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# Inverter Reliability Roadmap Exercise

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# Roadmap Brainstorm Session

- The top gaps noted during the breakout sessions on April 30 were used to begin the discussion.
- The top areas of interest for addressing a roadmap effort included:
  - Inverter Performance (focus on near-term of 1 year versus longer term 5-year goals)
  - Component Reliability
  - System-Level Inverter Reliability
- Did not address (due to time constraints):
  - Advanced Inverter Functions
  - O&M
  - Thermal management
  - Module-scale conversion
- The results of the discussion and the gaps for all topic areas are included.

# Inverter Performance

Gaps	1 year goal	Path	Responsible party	Comments
Efficiency Testing	Updated CEC guidelines	Inclusion of advanced functionalities to protocols Dynamic MPPT	Sandia Manufacturer IEs Users	
Manufacturing and design issues	QA audits Qual standard	Cross-industry pollination Design best practices Peer discussion group	BOS WG#6 IEs Financial Peer group Test labs	
System usage conditions/specs	Standardization of data request and reporting	Development of testing to capture usage conditions Test data from system operators Quality valuation ID relevant data	Peer group	
Standard testing protocols  Usage environment testing				Noted these topics are important. Did not discuss the path.

# Component Reliability

Gaps	5 year goal	Path	Responsible party	Comments
Design best practices	Design for reliability guideline	Define “criticality”	Industry consensus consortium (30,30,30)	
Physics of Failure based Models	Physics of failure based model for critical components or subassembly	ID Failure modes ID critical components Failure distributions Useful life prediction Prognostics/health management (how to test)	3 <sup>rd</sup> party labs Academia IEC WG Component/inverter manufacturer	
Reliability cost justification	Standard lifecycle cost model	Increase sample size/time of testing	Asset owners Financial community manufacturers	
Software parametric tests	Standard test protocol	One of critical components Investigate other standards (eg UL1998) Cross fertilization of software best practices		
System based failure models		Include system aspects in component design.		

# Inverter Reliability

Gaps	5 year goal	Path	Responsible party	Comments
Field to lab test correlation	App specific correction coefficients	ID/Develop dynamic field test conditions Expand field test Field diagnostics Accessibility to failure data Long term test	Test/National Labs	
Lifetime prediction	Acceleration factors Standard test profiles	Qual /comparative /reliability test ID failure modes and mechanisms		
System based failure models		ID Impact of grid Definitions of failure/degrad. Develop boundary diagrams for system types		
Field Application specific		Accessibility to operational data	Manufacturer	
Prognostics				Not discussed in roadmap session

# Module Scale Conversion

Gaps	5 year goal	Path	Responsible party	Priority
Reliability/Testing standards				
Understanding of environment				
Environmental protection				

# Advanced Inverter Functions

Gaps	5 year goal	Path	Responsible party	Priority
DC arc level				
Qualification standard				
Communication based standardization				
Standard forecasting				

# Thermal Management

Gaps	5 year goal	Path	Responsible party	Priority
Cooling rate and reliability interactions				
Thermal management standards				
Air cooling vs. liquid cooling studies				

# O&M

Gaps	5 year goal	Path	Responsible party	Priority
Best practices				
Definitions				
Models				
Optimizing operations				