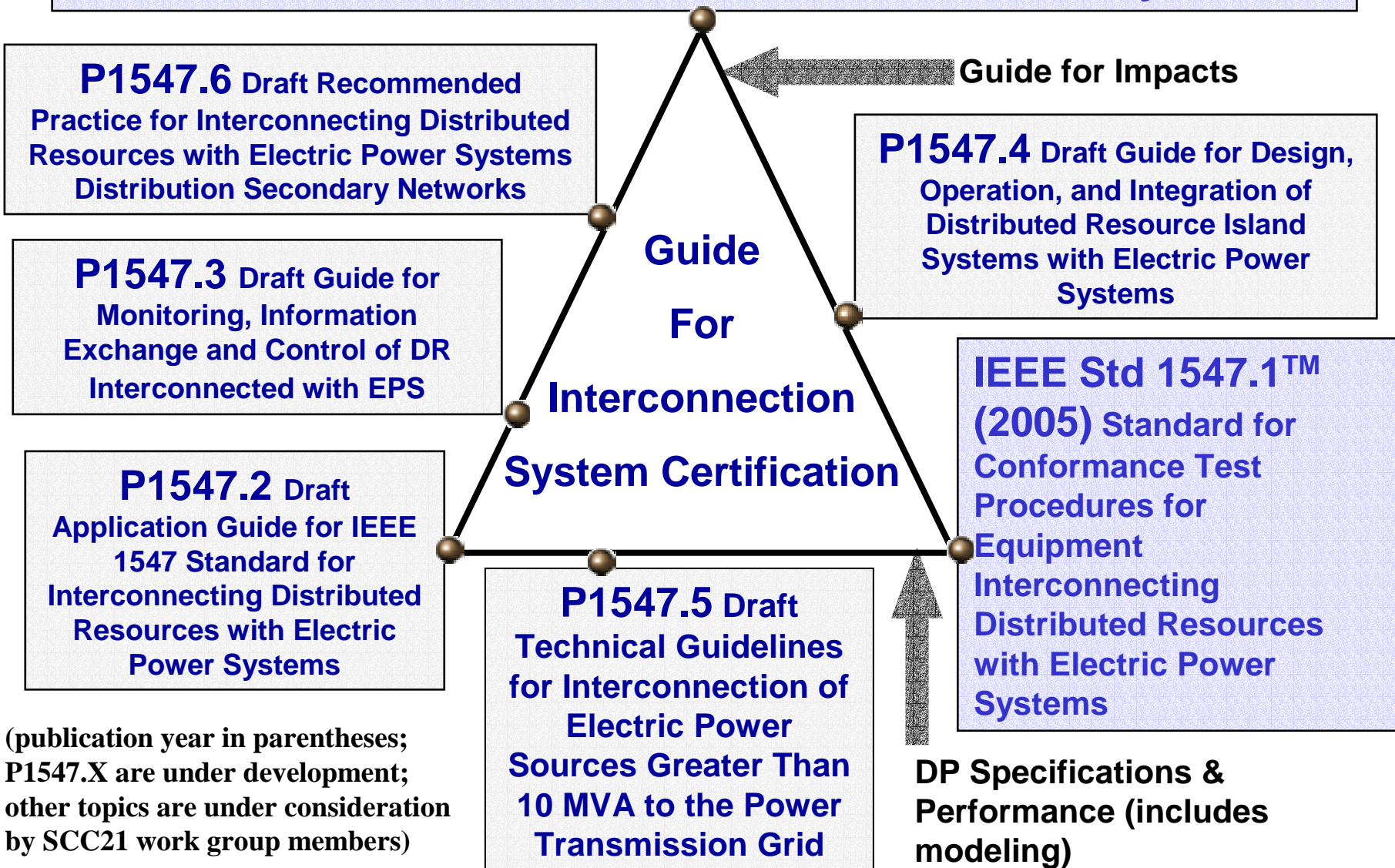


IEEE 1547 Interconnection Standards Will Help

- IEEE began work in 1999 to develop a consensus interconnection standard that could be used nationwide
- IEEE 1547 published in July of 2003
 - Technical requirements for systems < 10 MW
 - Test requirements
- IEEE 1547 developers identified additional standards needs and other issues
 - Series of 1547.X Standards
 - Federal/State Implementation (rules/procedures)

IEEE SCC21 1547 Series of Interconnection Standards

IEEE Std 1547™ (2003) 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)

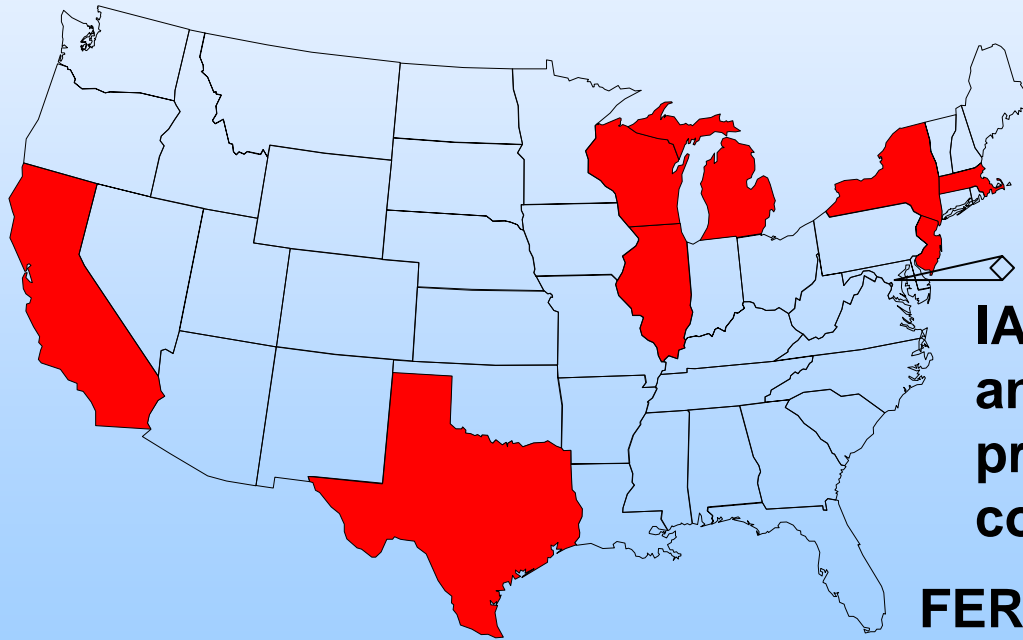
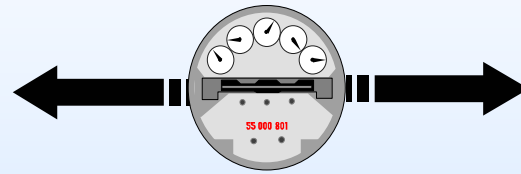
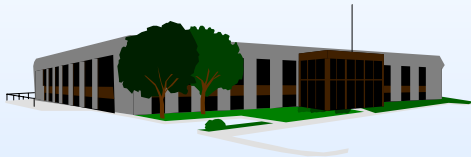


IEEE 1547 Standards Take Us A Long Way, But ...

- No national mandate for implementation
- Utilities are not required to develop interconnection standards based on 1547
- Different ways of implementing IEEE 1547
- How do you ensure quality and consistency?
 - Incorporate or Mandate 1547 standards
 - Certification of Equipment based on 1547
 - Standardized Interconnection Rules/Procedures



States (in red) and Other Jurisdictions with Interconnection Mandates



IA, ME, MN, NJ, OR, PA and others are in process or being considered.

FERC, PJM, RTOs/ISOs, and others such as MADRI, are in process or considering interconnection.



PJM Small Generator Interconnection Initiative

- Two Major Goals
 - Standardize interconnection requirements, based on IEEE 1547, throughout PJM business domain
 - Ensure that testing programs are developed to verify compliance with IEEE 1547 requirements
- PJM initiative allows pre-certification
- Technical Support by DOE/NREL



PJM Interconnection

- PJM is a regional transmission organization (RTO) playing a vital role in the US electric system -- over 80 GW load in PJM.
- PJM ensures the reliability of the largest centrally dispatched control area in North America - all or part of:
Delaware, Illinois, Indiana, Kentucky,
Maryland, Michigan, New Jersey,
Ohio, Pennsylvania, Tennessee,
Virginia, West Virginia and the District of Columbia.



PJM Business Territory





PJM/DOE/NREL Interconnection Strategy: Crawl – Walk - Run

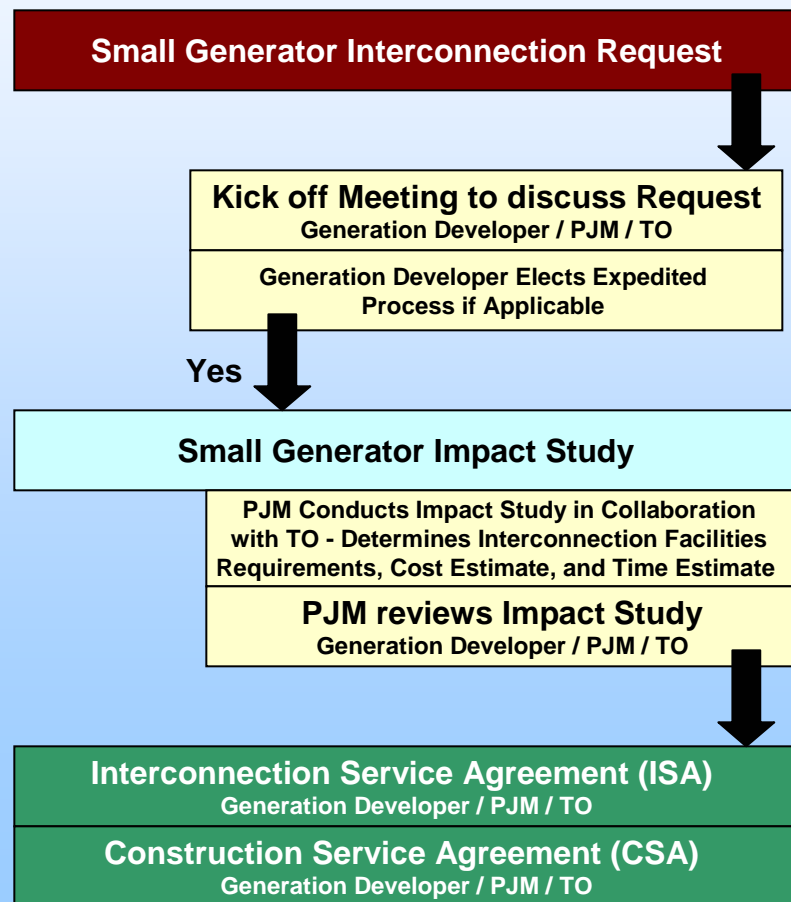
- Develop common technical standard for small generators (<2 MW) for all PJM jurisdictional interconnections; Includes:
 - Approximately 14 transmission owners (TOs)
 - 13 states/45 million people
- Consider 10 MW technical standard after approval of < 2 MW technical standard
- Work with MADRI to get states to adopt new interconnection procedures based on PJM technical standard for 0–10 MW systems
- Coordinate with ongoing certification efforts



Pre-Existing PJM Process Presented Major Challenges

All Interconnection Requests Evaluated Against Individual PJM TO Company Technical Standards

3-way agreement





Review of PJM Members pre-existing Interconnection Stds Revealed Issues

- Side-by-side comparisons difficult
- Not a lot of transparency - many requirements were not well defined
- Some requirements were deemed unnecessary during PJM review
- Not a great deal of consistency with 1547
- Number of stds only partially comply with 1547
- PJM Small Generator Interconnection Working Group - proponents for improvement

Proposal to PJM: NREL Model 1547 Pre-certification & Certification Program for DG Interconnection Systems

DRAFT Design for Utility, State, etc. Certification Interconnection Program

STEP 1

**Interconnection System
Pre-Certified to IEEE 1547**

Type tests in
IEEE 1547.1
satisfied

Pre-Certified to
IEEE 1547

STEP 2

**Interconnection System Meets
IEEE 1547 Requirements**

Certified to IEEE 1547

STEP 3

Interconnection System Installation

Operator Entity Approved

STEP 4

Additional Utility Operator Requirements
e.g., metering, monitoring, construction, etc.

Utility/State/etc. Interconnection System Approved

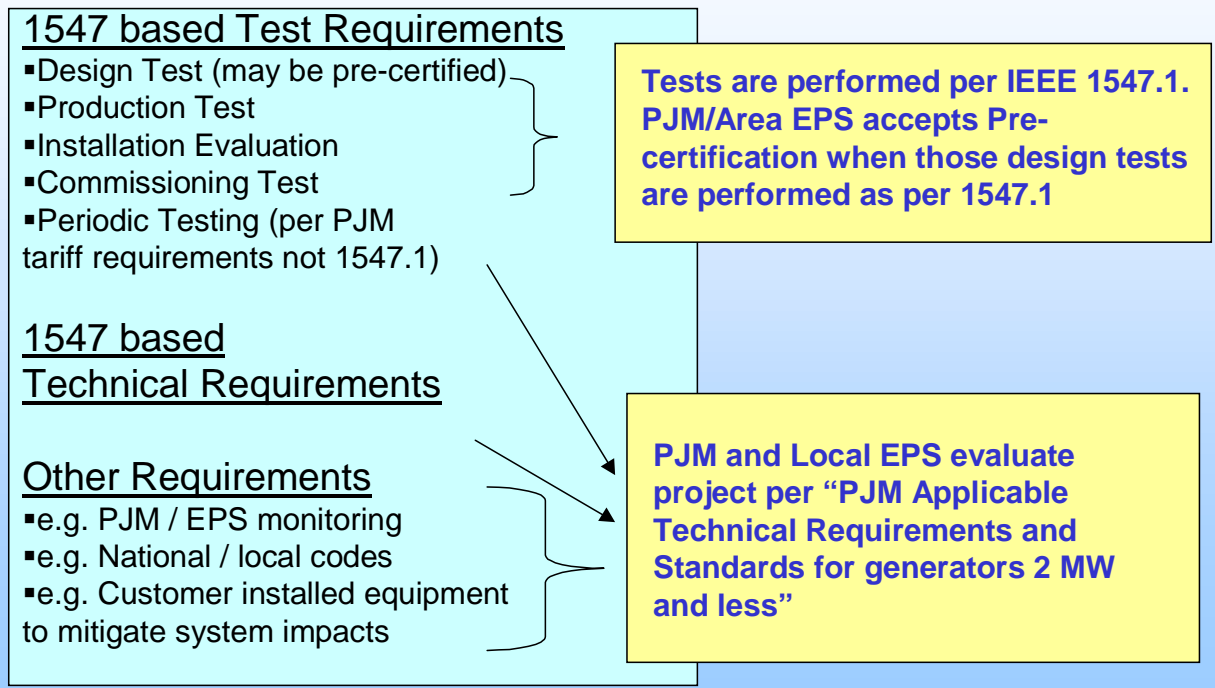


Prepared By:
R. DeBlasio, T. Basso
B. Kroposki – Feb. 2004;
To be published: NREL
TP-37293 (1st Q 2005)



PJM Working Group: Developed New PJM Technical Standard; Over 11 Months; Based on IEEE 1547; allows pre-certification; widespread stakeholder inputs.

Summary Overview PJM Small Generator Interconnection Technical Requirements





FERC Approved New PJM Technical Standard on March 8, 2005

PJM Standard based on IEEE 1547 – all PJM TOs and key stakeholders agreed -- few exceptions or additions to IEEE 1547

Exceptions or Additions to IEEE 1547

<p>Grounding (4.1.2) – some companies require a wye-grounded transformer</p> <p>Networks (4.1.4.1-2) – interconnection to a network allowed only by exception</p> <p>Monitoring (4.1.6) – some PJM TOs may require monitoring & tele-metering</p>	<p>Harmonics (4.3.4) – In addition to IEEE 1547’s harmonics requirement, DG units must meet limits specified in IEEE 519, Table 11.1</p> <p>Periodic Tests (5.5) – periodic tests required in accordance with PJM pre-existing practices.</p> <p>Voltage unbalance < 3%.</p>
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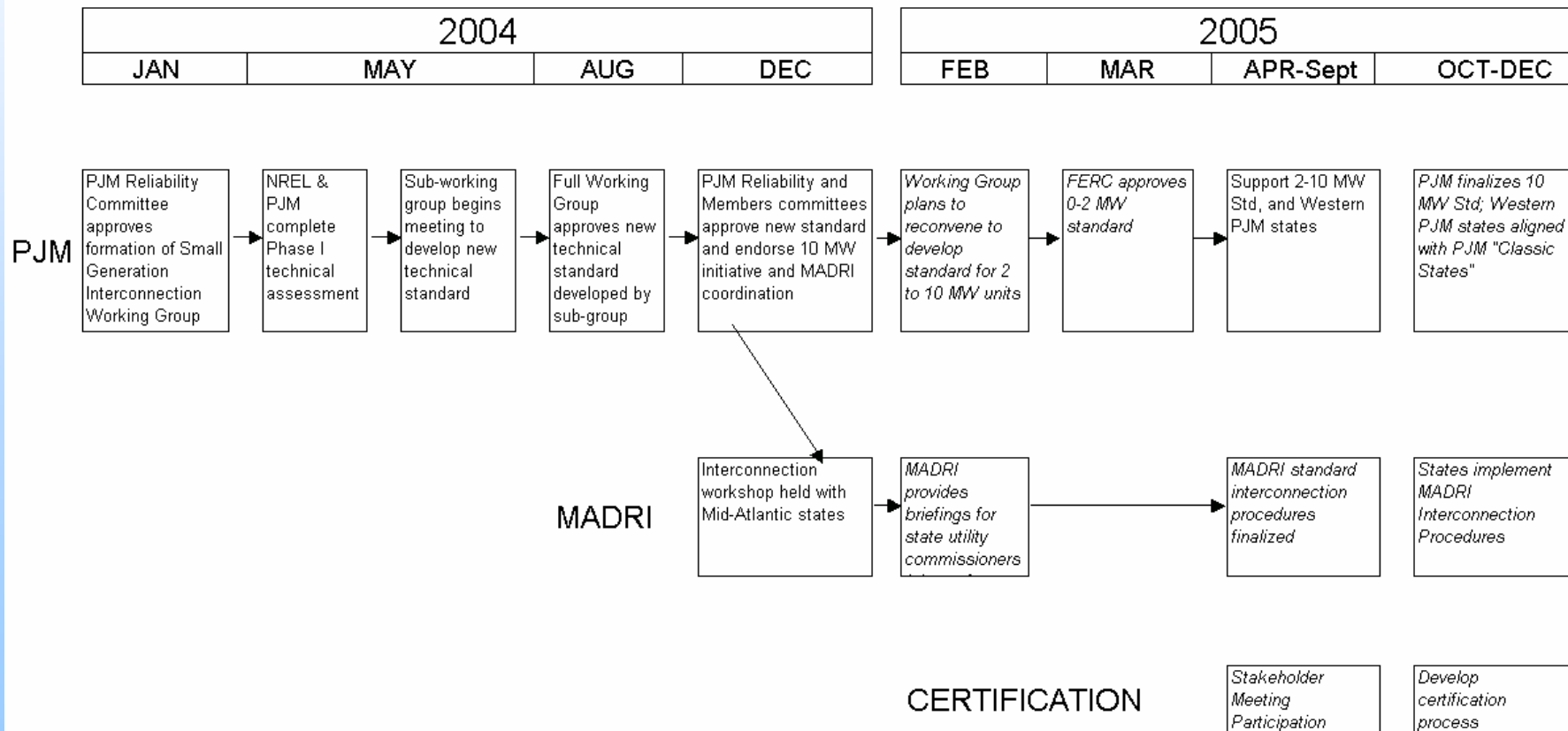
Progress and Accomplishments

- PJM expanding 2 MW Std to new PJM 10 MW Std:
April 4, 2005 PJM working group (WG) meeting consensus:
 - Radial distribution systems only
 - Very little change from 0 –2 MW PJM Std
 - “Looped systems” to be considered at next meeting
- MADRI has endorsed regional interconnection concept
 - Draft standard interconnection procedures prepared by NREL to be provided to states on May 1, 2005
- DOE/NREL contractor CTC held Certification Stakeholder meeting April 14, 2005
- Report on NREL Certification Model due May 2005



Pulling it All Together - Developing Regional Interconnection Procedures

Benefit: Consistent Interconnection Requirements Throughout the PJM Region – Wholesale & Retail





Budget

FY 2005

- Subcontracts: \$50,000
- NREL Inhouse: \$200,000

FY 2006 to be determined



What's Next?

- PJM Finalizes its new 10 MW PJM Technical Standard
- MADRI establishes/endorsees its own Interconnection Procedures Model
- PJM “Classic States” Develop their Interconnection Procedures Based on MADRI interconnection procedures
- Stakeholders Establish Certification Program
- PJM Harmonizes its Classic and Western States



Interactions and Collaborations

- PJM Interconnect, Inc.
- FERC
- Various States, e.g., utility commissions, energy offices, etc.
- Mid Atlantic Distributed Resources Initiative (MADRI) group
- Concurrent Technologies Corporation (CTC)



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