Applying New IEEE 1547 Interconnection Requirements

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EPRI

For UVIG Fall Meeting

October 11, 2017

Nashville, TN

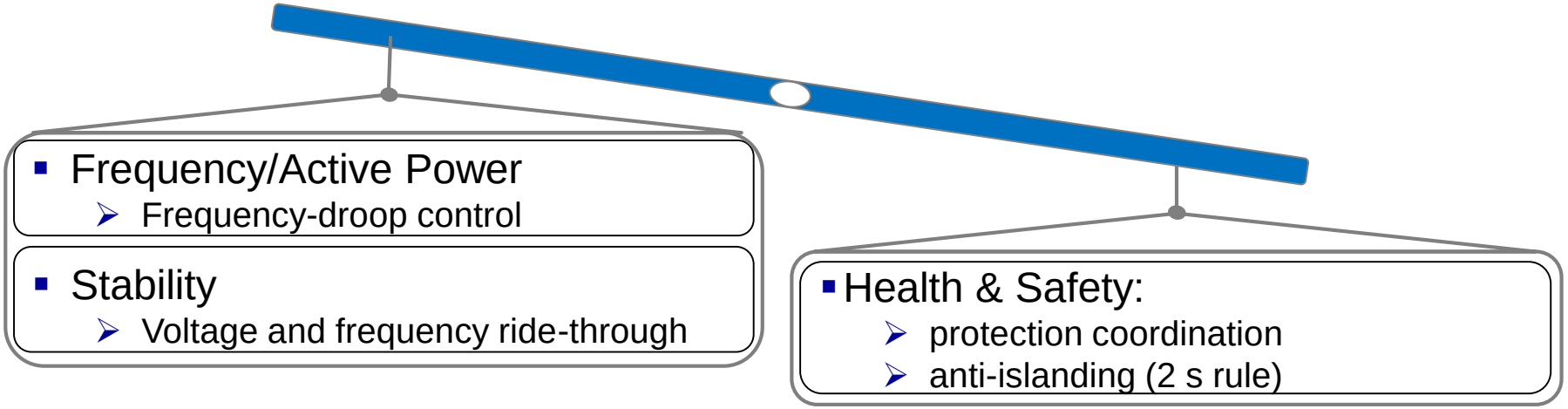
Proposed IEEE 1547 balances grid operations & planning challenges with distributed energy resources

Bulk System Needs

- Voltage/Reactive Power, Ride through
- Frequency/Active Power
  - Frequency-droop control
- Stability
  - Voltage and frequency ride-through

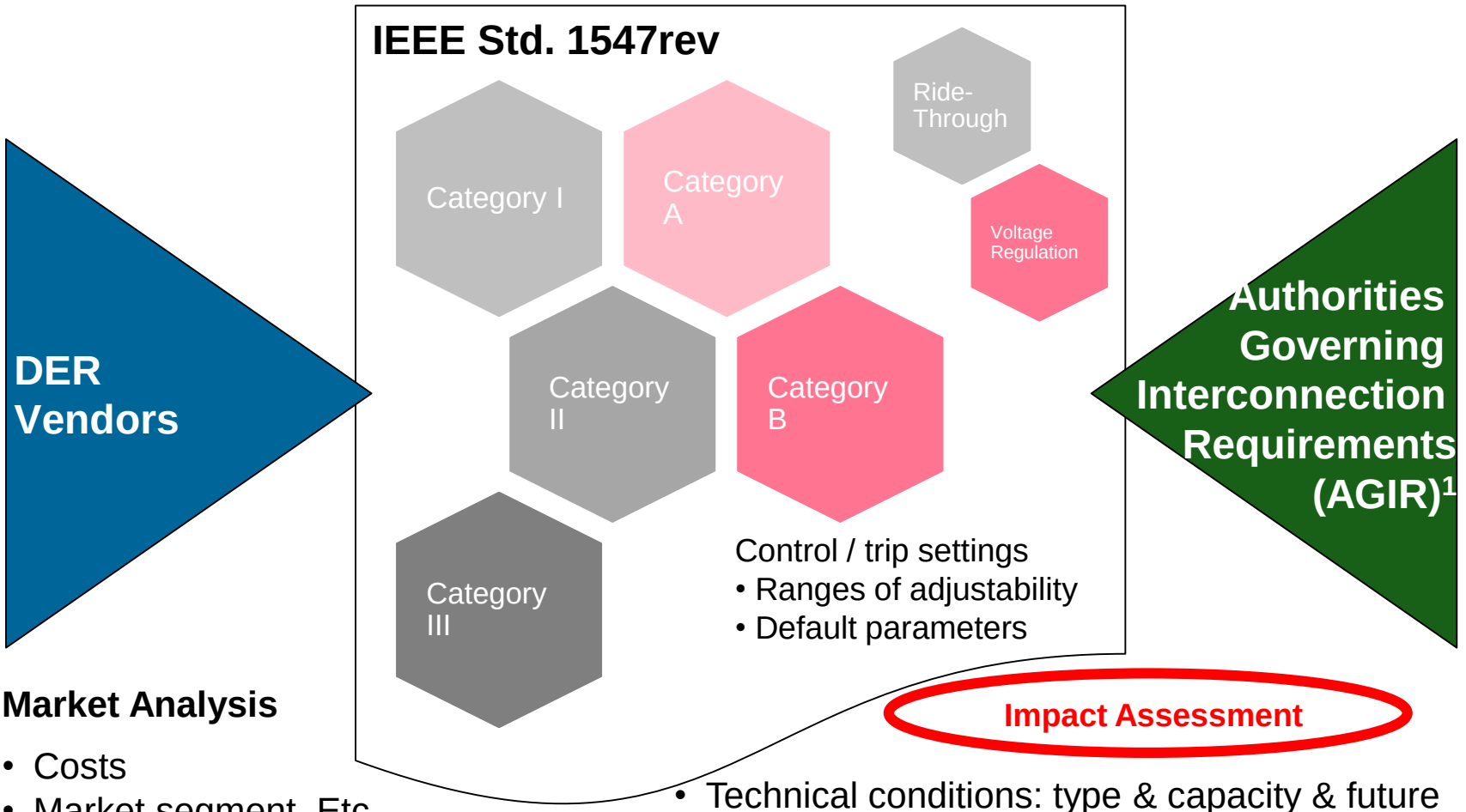
Distribution System Needs

- Power quality: voltage limits/power factor/harmonics, Volt/var controls
- Health & Safety:
  - protection coordination
  - anti-islanding (2 s rule)



IEEE P1547 addresses bulk system and distribution system needs.

Assignment of IEEE 1547 Performance Categories



Market Analysis

- Costs
- Market segment, Etc.

- Technical conditions: type & capacity & future penetration of DER, type of grid configuration, etc.
- Non-technical issues: DER use case, impacts on environment, emissions, and sustainability, etc.

1 State Regulator, Area EPS or bulk system operator, etc.

Application Example: Low Voltage due to 345kV fault in Massachusetts

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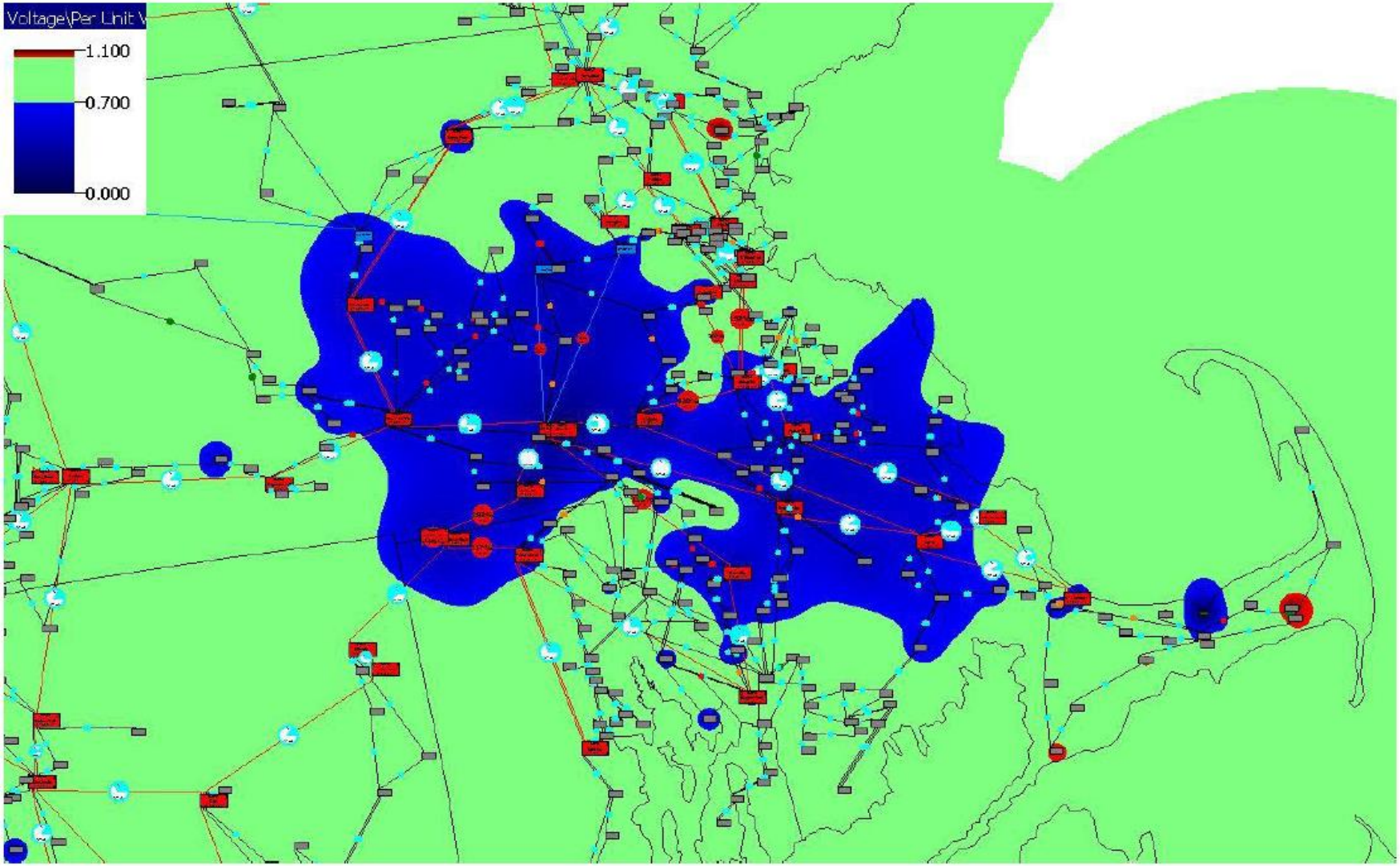

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How MA utilities address the ride through concerns

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- IEEE 1547 revision has been on the MA Technical Standards Review Group (TSRG) meeting agenda for past two years! (https://sites.google.com/site/massdgic/home/interconnection/technical-standards-review-group)
- Subgroup under TSRG formed to address ride through challenges. Target: ride through will be mandated in MA starting Jan 1, 2018.
  - Utilities and ISO-NE are members of this subgroup.
- MA TSRG working group has recently decided to expand the scope of the subgroup to address the voltage and frequency regulation implementation challenges as well.

DER Reliability Concerns
ISO-NE

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- Capabilities for all DER:
  - High/low frequency ride-through
  - High/low voltage ride-through
  - Default and emergency ramp rate limits
  - Reconnect by “soft start” methods
  - Voltage support
  - Communication capabilities
- Starting Jan 1, 2018, all inverter based generation must meet the IEEE 1547 Category III requirements.

ISO-NE Recommended IEEE 1547 Categories

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DER Type	Example of Applications	Proposed Category
Engine	land fill gas	Category I
Synchronous generators	small hydro	Category I
Synchronous generators	combined heat and power	Category I
Synchronous generators	self-generation	Category I
Inverters sourced by solar PV		Category III
Inverters sourced by fuel cells		Category III
Inverters sourced by energy storage	Batteries either stand alone or associated with solar PV	Category III
Wind Turbines		Category III

7

Tentative ride-through settings for Solar installations in MA

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Voltage range (% of Nominal)	Minimum Ride-through Time in seconds
V > 120	N/A
110 < V ≤ 120	12 seconds
70 ≤ V < 88	2 seconds
50 ≤ V < 70	1 second
V < 50	1 second

Frequency range (Hz)	Operating Mode	Minimum time(s) (design criteria)
f > 62.0	N/A	N/A
60.6 < f ≤ 62.0	Mandatory Operation a	299
58.5 ≤ f ≤ 60.6	Continuous Operation	Infinite (c)
57.0 ≤ f < 58.5	Mandatory Operation b	299
f < 57.0	N/A	N/A

NRECA articles and EPRI white papers on 1547

NRECA *Revision of IEEE Standard 1547™* Articles	Availability
1. The Background for Change, November 2016	NRECA + EPRI
2. Reactive Power and Voltage Regulation Capability Requirements, December 2016.	NRECA + EPRI
3. Disturbance Response Requirements, February 2017.	NRECA + EPRI
4. New Power Quality and Islanding Issues, April 2017.	NRECA + EPRI

EPRI white papers	Availability
5. Anti-islanding vs. ride-through	Draft
6. Communications interface and interoperability	Published
7. Power quality	Draft
8. Ride-through and coordination with protection	Draft

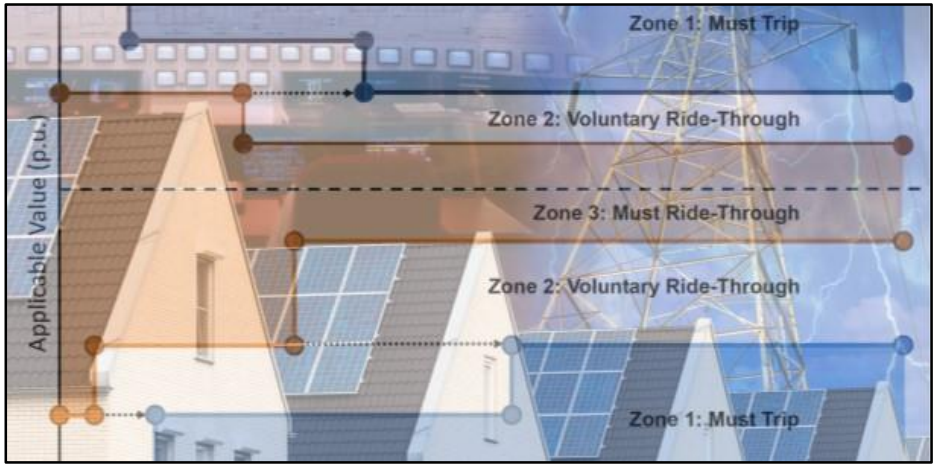
EPRI Fact Sheet *available on epri.com*

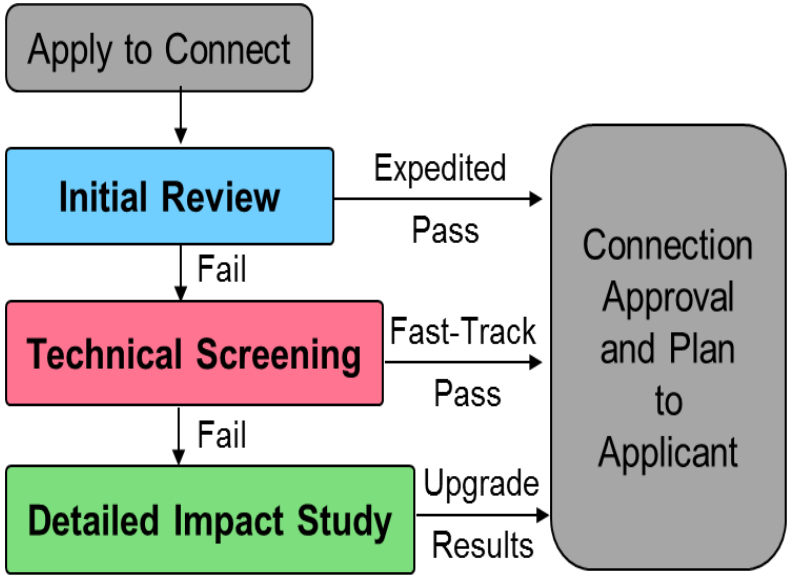
What's next in 1547 process?

- May – September 2017: Ballot and resolution
  - Successful, 80% returned votes, 78% approval rate, >1500 comments
- September/October 2017: 1st Recirculation
- October 16, 2017: Submission to IEEE SA RevCom
  - Either need 100% approval, or >75% approval rate and resolution of all "must be satisfied" comments.
  - Otherwise: 2nd recirculation in October/November
- December 6, 2017: IEEE SA Standards Board Approval
- Q1/Q2 2018: Publication of revised IEEE Std 1547
- 2018-2019: Complete revision of test requirements (IEEE 1547.1)
- 2019+: Adoption of IEEE 1547 & 1547.1 by state regulators and utilities

- Latest timeline available online at: http://grouper.ieee.org/groups/scc21/1547_revision/docs/1547-Revision-Milestone-Schedule.pdf

Navigating DER Interconnection Practices





Project Highlights

- Support adoption and application of revised IEEE Standard 1547 and forthcoming 1547.1.
- Identify leading interconnection practices in application management and technical review.
- Analyze gaps and assess opportunities for streamlining and harmonizing practices.
- Expand knowledge of utility staff to improve DER interconnection and integration processes.

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