



DG Interconnection Issues Update

Planning Advisory Committee Teleconference

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Background

- ISO has been working to revise the interconnection requirements for DER to enable their deployment without compromising the reliability of the New England transmission system
- ISO believes that interconnection requirements can be established that satisfy the goals of both Transmission and Distribution systems without imposing undue financial burden on DER
- This presentation provides an update of these issues



Summary

- Two standards, IEEE 1547 and UL 1741, are key to the safe and reliable interconnection and operation of DER
- IEEE 1547-2003 and IEEE 1547a-2014 are approved standards
- IEEE 1547 is undergoing a complete revision
- A revised UL 1741 is being balloted
- It is important to monitor the status of these two standards



IEEE Interconnection Standards

- State jurisdictional interconnection standards for DER are generally consistent with IEEE Standard 1547-2003
- An amendment to IEEE 1547-2003 was been approved in 2014 and is entitled IEEE 1547a-2014
- The test procedure for IEEE 1547a (1547.1a) was approved in 2015
- IEEE 1547a revises the requirements for responding to voltage and frequency excursions and allows DG resources to regulate voltage if the interconnecting utility approves this mode of operation

IEEE Interconnection Standards, cont.

- Neither IEEE 1547 nor 1547a establish voltage or frequency ride-through standards
- IEEE is revising 1547 to address ride-through, voltage regulation and other issues
- IEEE's goal is to complete the total update of 1547 by the end of 2016
- The committee working on revising IEEE 1547 has been meeting three times a year. The majority of the work is done in working groups that hold conference calls as frequently as weekly.



Clearing Times for DER in IEEE 1547-2003

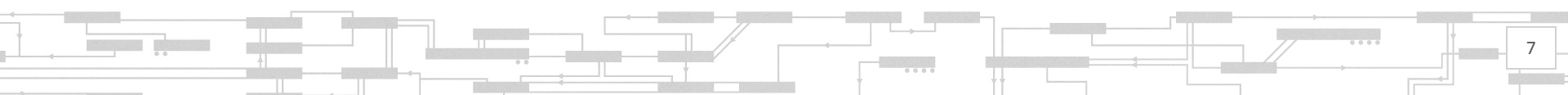
Voltage Range in percent of the nominal voltage at the point of common coupling	Maximum Clearing Times
$V < 50$	0.16 seconds
$50 \leq V \leq 88$	2.00 seconds



Clearing Times for DER – IEEE 1547a

Voltage Range in percent of the nominal voltage at the point of common coupling	Default Clearing Time in Seconds	Clearing Time Range in Seconds
$V < 45$	0.16	0.16
$45 \leq V \leq 60$	1	1-11
$60 \leq V \leq 88$	2	2-21

Under mutual agreement between the Electric Power System and Distributed Energy Resource operators, other static or dynamic voltage and clearing time trip settings shall be permitted



Under Frequency Tripping for DER– IEEE 1547a

Function	Frequency (Hz)	Clearing Time in Seconds	Frequency Range (Hz)	Clearing Time adjustable up to and including (in Seconds)
UF1	57	0.16	56-60	10
UF2	59.5	0.16	56-60	300
OF1	60.5	2	60-64	300
OF2	62	0.16	60-64	10



IEEE 1547 Guidelines on Technology Neutrality

- Objective:
 - Any IEEE standard should not create (market) barriers for any specific technology
- General Rules:
 - Technology neutrality is **desired** and *should* not create (market) barriers for any specific technology. Different approaches exist to overcome challenges.
 - If different technologies have more or less difficulties with certain requirements, only those requirements shall be made **mandatory (“shall”)** that can be met by **all** technologies
 - Any requirements that may not be met by certain technologies will be made **permissive (“should” or “may”)**

IEEE 1547 Performance-Based Category Approach

- Differentiate interconnection requirements in a technology-neutral way by use of performance based categories
 - Category [X]: based on essential bulk electric system (BES) stability/reliability needs and reasonably attainable by all state-of-the-art DER technologies
 - Category [Y]: covers all BES stability/reliability needs and coordinated with existing reliability standards to avoid tripping for a wider range of faults
 - Category [Z]: based on both BES stability/reliability and distribution system reliability/power quality needs and coordinated with existing interconnection requirements for very high penetration DER regions

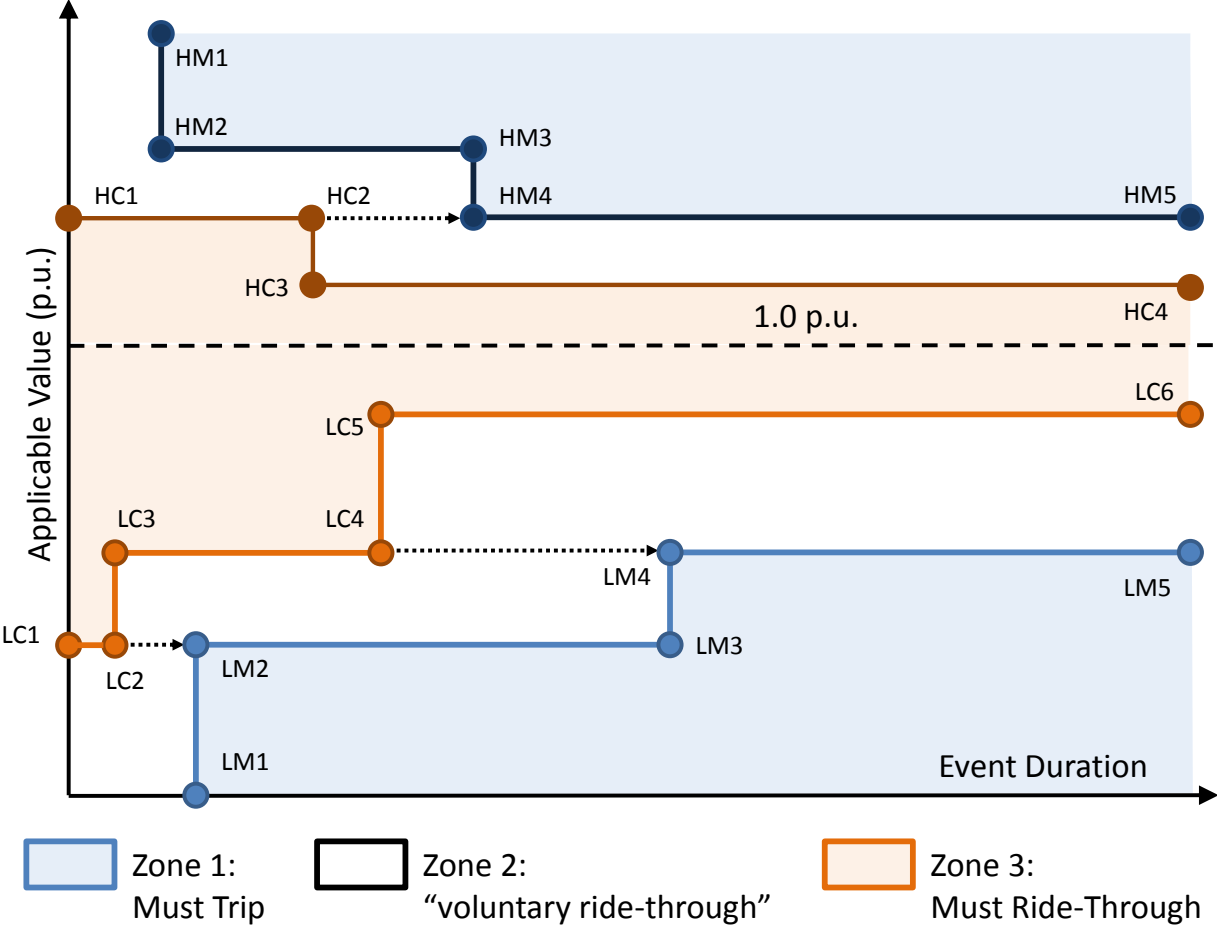


Voltage and Frequency Ride-Through Foundations

Requirement	Category	Foundation
Voltage Ride-Through	Category [X]	German grid code for medium voltage connected DER
	Category [Y]	PRC-024-2 but w/o stability exception, plus extended LVRT duration for 70-88% V_{nom} to consider fault-induced delayed voltage recovery (FIDVR)
	Category [Z]	CA Rule 21
Frequency Ride-Through	All Categories (harmonized)	CA Rule 21, PRC-006



IEEE 1547 High-level Trip & Ride-through Concepts



Voltage Ride-through – ISO recommendation is to establish a minimum time for inverter-based generation to stay connected after IEEE 1547 is revised – until then use 1547a

Voltage Range in percent of the nominal voltage at the point of common coupling	Stay Connected Until (in seconds)
$V < 45$	1
$45 \leq V \leq 60$	1
$60 \leq V \leq 88$	2



UL 1741

- UL 1741 cover inverters, converters, charge controllers, and interconnection system equipment (ISE) intended for use in stand-alone (not grid-connected) or utility-interactive (grid-connected) power systems. Utility-interactive inverters, converters, and ISE are intended to be operated in parallel with an electric power system (EPS) to supply power to common loads.
- For utility-interactive equipment, UL 1741 requirements are intended to supplement and be used in conjunction with the Standard for Interconnecting Distributed Resources With Electric Power Systems, IEEE 1547, and the Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems, IEEE 1547.1



UL 1741, cont.

- A draft revision of UL 1741 was issued on May 18, 2015
- This revision addresses the functions required under California Rule 21 which resulted from the Smart Inverter Working Group. These functions would satisfy the needs of the New England transmission system.
- The draft could be approved by August 18, 2015
- California will require inverter-based generation to meet Rule 21 within one year of the approval of the UL standard



ISO Activities

- ISO participated in all the meetings to address the complete revision of IEEE Standard 1547
- The next meetings to address the complete revision of IEEE 1547 will be:
 - October 27-29, 2015 in Tempe, Arizona hosted by Salt River Project
 - February 2016 at location TBD
- ISO participates in weekly conference calls on the subgroup addressing the response to abnormal conditions
- ISO participates in the Massachusetts Technical Standards Review Group (MTSRG) meetings
- ISO participates in a Vermont Public Service Department effort to update DER interconnection requirements and net metering rules

Questions

