



# DER Connection Application and Screening

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Senior Technical Executive

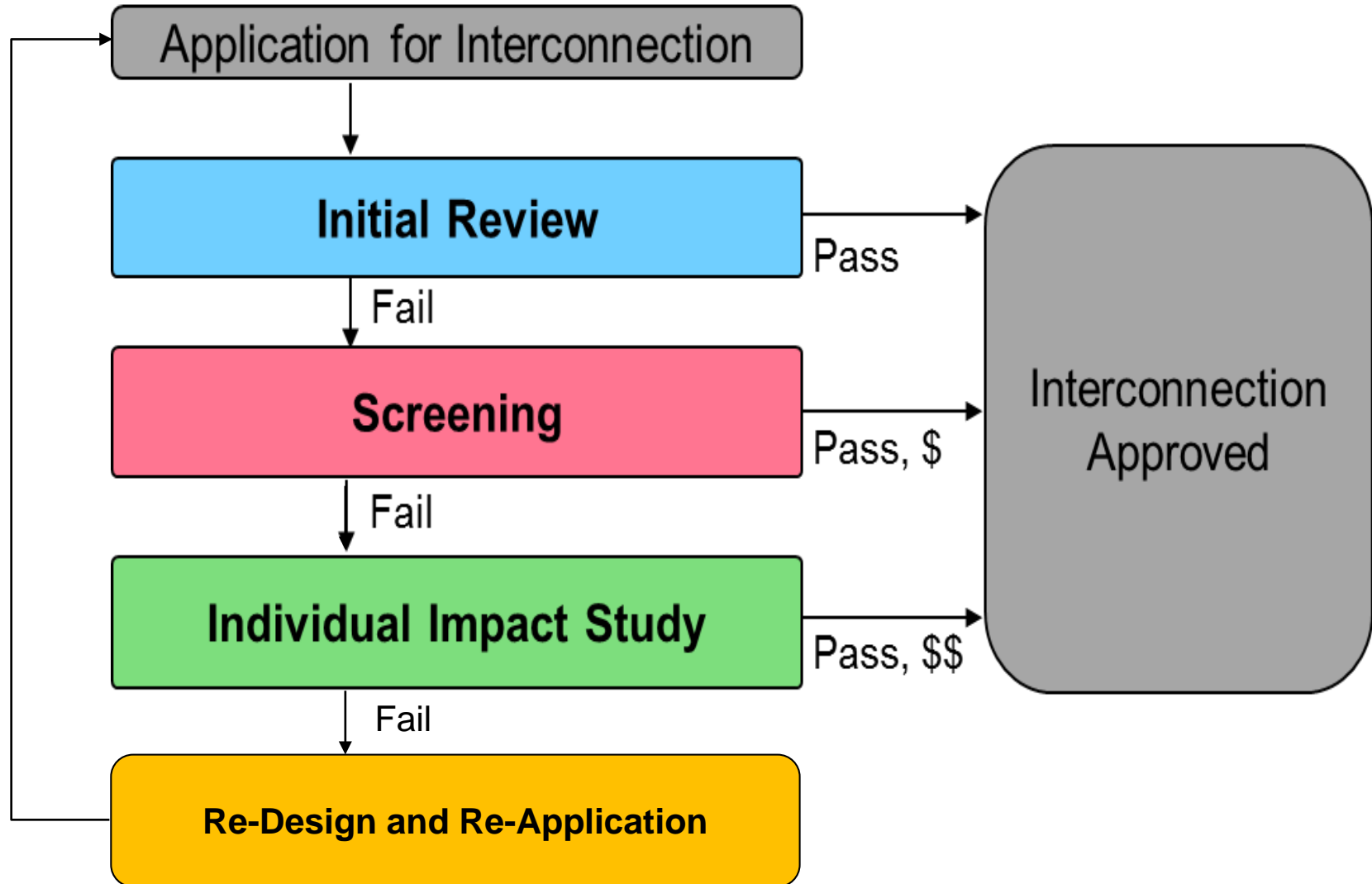
**Minnesota PUC Workshop  
on IEEE Std 1547-2018**  
Saint Paul, MN  
March 12, 2018



# Topics

1. Examples of Screening
2. Where Screening Fits in Process
3. Purposes of Screening and Relationship to 1547/Certification/Commissioning
4. Typical Scope of Screenings
5. Implementations and Mitigations
6. Key Takeaways

# Proposed Interconnection Site Technical Review (Screening, Studies, Commissioning)



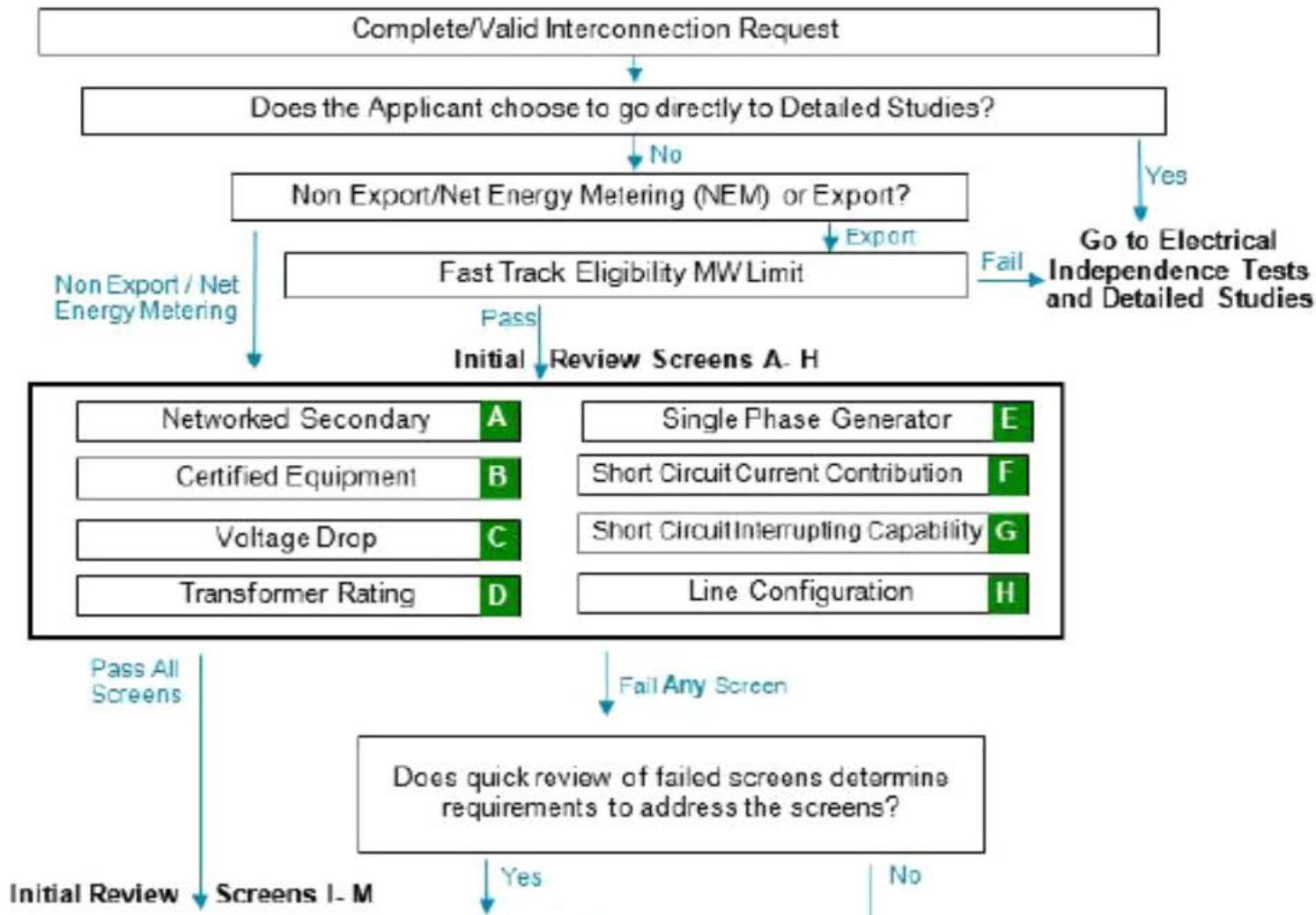
# Examples of Screening

- **CA Rule 21** (initial and supplemental, ~14 screens, are defined in the rule, since 1999, and with many updates)
- **FERC SGIP** (*Small Generator Interconnection Procedure*, since 2005, several updates)
- **MN DIP\*** (new *DER Interconnection Process*, development in process)
- **NY SIR** (update in process, 8 to 11 screens *Standard Interconnection Requirements*)
- **HI 14H**, and so on....

\* Also MN utilities have proposed a (TIIR) Technical Interconnection and Interoperability Requirements

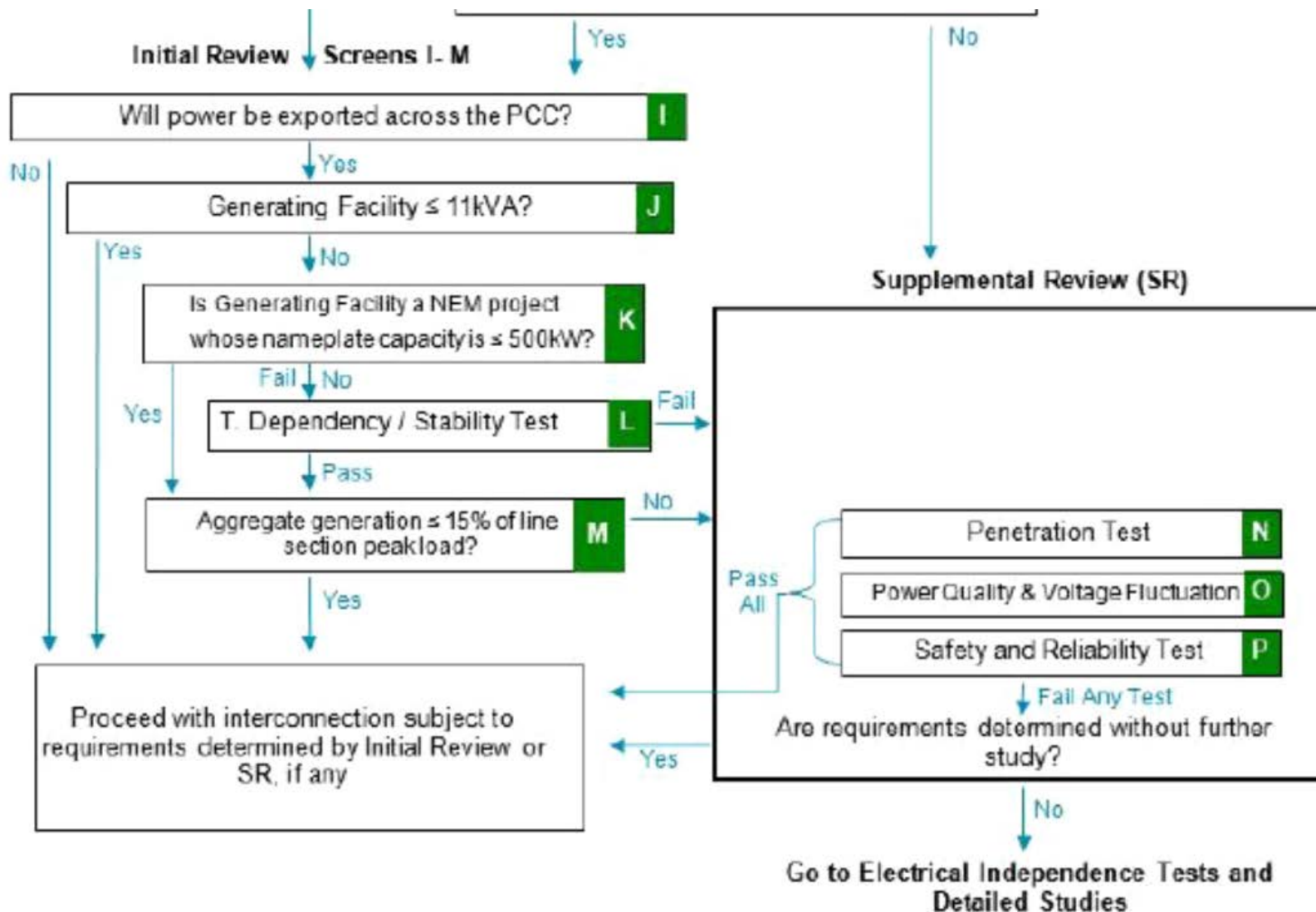
# CA Rule 21 Initial Review Screens A thru H (2015)

## Interconnection Technical Framework Overview



California Public Utilities Commission, <http://www.cpuc.ca.gov/Rule21/>

# CA Rule 21 Initial & Supplemental (I thru Q, 2015)



California Public Utilities Commission, <http://www.cpuc.ca.gov/Rule21/>

# Evolution of FERC SGIP (and SGIA)

[Order No. 828](#), issued July 21, 2016

- added voltage and frequency ride thru

[Order No. 827](#), issued June 16, 2016

- added requirement for reactive power support

[Order No. 792](#), issued November 22, 2013,

- increased thresholds for fast track
- offered supplemental review
- increased minimum load limit for inverter from 15 to 100%

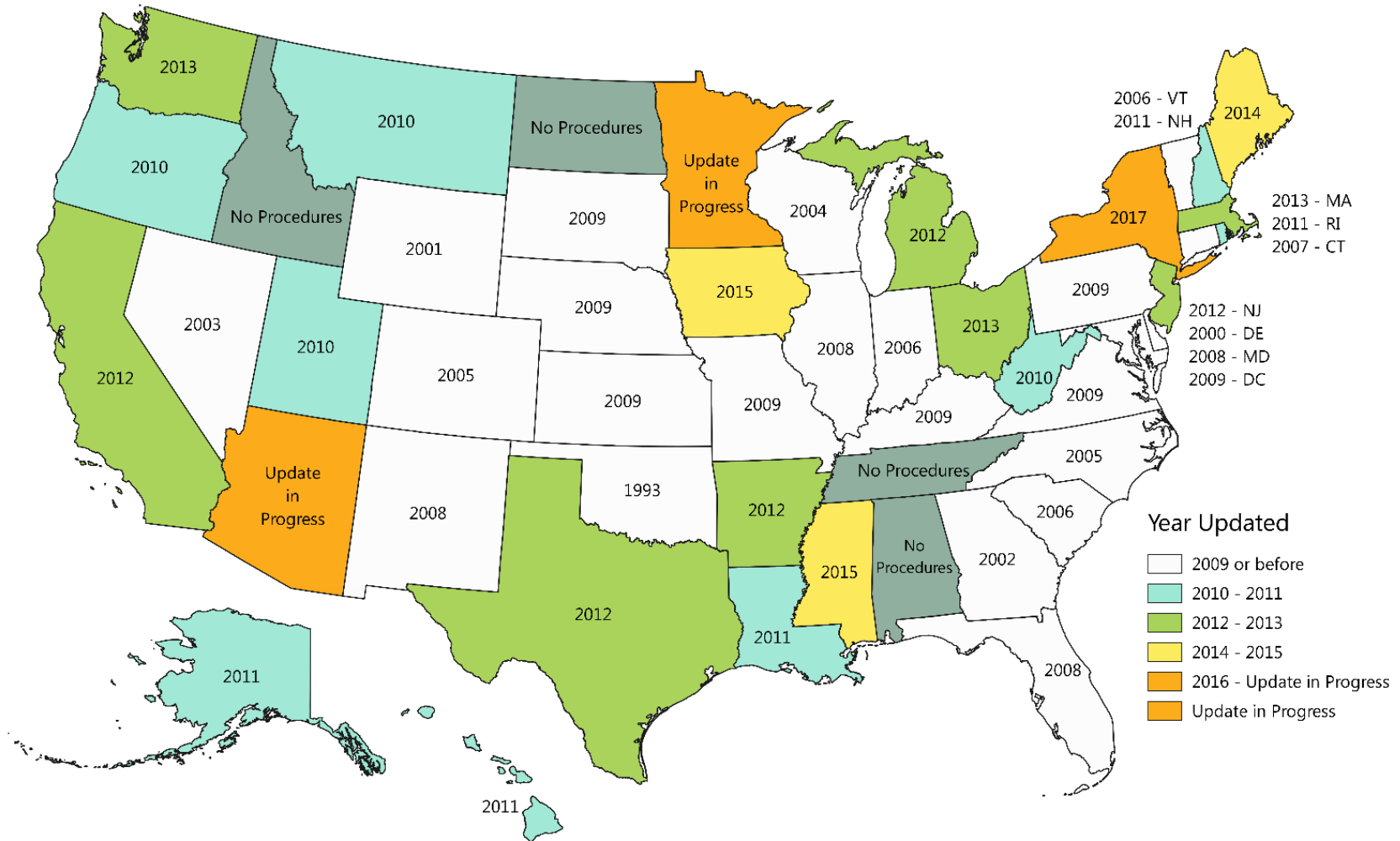
[Original SGIP](#), May 12, 2005,, *Standardization of Small (<20 MW) Generator Interconnection Agreements and Procedures*, FERC jurisdiction

- Also provided model procedures for DG in distribution

[Search for FERC SGIP](#)

<https://www.ferc.gov/industries/electric/indus-act/gi/small-gen.asp>

# Recent Updates to State Interconnection Standards

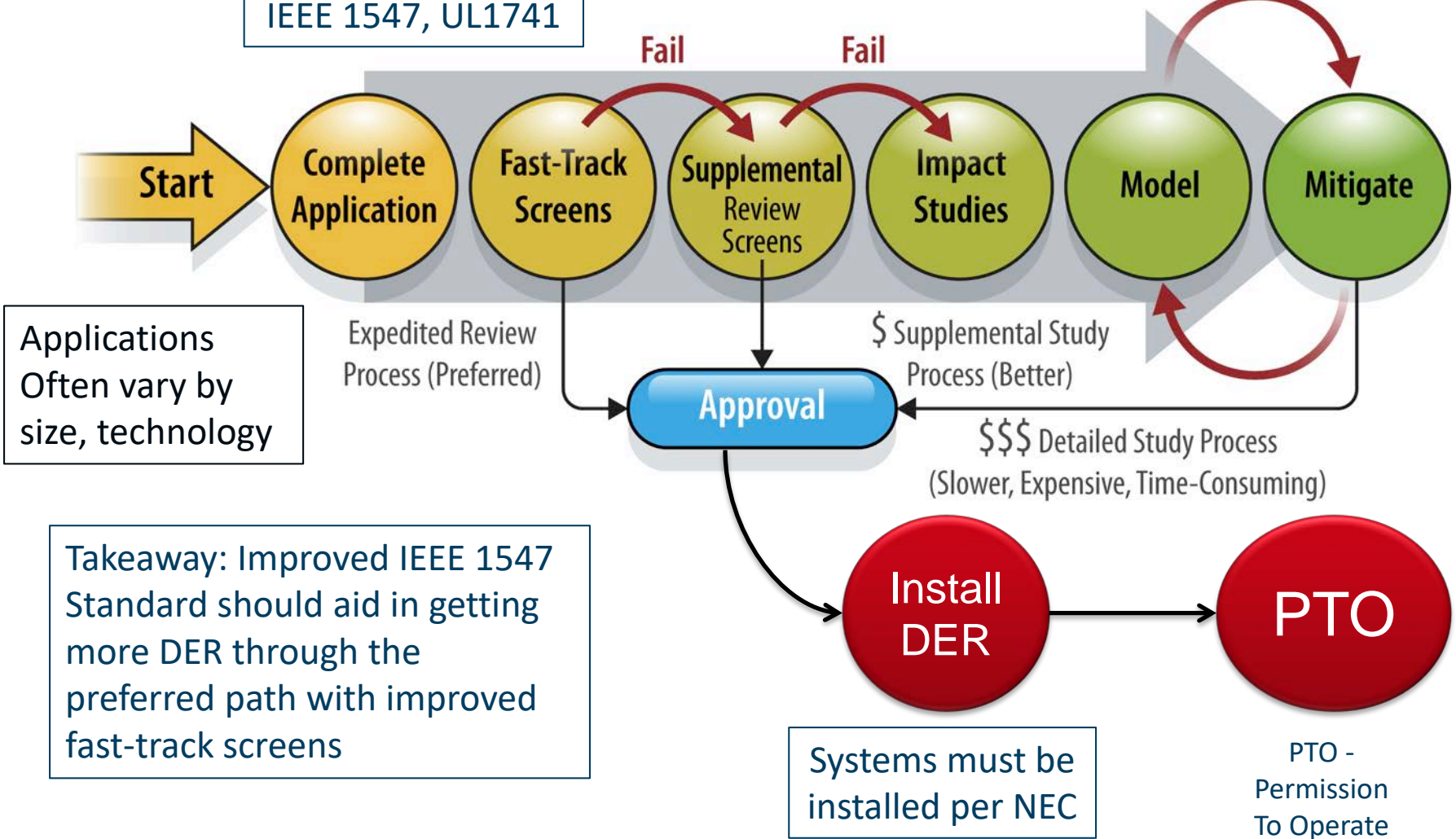




# Purposes of Screening and 1547 Contrasts

- Supports EPS decision to connect at a specific site (more than performance)
- Defines requirements to allow fast track
- Covers individual and aggregate DER at specific PCC (mostly MV, shared LV)
- Provides a hierarchy for technical review (initial or preliminary, supplemental, study)
- Points to settings, connection requirements and potential mitigations

DER must meet IEEE 1547, UL1741



Applications Often vary by size, technology

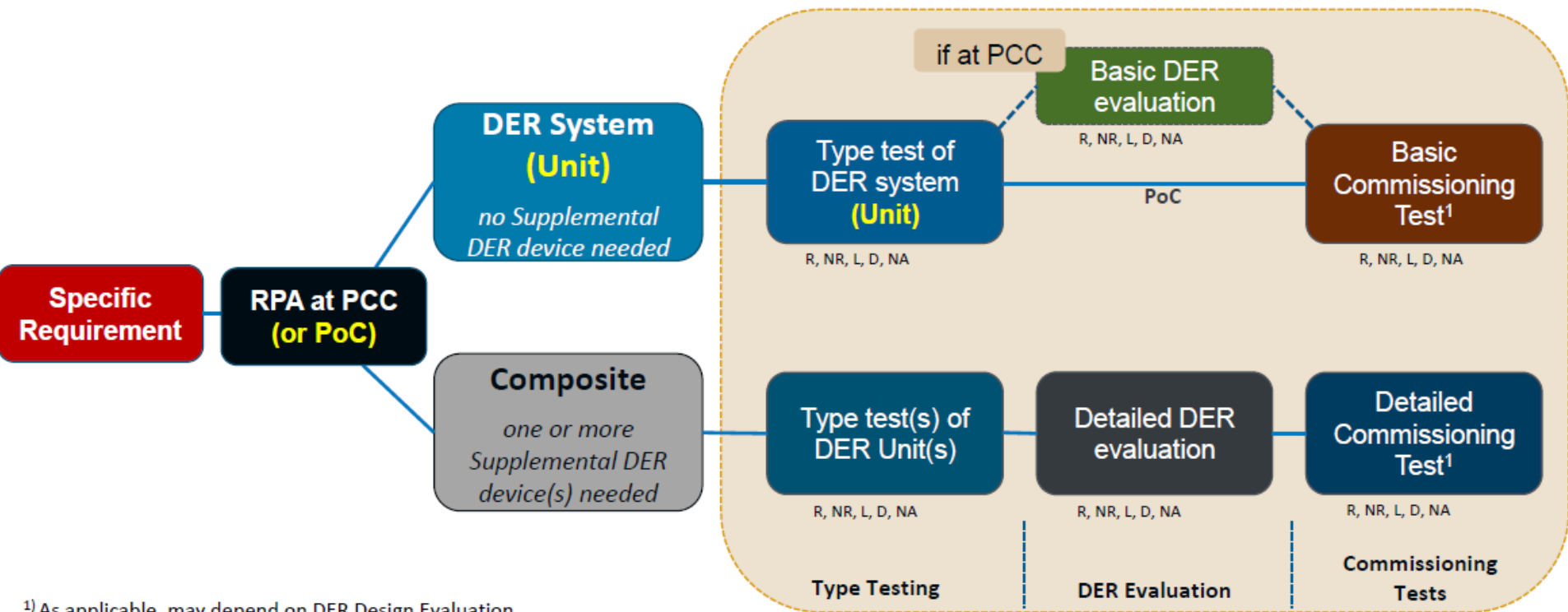
Takeaway: Improved IEEE 1547 Standard should aid in getting more DER through the preferred path with improved fast-track screens

Systems must be installed per NEC

PTO - Permission To Operate

From NREL, also see *A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States*, 63556 January 2015

# Determination of Requirements Testing



The type of evaluation or testing needed for each requirement depends on the reference point of applicability and whether there are any supplemental DER devices

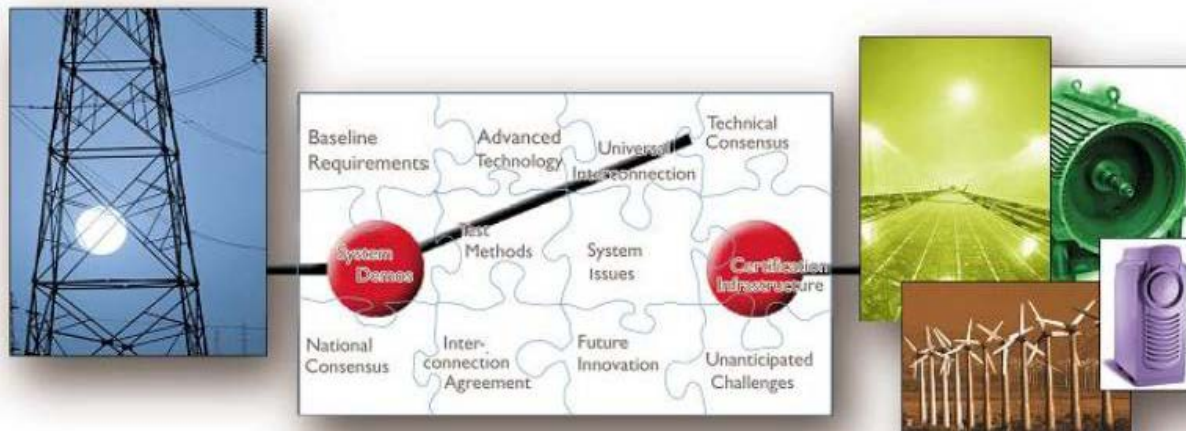
-help in Annex F (informative) Discussion of Testing and Verification Requirements at PCC or PoC

# Distinction between connecting to, and integrating with, the electric power grid

“**DER Interconnection**” Deals with the individual DER performance capabilities and interface issues specific to the DER and **focus of IEEE 1547**

**VS**

“**DER Integration**” at PCC, larger picture dealing with whole power system and aggregate DG affect on a feeder and grid planning operation and protection. This is usually the main topic of **technical screening and studies**.



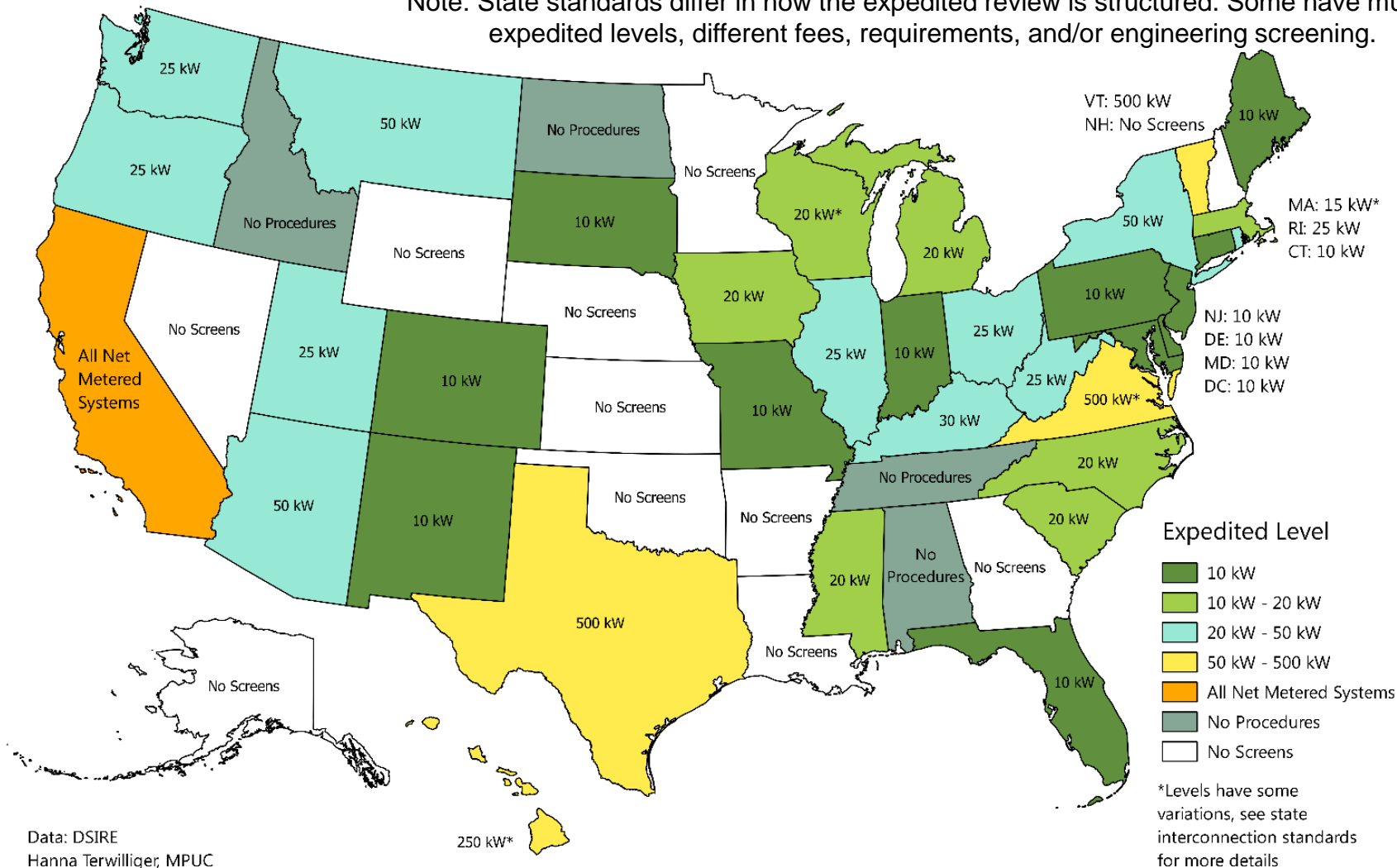
# Recommended approach for technical review:

1. ***initial review and preliminary*** screens are well defined, with available system data, allow a technician-level review/decision and have potential to be automated
2. ***supplemental*** screens are next level of detail, compliment preliminary, consider aggregate DG, may involve definition of upgrades and require engineering judgement...also leverage grow interconnection experience and expertise.
3. Inform ***study process*** to address screening failures and to adopt more uniform criterion in scoping and reporting study results.
4. Provide in the connection process a mechanism to address ***unforeseen site incompatibilities that may not be identified*** until commissioning or after installation.

# Supplemental Material

## State Expedited Review Levels

Note: State standards differ in how the expedited review is structured. Some have multiple expedited levels, different fees, requirements, and/or engineering screening.



Data: DSIRE  
Hanna Terwilliger, MPUC  
May 2, 2017

# Common Technical Areas Address in Scope of Screening and Studies

- A. Site qualifies (size, grid type, certified)
- B. Feeds into grid (behind the meter)
- C. Voltage (imbalance, drop, limits)
- D. Thermal (primary, secondary)
- E. Protection (islanding, effect on short circuit, ground fault overvoltage, coordination)
- F. Power Quality (flicker, I<sub>thd</sub>, LRO)



# Comparison of voltage related screens

Requirements	CA Rule 21	FERC SGIP	MN <sup>2</sup>	NY SIR <sup>1,2</sup>	IEEE 1547 <sup>5</sup>
<b>Preliminary and Initial Screening Reviews</b>					
% Peak Load limit_	15% (M) <sup>4</sup>	15% <sup>4</sup>	15% & 30% <sup>4</sup>	15% (E) <sup>4</sup>	N/A
1Φ/240V Service Unbalance limit_	Yes (E)	<20kW and <20% <sub>Unbalance</sub>	<65% <sub>Rated</sub> <20% <sub>Unbalance</sub>	None	N/A
Starting ΔV limit_	2.5/5% (C)	N/A	N/A	N/A	3%/5%
Stiffness Ratio limit_	DER <sub>SC</sub> /PCC <sub>SC</sub> <.1 (H) <sup>4</sup>	N/A	N/A	(V <sup>2</sup> /R <sub>s</sub> )/I <sub>DER</sub> >50 (F) <sup>4</sup>	N/A
<b>Supplemental Screening Review</b>					
% Min Load limit_	100% (N) <sup>4</sup>	100% <sup>4</sup>	100% <sup>4</sup>	100% (G) <sup>4</sup>	N/A
V <sub>REG</sub> limit_	CA Rule 2 (O) <sup>4</sup>	no	1.5/3/5% <sup>4</sup>	MV-3%,LV-5% (H) <sup>4</sup>	N/A
RVC limit_	Yes (O) <sup>3</sup>	Yes <sup>3</sup>	MV-3%, LV-5%	IEEE1547 (H) <sup>5</sup>	MV-3%, LV-5%
Flicker limit_	Yes (O) <sup>3</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>	IEEE1547 (I) <sup>5</sup>	P <sub>st</sub> <.35
Distortion limit_	IEEE 519 (O)	IEEE 519	IEEE 519	IEEE1547 <sup>5</sup>	I <sub>THD</sub> <5%

## Table Notes:

1 Proposed by EPRI to NYSERDA and NYDPS to be considered, March 2018

2 Screening requirements currently under revision in these jurisdictions

3 Refers to IEEE 1453 for planning, assessment and measurement practices (with no individual DER limits)

4 Limits apply to both individual and aggregate DER

5 Refers to new limits in IEEE 1547, these address individual DER effect on voltage.



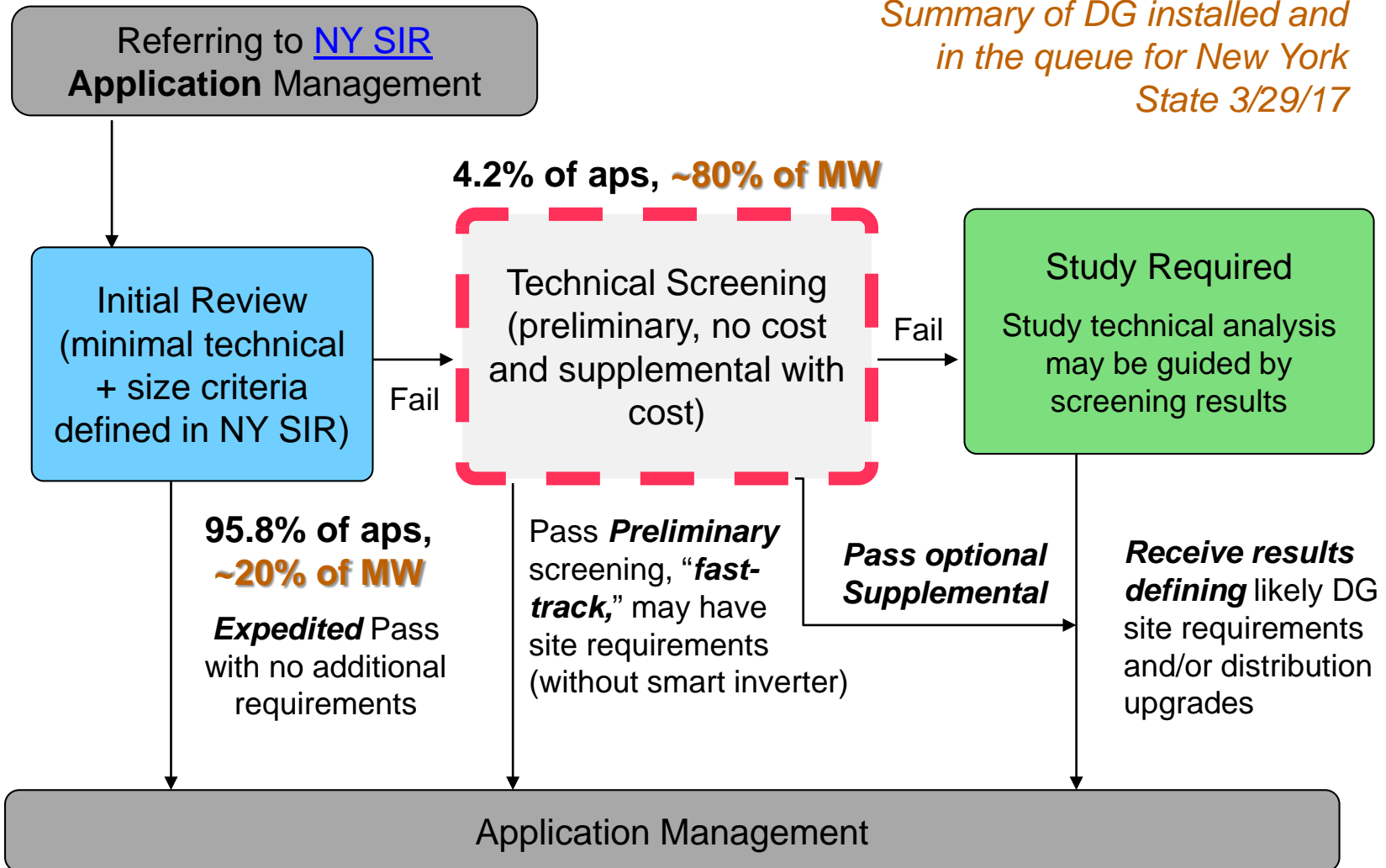
# Example of Preliminary Screening proposed by EPRI in NY State

- A. Is the Point of Common Coupling (PCC) on secondary network (such as city underground)?
- B. Is certified equipment used?
- C. Is the Electric Power System Rating exceeded by aggregate DER?
- D. Is the DER prone to support ground fault overvoltage or Service Connection at (PCC)?
- E. Does aggregate DG exceed 15% of the feeder peak load (usually considered over one year period)?
- F. Is feeder capacity at PCC adequate for individual and aggregate DER? (feeder stiffness tests)

*Failing any preliminary screening means mitigations or further review, supplemental or study options.*

# Additional Context Regarding Connection Application and Technical Review in NY

Summary of DG installed and  
in the queue for New York  
State 3/29/17



# When Mitigation Solutions Are Needed

		Hosting Capacity Violation		
Mitigation Solution		Voltage	Thermal	Protection
Grid-Side Enhancements	Reconductoring	Green	Green	Red
	Voltage uprating	Green	Green	Green
	Transformer replacement	Green	Green	Yellow
	Additional voltage regulator	Green	Red	Red
	Comm/control (curtailment)	Green	Green	Yellow
	Additional relaying	Red	Red	Green
Operational Changes				
	Voltage regulation changes (LTC adjustment, etc.)	Green	Red	Red
	Relay setting modification	Red	Red	Green
Technology Solutions				
	Smart Inverter (var control)	Green	Red	Red
	Smart Inverter (watt control)	Green	Green	Yellow
	Distributed var control	Green	Red	Red
	Energy storage	Green	Green	Yellow
	PV panel orientation	Green	Red	Red
Demand response	Yellow	Yellow	Yellow	

# Some Takeaways

1. Screening is still a bit of an *art* rather than science
2. Industry practices are evolving along with experience and internal expertise.
3. Supporting standards also evolving, in particular the IEEE 1547 further defines DER expectations, related certification and testing.
4. Automation of both application management and technical reviews will increase
5. Planning and analysis tools are coming to support this.
6. Big challenges will be:
  - Having *good data* for system, deciding on future *options for support* of grid by DG (smart inverters), *levels needed* for communication and control



# Together...Shaping the Future of Electric

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