

Report Out

Evolution of Straw Proposals and Way Forward

**MISO IEEE 1547 Workshop,
April 23-24, 2018, Eagan, MN**

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“Navigating DER Interconnection Standards and
Practices” Supplemental Project
(SPN 3002012048)



Evolution of MISO Straw Proposals

Scope

In Scope

- Types of Distributed Energy Resources
 - Distribution-connected **generation**
 - Inverter-based
 - Focus on solar PV
 - But also fuel cells, microturbines
 - Synchronous generation based
 - Distribution-connected **storage** in generation mode
 - May include electric vehicles feeding into grid

Outside Scope

- Types of Distributed Energy Resources
 - Controllable loads / demand side management
 - Distribution-connected storage in load mode
 - May exclude charging electric vehicles

Scope, based on mention of “Regional Reliability Coordinator” in IEEE Std 1547-2018

In Scope

- Ride-through performance category assignment
 - Clause 1.4 (General Remarks and Limitations):
 - Clause 6.4.2 (Voltage disturbance ride-through requirements)
 - Clause 6.5.2 (Frequency disturbance ride-through requirements)
 - Annex B (Guidelines for DER performance category assignment)
- Clause 4.10.3 (Performance during entering service)
- Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
- Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
- Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
- Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
- Clause 6.4.2.6 (Dynamic Voltage Support)

Outside Scope

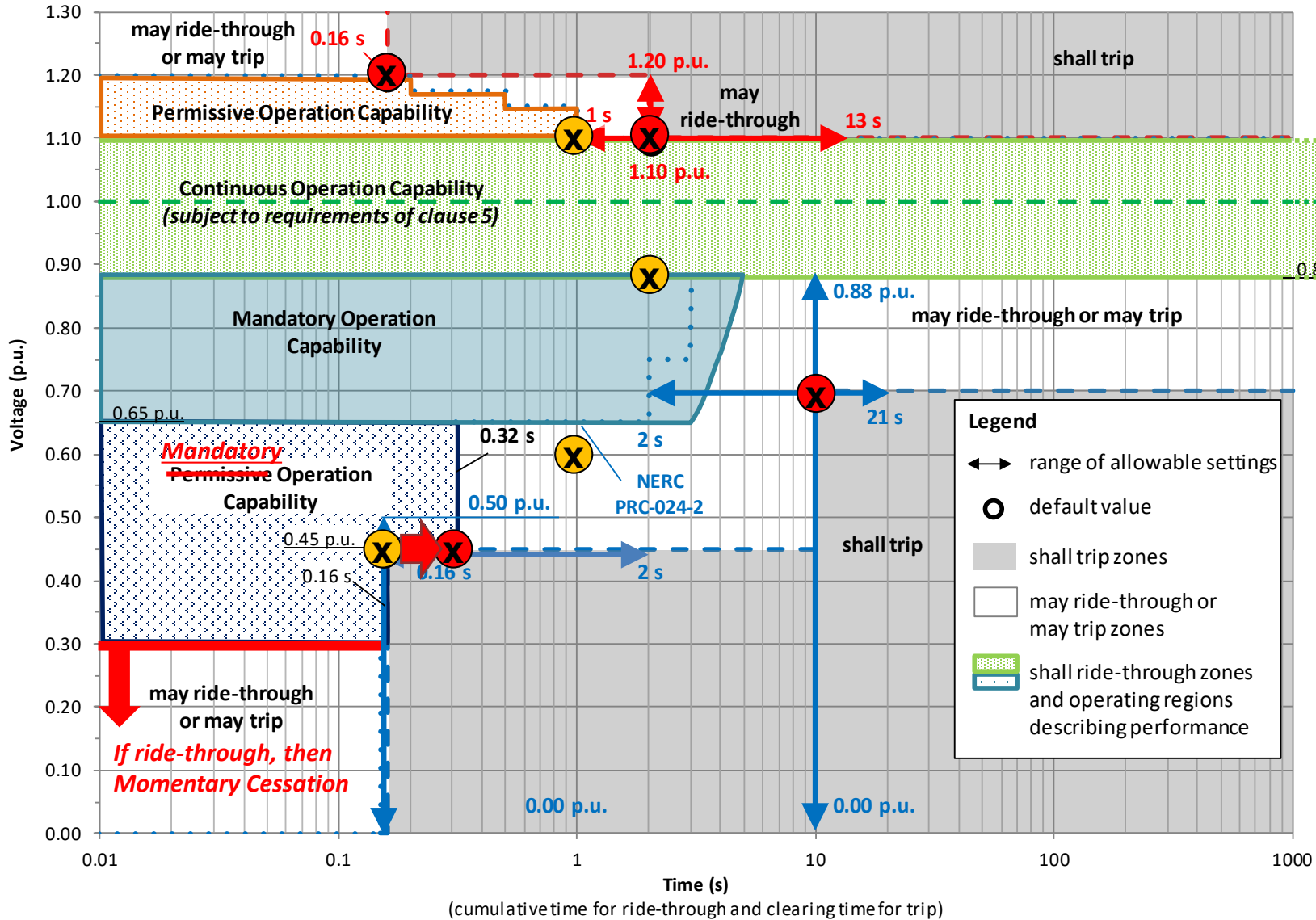
- Clause 6.5.2.8 (Inertial Response)
- Clause 8.2.8 (DER Categories for Intentional Islands)
- Clause 10.7 Communication protocol requirements
 - Local DER Communication Interface
 - Work with distribution utilities to develop roadmap to integrate DER into DER managing networks / DERMS
- Decision whether to implement the MISO guideline for new DER installations only or also retroactively for existing DER installations

MISO 2nd Straw Proposal – Overview (from 4th Pre-WS call)

- Ride-through performance category assignment
 - Synchronous generation: Category I
 - Inverters-based generation & storage: Category II
- Clause 4.10.3 (Performance during entering service)
 - Default settings
- Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
 - UV1, OV1, and OV2 default settings
 - UV2 = default plus 160 ms margin
- Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
 - Default settings
- Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
 - Note difference in specification between NERC IRPTF and IEEE 1547
 - Momentary Cessation mandatory for Inverters (Category II) in part of the Permissive Operation Capability Region
 - Momentary Cessation threshold of 0.3 pu (less than the 0.5 pu default value)
- Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
 - Enabled per 1547, standard does not allow to disable
 - Default settings
- Clause 6.4.2.6 (Dynamic Voltage Support)
 - Enabled in Mandatory Operation Capability region if the DER is capable of this function

MISO 2nd Straw Proposal – Voltage Ride-Through for Inverters (Category II)

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- Ranges of allowable settings (\leftrightarrow) defined such that IEEE Std 1547a-2014 default settings (⊗) can be accommodated.
- Permissive Operation Capability region may include requirements for Momentary Cessation, similar to Category III. !
- Trip settings (⊗) proposed in MISO's 1st Straw Proposal
 - UV1, OV1, and OV2 default settings
 - UV2 = default plus 160 ms margin
 - Momentary Cessation threshold of 0.3 pu
 - If available, enable DVS in Mandatory Operation Capability region, *specs pending*

MISO 3rd Straw Proposal – Overview (at noon on Day 1)

- Ride-through performance category assignment
 - Synchronous generation: Category I
 - Inverters-based generation & storage: Category II
- Clause 4.10 (Enter Service)
 - **Clause 4.10.2 (Enter Service Criteria)**
 - **Default settings**
 - Clause 4.10.3 (Performance during entering service)
 - Default settings
- Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
 - UV1, OV1, and OV2 default settings
 - UV2 = default plus 160 ms margin
- Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
 - Default settings
- Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
 - Note difference in specification between NERC IRPTF and IEEE 1547
 - Momentary Cessation mandatory for Inverters (Category II) in part of the Permissive Operation Capability Region
 - Momentary Cessation threshold of 0.3 pu (less than the 0.5 pu default value)
- Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
 - Enabled per 1547, standard does not allow to disable
 - Default settings
- Clause 6.4.2.6 (Dynamic Voltage Support)
 - Enabled in Mandatory Operation Capability region if the DER is capable of this function

MISO's 4th Straw Proposal – Overview (at start of Day 2)

red = modification relative to 3rd proposal; yellow = under discussion; green = consensus

- Ride-through performance category assignment
 - Synchronous generation: Category I
 - Inverters-based generation & storage: Category II
 - Clause 4.10 (Enter Service)
 - Clause 4.10.2 (Enter Service Criteria)
 - Default settings
 - Clause 4.10.3 (Performance during entering service)
 - Default settings – *allow for flexibility since transmission may desire longer while distribution may desire shorter ramps?*
 - Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
 - OV1, and OV2 default settings
 - UV1 = 5 sec (bulk needs, AID, reclosing)
 - UV2 = default plus 160 ms margin = 320 ms
 - Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
 - Default settings – *may require change of UFLS*
 - Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
 - Note difference in specification between NERC IRPTF and IEEE 1547
 - **Mandatory Operation above at least 0.5 pu**
 - Momentary Cessation mandatory for Inverters (Category II) in part of the Permissive Operation Capability Region
 - **Momentary Cessation threshold of 0.3 pu (less than the 0.5 pu default value) – MC subject to further study / alignment with PJM?**
 - Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
 - Enabled per 1547, standard does not allow to disable
 - Default settings
 - Clause 6.4.2.6 (Dynamic Voltage Support)
 - Option A: Wait for next revision of IEEE 1547.
 - Option B: Refer to guidance in IEEE P1547.2
 - Option C: Enabled in Mandatory Operation Capability region if a) DER is capable and b) subject to approval of distribution utility; specs as in Function 18 of EPRI's [3002008217](#) *discuss deadband, slope?*
- (Guide, exceptions require notification of MISO)**

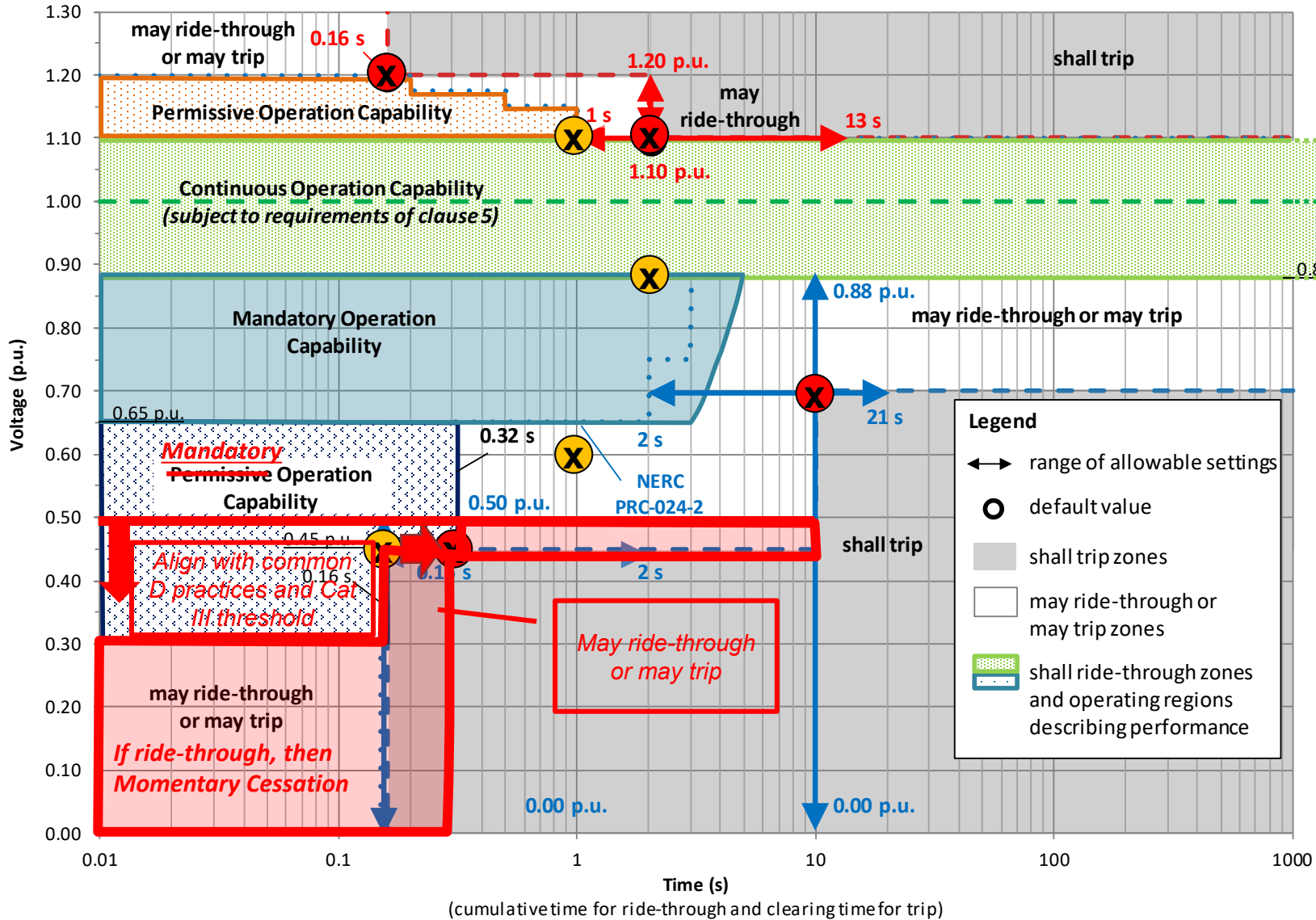
MISO's 5th Straw Proposal – Overview (at wrap-up of Day 2)

yellow = under discussion; green = consensus

- Ride-through performance category assignment
 - Synchronous generation: Category I
 - Inverters-based generation & storage: Category II
 - Allow for exceptions with notification of MISO
 - Clause 4.10 (Enter Service)
 - Clause 4.10.2 (Enter Service Criteria)
 - Default settings
 - Clause 4.10.3 (Performance during entering service)
 - Default settings – *allow for flexibility since transmission may desire longer while distribution may desire shorter ramps?*
 - Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
 - OV1, and OV2 default settings
 - UV1 = 10 sec (bulk needs, AID, reclosing)
 - UV2 = default plus 160 ms margin = 320 ms
 - Allow for exceptions with notification of MISO
 - Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
 - Default settings – *UFLS is out of scope here but may have to be appropriately coordinated*
 - Do NOT allow for exceptions **Different levels of guidance?**
 - Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
 - Note difference in specification between NERC IRPTF and IEEE 1547
 - Mandatory Operation above at least 0.5 pu
 - Momentary Cessation mandatory for Inverters (Category II) in part of the Permissive Operation Capability Region
 - Momentary Cessation threshold of 0.5 pu = default value for Cat III to align with common distribution practices and keep certification simple – *alignment with PJM / desire for MISO to justify lower value*
 - Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
 - Enabled per 1547, standard does not allow to disable
 - Default settings
 - Do NOT allow for exceptions
 - Clause 6.4.2.6 (Dynamic Voltage Support)
 - Option A: Wait for next revision of IEEE 1547 (202x?) – **Group III (as amendment?) - 0**
 - Option B: Refer to guidance in IEEE P1547.2 (Guide - 2020) – **Group II and III (quickest way) - 9**
 - Option C: Enabled in Mandatory Operation Capability region if a) DER is capable and b) subject to approval of distribution utility; specs as in Function 18 of EPRI's [3002008217](#) discuss envelopes for deadband, slope? – **Group I and III (at interim?) - 4**
- (Guide, exceptions at company policy level require notification of MISO)

MISO's 5th Straw Proposal – VRT for Inverters (Category II) (at wrap-up of Day 2)

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- Ranges of allowable settings (↔) defined such that IEEE Std 1547a-2014 default settings (○) can be accommodated.

- Permissive Operation Capability region may include requirements for Momentary Cessation, similar to Category III. !

- Trip settings (X) proposed in MISO's 1st Straw Proposal
 - OV1, and OV2 default settings
 - **UV1 = 10 sec.**
 - UV2 = default plus 160 ms margin = 320 ms
 - Momentary Cessation threshold of 0.5 pu
 - If available and approval by distribution utility, enable DVS in Mandatory Operation Capability region, *specs as in Function 18 of EPRI's 3002008217, deadband?*

Way Forward

MISO's 6th Straw Proposal – Overview (based on WS outcomes)

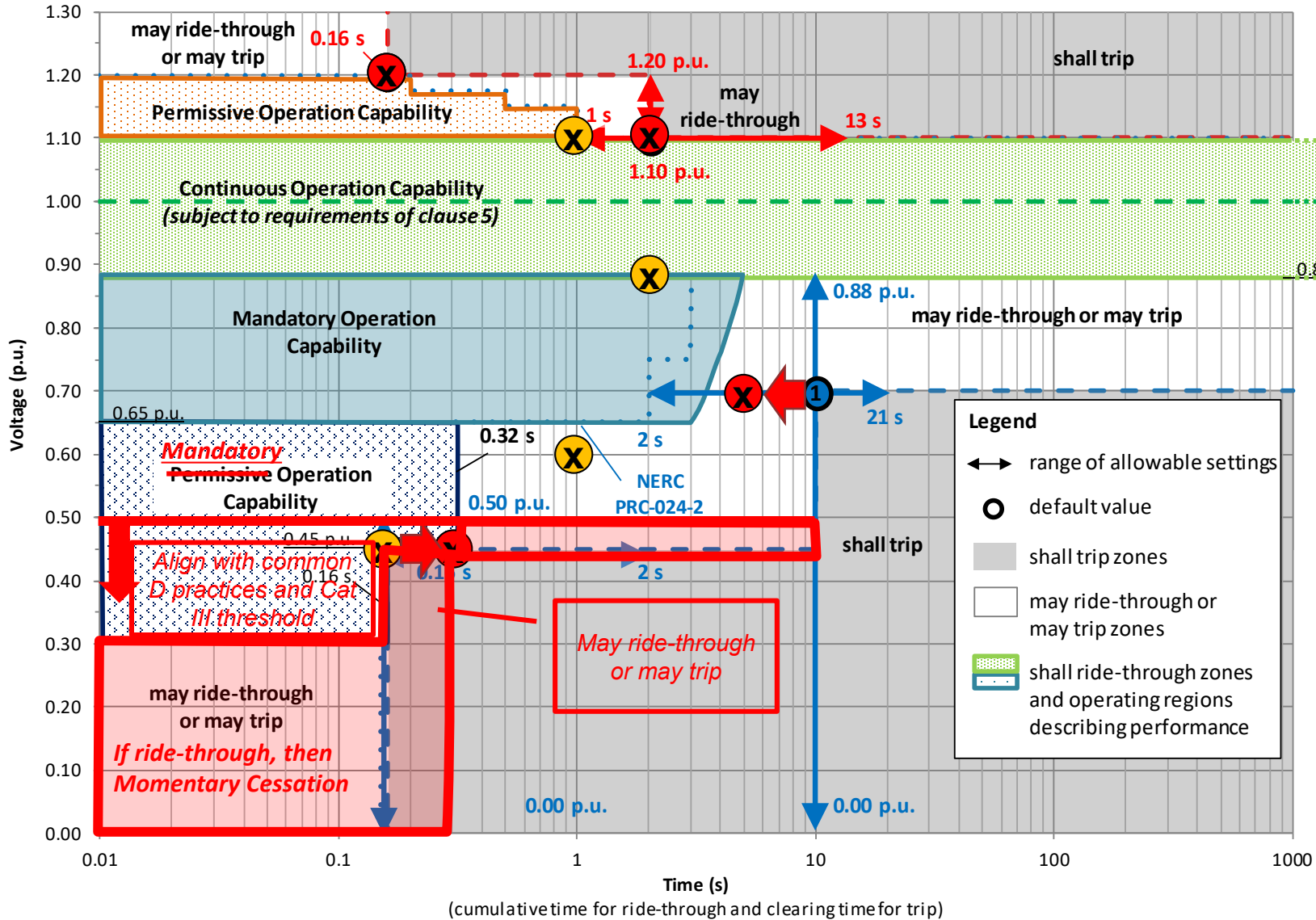
red = modification relative to 2nd proposal from 4th Pre-WS call

- Ride-through performance category assignment
 - Synchronous generation: Category I
 - Inverters-based generation & storage: Category II
 - Allow for exceptions with notification of MISO
- Clause 4.10 (Enter Service)
 - Clause 4.10.2 (Enter Service Criteria)
 - Default settings
 - Clause 4.10.3 (Performance during entering service)
 - Default settings – *MISO would welcome a longer ramp time but gives distribution utilities latitude to select shorter ramp time in which case they should notify MISO.*
- Clause 6.4.1 (Mandatory Voltage Tripping Requirements)
 - OV1, and OV2 default settings
 - UV1 = 5 sec – *bulk needs, AID, reclosing*
 - UV2 = default plus 160 ms margin = 320 ms
 - Allow for exceptions with notification of MISO
- Clause 6.5.1 (Mandatory Frequency Tripping Requirements)
 - Default settings – *UFLS is out of scope here but may have to be appropriately coordinated*
 - Do NOT allow for exceptions
- Clause 6.4.2.7.3 (Transition between performance operating regions for Category III DER)
 - Momentary Cessation mandatory for Inverters (Category II) in part of the Permissive Operation Capability Region
 - Momentary Cessation threshold of 0.5 pu = *default value for Cat III to align with common distribution practices and keep certification simple*
- Clause 6.5.2.7.2 (Frequency-DrXp (Frequency/Power) Operation)
 - Enabled per 1547, standard does not allow to disable
 - Default settings
 - Do NOT allow for exceptions
- Clause 6.4.2.6 (Dynamic Voltage Support)
 - Refer to guidance in IEEE P1547.2 (Guide - 2020)

(Guide, exceptions at company policy level should be notified to MISO)

MISO's 6th Straw Proposal – VRT for Inverters (Category II) (based on WS outcomes)

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- Ranges of allowable settings (↔) defined such that IEEE Std 1547a-2014 default settings (○) can be accommodated.
- Permissive Operation Capability region may include requirements for Momentary Cessation, similar to Category III. !
- Trip settings (X) proposed in MISO's 1st Straw Proposal
 - OV1, and OV2 default settings
 - UV1 = 5 sec.
 - UV2 = default plus 160 ms margin = 320 ms
 - Momentary Cessation threshold of 0.5 pu
 - For Dynamic Voltage Support, refer to guidance in IEEE P1547.2 (Guide - 2020)

Concerns of Distribution Grid Planners, Operators, and Line Workers

1. Unintentional islanding risk with DERs that ride-through disturbances and regulate voltage and/or frequency.
2. Coordination with distribution feeder relays and other equipment/practices.
 - i. DER coordination with Area EPS protection.
 - ii. DER coordination with Area EPS automatic reclosing. *Which utilities use instant reclosing on distribution feeders?*
 - iii. Coordination with under-frequency load-shedding, particularly for radial-fed substations when source is lost
3. Certification and re-verification and persistence of actual DER settings beyond assumption that specified settings are implemented. Firmware upgrades may affect AID methods? Remote upgrades?
4. DER impact on line workers' safety during hot-line maintenance. - X
5. Potential DER operation outside ANSI range in some cases, not only during unintentional islanding (only adjacent to our scope). *Improve understanding of Volt/Watt function and its settings beyond ANSI range.*
6. "Cease to energize" with or without electrical separation?

Follow-up actions

- Verify that all distribution feeder relays are capable of the specified ranges of allowable settings, or at least the MISO proposed settings:
 - Frequency relays
 - Voltage relays
- Verify whether all inverter-based DER (e.g., Forum for Inverter Integration Issues) are capable of reducing the momentary cessation threshold from 0.65 pu to 0.3 pu. and still comply with all other 1547 requirements, incl. restore output.
 - Fuel-cells
 - Synchronous generation behind inverters
- Discuss with UL and other certifiers / NRTLs whether equipment can / shall be certified to the MISO guideline.
- Check in IEEE Std 1547-2018 whether MC continues beyond ride-through.
- Bulk system planners to substantiate
 - Reason for MC threshold of less than 0.65 pu.
 - need for dynamic voltage support.
- Education of distribution utilities on needed adjustments of distribution equipment settings.
- Determine additional information on dynamic voltage support
 - DER vendor capabilities
 - DER performance

Schedule

Pre-Workshop Call	Objective
February 28, 2019, 1-3PM ET	Frame the challenge and need, and identify training resources available
March 14, 2019, 1-3PM ET	Q&A from call #1, presentation of strawman of the implementation guideline
March 28, 2019, 1-3PM ET	Discuss the strawman guideline, identify key concerns, identify stakeholders interested in giving presentations at the workshop in April
April 18, 2019, 1-3PM ET	Discuss list of concerns raised in call #3, workshop logistics, AOB
Workshop	Objective
April 23, 2019, 8:30 CT to April 24, 2019, 12:00 CT Registration	Develop regional guideline for ride-through performance category selection, specification of preferred settings for voltage/frequency trip, frequency droop, enter service
Post-Workshop Call	Objective
TBD	Review MISO's 6 th Straw Proposal that has been developed based on the discussions and outcomes from the workshop and follow-up actions

Work Plan

Item	Description	Time
MISO internal workshops	Internal workshops to digest and discuss IEEE 1547-2018	Late June - August 2018
Stakeholder workshop prep	Logistics Stakeholder communication and registration	October 2018 - March 2019
Stakeholder online training and pre-test	Pre-training and test required to register for the workshop	December 2018 - March 2019
Stakeholder workshop	Facilitated by MISO and EPRI	8:00 AM April 23, 2019 - 12:00 PM April 24, 2019
Reach stakeholder consensus of IEEE 1547 adoption	IEEE 1547 gives options to requirements adoption. This is to achieve a 'preferred' option in the MISO region.	August 2019
Publish MISO region guideline of IEEE 1547		August 2019