Default New England Bulk System Area Settings Requirement

Purpose

The purpose of this document is to create a required profile (NE Required Utility Profile) of settings from IEEE 1547-2018 (as amended by IEEE-1547a-2020) to ensure robust and predictable performance of DER for events on the bulk power system. This can help maintaining bulk power system reliability with increasing penetration of DER. This document was developed by the MA TSRG in conjunction with ISO-NE and supersedes the "Inverter Source Requirement Document of ISO New England."

Applicability

ALL DER projects of ALL sizes with applications submitted prior to June 1, 2022 are exempt from the requirements listed in this document, but are required to meet the ride through requirements listed in the ISO-NE Source Requirement – 2018.

ALL DER projects greater than 100KW with applications submitted on or after June 1, 2022 are subject to requirements described in this document. If UL1741-SB (Third Edition, Dated September 28, 2021) certification is not available at the time the application is submitted, it will be required prior to interconnection

ALL DER projects 100kW or less with applications submitted on or after October 1, 2022 are subject to the requirements described in this document. If UL1741-SB (Third Edition, Dated September 28, 2021) certification is not available at the time the application is submitted, it will be required prior to interconnection.

This document states the requirements for all DERs with the following sections:
Section 1-Requirements that apply to ALL DER
Section 2-Requirements that apply for DERs certified as UL1741-SB Grid Support Interactive Inverters
Section 3-Requirements that apply for non-inverter based DERs

The settings presented below are required default settings. Settings for individual facilities may need to be adjusted on a case-by-case basis per the utility requirements.

NOTE: All graphics in this document are used as a visualization tool. In the case of any differences between the graphics and the tables, the tables shall supersede the graphics and any discrepancies should be reported to the interconnecting utility and/or the MA TSRG.

Section 1-Requirements common to ALL DER

All applicable DER:

- Shall be compliant with the latest revision of IEEE-1547-2018 (as amended by IEEE-1547a-2020).
- Shall comply with the required default settings in this document. Tighter settings are not permitted unless otherwise approved in writing by the interconnecting utility.

1.1 Unintentional islanding for ALL DER

Per IEEE 1547- 2018 (as amended by IEEE-1547a-2020) Clause 8.1.1 “For an unintentional island in which the DER energizes a portion of the Area EPS through the PCC, the DER shall detect the island, cease to energize the Area EPS, and trip within 2 s of the formation of an island.” No requirements in this document shall be construed as an amendment, alteration or rescindment of this requirement.

1.2 Frequency trip settings for ALL DER

Table I: DER response (shall trip) to abnormal frequencies-Category I, Category II and Category III

Shall Trip Function	Required Settings		Comparison to default IEEE td. 1547-2018 for Category I II, III		
	Frequency (Hz)	Clearing Time(s)*	Frequency	Clearing Time (s)	Within Ranges of Allowable settings?
OF2	62.0	0.16	Identical	Identical	Yes
OF1	61.2	300.0	Identical	Identical	Yes
UF1	58.5	300.0	Identical	Identical	Yes
UF2	56.5	0.16	Identical	Identical	Yes

***** ALL DER device trip times shall account for relay/inverter processing times as prescribed by IEEE 1547-2018. In no instance may relay and/or inverter settings trip faster than permitted by IEEE 1547-2018.

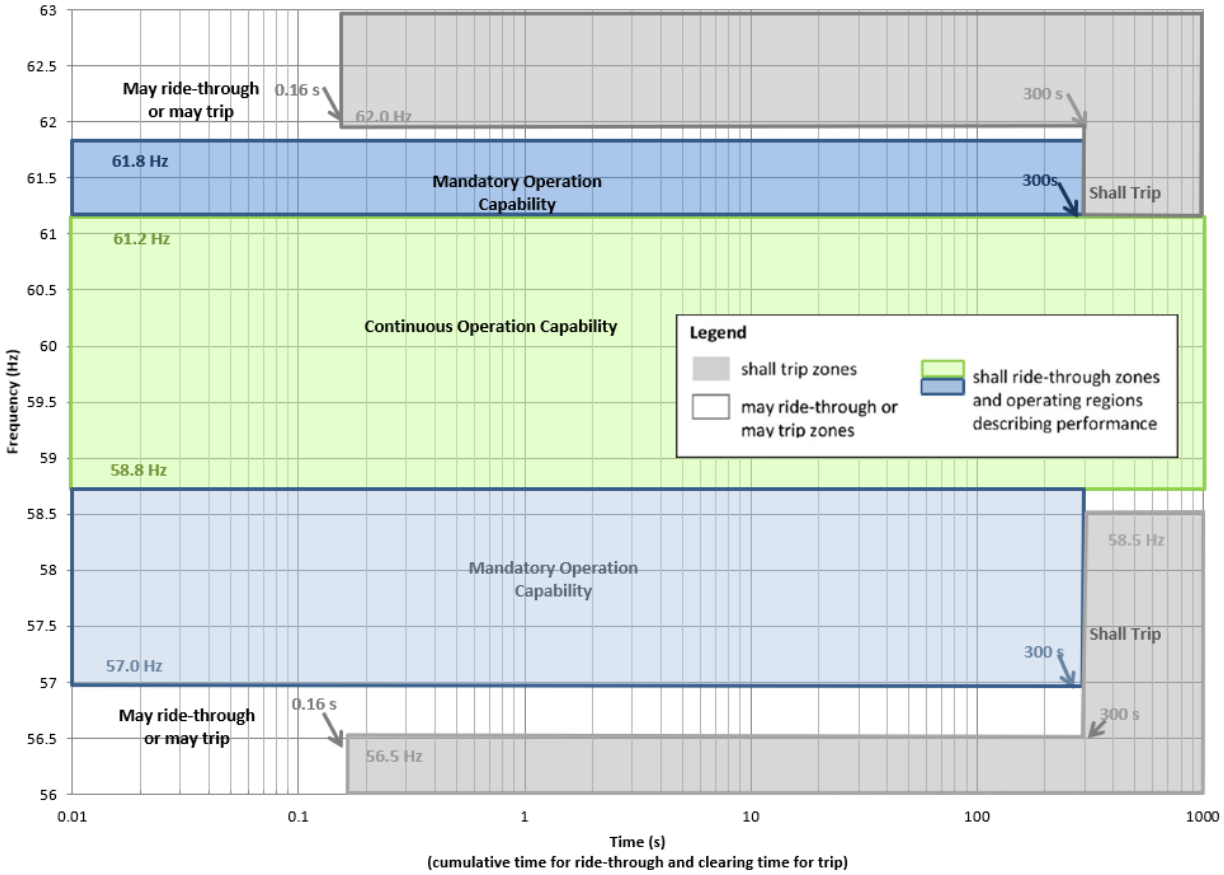
1.3 Abnormal frequency performance capability (ride-through) requirements for ALL DER

The DER shall have the ride-through capability per abnormal performance Category I, Category II and Category III as specified in IEEE 1547-2018 Section 6.5.2.1. Except when tripping in accordance with the other requirements of IEEE 1547-2018 and this document, the DER must ride through abnormal frequency conditions as required in IEEE 1547-2018. This is shown in Table II and Figure 1 in this document and the DER shall be capable of the entire ride through region required by the standard if the tripping requirements were to be adjusted or disabled.

NOTE: Per IEEE 1547- 2018, Clause 8.1.1, false detection of an unintentional island that does not actually exist shall not justify non-compliance with ride-through requirements.

Table II: Frequency ride-through requirements for DER of abnormal operating performance-Category I, Category II, and Category III

Frequency Range (Hz)	Operating Mode	Comparison to IEEE Std. 1547-2018 for Category I, II, III
$f > 62.0$	No ride-through requirements apply to this range	Identical
$61.2 < f \leq 61.8$	Mandatory Operation	Identical
$58.8 \leq f \leq 61.2$	Continuous Operation	Identical
$57.0 \leq f < 58.8$	Mandatory Operation	Identical
$f < 57.0$	No ride-through requirements apply to this range	Identical



NOTE: All diagrams are for illustrative purposes only and in no way change the requirements from those stated in the tables in this document and IEEE 1547-2018.

Figure 1: Frequency ride-through and trip requirements for DER of abnormal operating performance-Category I, Category II, and Category III

1.4 Grid Support Default Functions Statuses

The functions below required by IEEE 1547-2018 shall comply with the requirements specified in Table III by default.

Table III: Grid support utility interactive inverter default functions status

IEEE 1547-2018 Function	Default Activation State
Constant power factor mode	Unity
Frequency-droop mode (Freq-Watt)	ON[1]
Voltage—reactive power mode (Volt/VAR)	OFF
Active power—reactive power mode (Watt/VAR)	OFF
Constant reactive power mode (Fixed VAR)	OFF
Voltage—active power (Volt-Watt) mode	OFF

[1] Per IEEE 1547-2018, frequency-watt is not allowed to be turned off.

1.5 Return to service

The DER shall not connect or return to service following a trip (including any ground fault current sources) until detecting 5 minutes of healthy utility voltage and frequency in accordance with IEEE 1547-2018 Clause 4.10. The DER shall enter service in accordance with IEEE 1547-2018 Clause 4.10.3, part c. The DER active power output shall increase linearly or in a stepwise linear ramp with a default time of 300s, with steps no greater than 20% of the DER rating. The DER may increase slower than specified, or by other means requested by the DER impact study in accordance with 1547-2018.

Default Enter service delay[2]: 300s

Default Enter service duration: 300s (DER shall ramp according to IEEE 1547 for 5 minutes by default).

Exception 1: is permitted for all small-scale DERs in accordance with IEEE 1547-2018.

Exception 2: will be evaluated on a case-by-case basis. DERs 500kVA and larger desiring to use Exception 2 shall send the rationale and request to the utility. An additional 10 Business Days will be required to be added to all tariff milestones to accommodate utility processing/review as well as ISO review. All requests are subject to utility and ISO acceptance.

1.6 Rate of change of frequency (ROCOF) ride-through requirements

The DER shall ride through as stated in IEEE 1547-2018 Section 6.5.2.5 (Category III or Category I as applicable). The UL 1741 SB certification shall be considered sufficient for individual inverter based DER devices meeting ride through requirements for this function.

In addition, no site equipment (e.g. relays, controllers, etc. outside the inverter) is permitted to trip using this function.

The utility reserves the right to verify that protective relay settings & controller settings do not have ROCOF. Note that this will not verify ride through, nor does it imply that verification is required. No device(s) outside the certified inverter are permitted to enable ROCOF.

1.7 Voltage phase angle change ride through

All DERs shall meet the minimum voltage phase angle change ride through requirements in IEEE 1547-2018 Clause 6.5.2.6. The UL 1741 SB certification shall be considered sufficient for individual inverter-based DER devices meeting ride through requirements for this function.

In addition, no site equipment (e.g. relays, controllers, etc. outside the inverter) is permitted to trip using this function.

The utility reserves the right to verify that protective relay settings & controller settings do not have Voltage Phase Angle Change trip settings enabled. Note that this will not verify ride through, nor does it imply that verification is required. No device(s) outside the certified inverter are permitted to have Voltage Phase Angle Change trip settings enabled**.**

[2] The Enter Service delay is the legacy IEEE 1547-2003 five-minute healthy utility check, in which the inverter measures 5 minutes of healthy utility voltage & frequency prior to the DER coming back online.

1.8 General Requirements on Tripping

In accordance with IEEE 1547-2018, DER tripping requirements specified in this document shall take precedence over the abnormal performance capability (ride-through) requirements in this section, subject to the following:

1. Where the prescribed trip duration settings for the respective voltage or frequency magnitude are set at least 160 ms or 1% of the prescribed tripping time, whichever is greater, beyond the prescribed ride-through duration, the DER shall comply with the ride-through requirements specified in this section prior to tripping.

2. In all other cases, the ride-through requirements shall apply until 160 ms or 1% of the prescribed tripping time, whichever is greater, prior to the prescribed tripping time.

Section 2-Requirements for UL1741 SB certified inverter based DER

All applicable **inverter based DER**:

- Shall be compliant with the latest revision of IEEE 1547-2018
- Shall be certified under UL 1741 SB (Third Edition, Dated September 28, 2021) as a Grid Support Interactive Inverter to IEEE 1547-2018 Category III requirements.
- Shall provide documentation verifying certification, (e.g. UL 1741 SB certification document)
- Shall comply with the required default settings in this document. Tighter settings are not permitted unless otherwise approved in writing by the interconnecting utility.

2.1 Voltage trip settings

Applicable DER shall have the voltage trip settings specified in Table IV below.

Table IV: Certified inverter response (shall trip) to abnormal voltages -Category III

Shall Trip Function	Required Settings		Comparison to default IEEE Std. 1547-2018 (as amended by IEEE-1547a-2020) for Category III		
	Voltage (p.u. of nominal voltage)	Clearing Time(s)*	Voltage	Clearing Time (s)	Within ranges of allowable settings?
OV2	1.20	0.16	Identical	Identical	Yes
OV1	1.10	2.0	Identical	Much shorter (default is 13 s)	Yes
UV1	0.88	3.0	Identical	Much shorter (default is 21 s)	Yes
UV2	0.50	1.1	Identical	Shorter (default is 2 s)	Yes

***** ALL DER device trip times shall account for relay/inverter processing times as prescribed by IEEE 1547-2018. In no instance may relay and/or inverter settings trip faster than permitted by IEEE 1547-2018.

NOTE: No DER is permitted to energize an unintentional island for more than 2 seconds per IEEE 1547-2018 Clause 8.1.1 and Clause 1.1 of this document. The settings above do not change that requirement in any way.

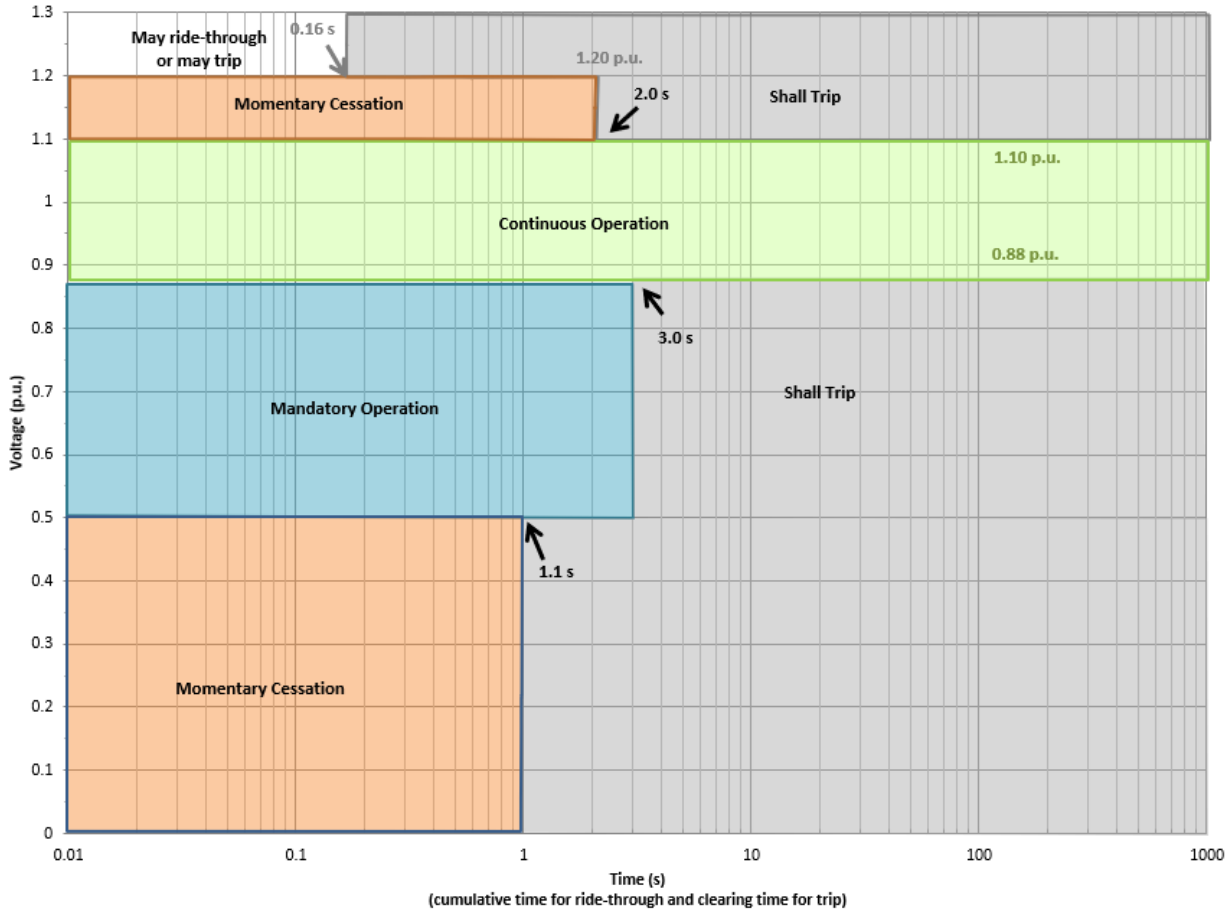
2.2 Abnormal voltage performance capability (ride-through) requirements

The DER shall have the ride-through capability per abnormal performance Category III of IEEE Std 1547-2018 Section 6.4.2.1. Except when tripping in accordance with the other requirements of IEEE 1547-2018 and this document, the DER must ride through abnormal voltage conditions as required by IEEE 1547-2018. This is shown in Table V and in Figure 2 in this document, and the DER shall be capable of the entire ride through region required by the standard if the tripping requirements were to be adjusted or disabled.

NOTE: Per IEEE 1547- 2018, Clause 8.1.1, false detection of an unintentional island that does not actually exist shall not justify non-compliance with ride-through requirements.

Table V: Voltage ride-through requirements for certified inverter abnormal operating performance-Category III

Voltage Range (p.u.)	Operating Mode/ Response	Comparison to IEEE Std. 1547-2018 for Category III
V > 1.20	Cease to Energize	Identical
1.10 < V ≤ 1.20	Momentary Cessation	Identical
0.88 ≤ V ≤ 1.10	Continuous Operation	Identical
0.5 ≤ V < 0.88	Mandatory Operation	Identical
V < 0.50	Momentary Cessation	Identical



NOTE: All diagrams are for illustrative purposes only and in no way change the requirements from those stated in the tables in this document and IEEE 1547-2018.

Figure 2: Voltage ride-through and trip requirements for certified Inverter abnormal operating Performance-Category III[3]

[3] As defined in IEEE 1547:
Mandatory Operation: Required continuance of active current and reactive current exchange of DER with utility's distribution system as prescribed, notwithstanding disturbances of the utility's distribution system voltage or frequency having magnitude and duration severity within defined limits.
Momentary Cessation: Temporarily cease to energize the utility's distribution system while connected to the utility's distribution system, in response to a disturbance of the applicable voltages or the system frequency, with the capability of immediate restore output of operation when the applicable voltages and the system frequency return to within defined ranges.
Continuous operation: Exchange of current between the DER and an EPS within prescribed behavior while connected to the Area EPS and while the applicable voltage and the system frequency is within
specified parameters.

2.3 Frequency-droop (frequency-power) capability

Table VI: Parameters of frequency droop (frequency power) operation of certified Inverter based DER-Category III

Required Default Settings		Comparison to IEEE Std. 1547-2018 Default Settings for Category III	
Parameter	**Settings**	**Settings**	**Within ranges of allowable settings?**
dbOF, dbUF (Hz)	0.036	Identical	Yes
kOF, kUF	0.05	Identical	Yes
T-response (small-signal) (s)	5	Identical	Yes

Section 3-Settings for non-inverter based DER

All applicable **non-inverter based DER**:

- Shall be compliant with the latest revision of IEEE 1547-2018
- Shall meet IEEE 1547-2018 Category I requirements
- Shall provide documentation verifying compliance to IEEE 1547-2018 Category I (e.g. UL 1741 SB certification document)
- Shall comply with the required default settings in this document. Tighter settings are not permitted unless otherwise approved in writing by the interconnecting utility.

3.1 Voltage trip settings

Applicable DER shall have the voltage trip settings specified in Tables VII below.

Table VII: Non- Inverter Based DER response (shall trip) to abnormal voltages – Category I

Shall Trip Function	Required Settings		Comparison to IEEE Std. 1547-2018 for Category I		
	Voltage (p.u. of nominal voltage)	**Clearing Time(s)***	**Voltage**	**Clearing Time (s)**	**Within ranges of allowable settings?**
OV2	1.20	0.16	Identical	Identical	Yes
OV1	1.10	2.0	Identical	Identical	Yes
UV1	0.88	2.0	Higher (default is 0.70 p.u.)	Identical	Yes
UV2	0.50	0.16	Slightly higher (default is 0.45 p.u.)	Identical	Yes

***** ALL DER device trip times shall account for relay/inverter processing times as prescribed by IEEE 1547-2018. In no instance may relay and/or inverter settings trip faster than permitted by IEEE 1547-2018.

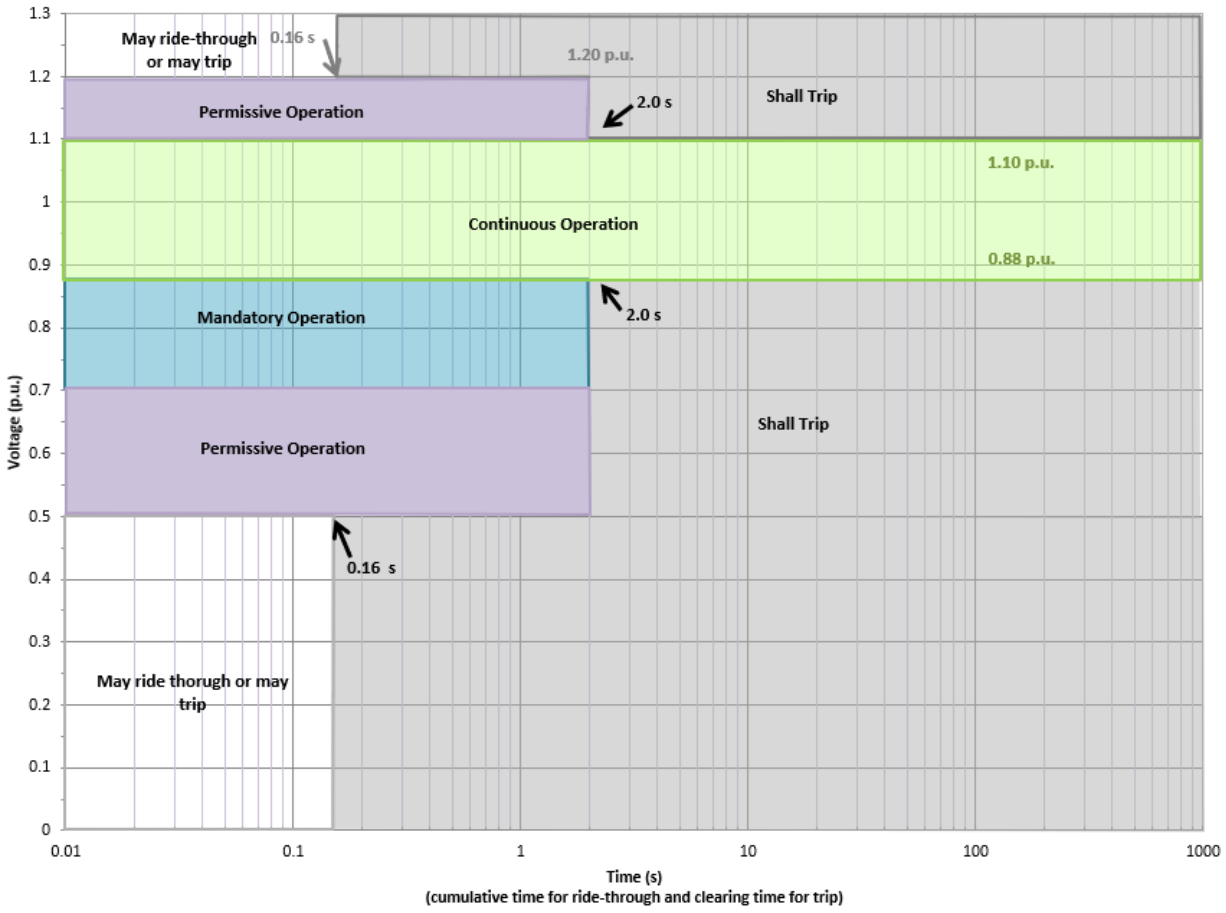
3.2 Abnormal voltage performance capability (ride-through) requirements

The non-inverter based DER shall have the ride-through capability per abnormal performance Category I of IEEE Std 1547-2018 Section 6.4.2.1. Except when tripping in accordance with the other requirements of IEEE 1547-2018 and this document, the DER shall ride through abnormal voltage conditions as required in IEEE 1547-2018. This is shown in Table VIII and Figure 3 in this document and the DER shall be capable of the entire ride through region required by the standard if the tripping requirements were to be adjusted or disabled.

NOTE: Per IEEE 1547- 2018, Clause 8.1.1, false detection of an unintentional island that does not actually exist shall not justify non-compliance with ride-through requirements.

Table VIII: Voltage ride-through and trip requirements for non – inverter based DER abnormal operating performance-Category I

Voltage Range (p.u.)	Operating Mode/ Response	Comparison to IEEE Std. 1547-2018 for Category I
V > 1.20	Cease to Energize	Identical
1.1 < V ≤ 1.20	Permissive Operation	Identical
0.88 ≤ V ≤ 1.10	Continuous Operation	Identical
0.70 ≤ V < 0.88	Mandatory Operation	Identical
0.5 ≤ V < 0.70	Permissive Operation	Identical
V < 0.50	Cease to Energize	Identical



NOTE: All diagrams are for illustrative purposes only and in no way change the requirements from those stated in the tables in this document and IEEE 1547-2018.

Figure 3: Voltage ride-through and trip requirements for non- inverter based DER abnormal operating performance - Category I[4]

[4]As defined by IEEE 1547-2018: Permissive Operation: Operating mode where the DER performs ride-through either in mandatory operation or in momentary cessation, in response to a disturbance of the applicable voltages or the system frequency.

3.3 Frequency-droop (frequency-power) capability

Table IX: Parameters of frequency droop (frequency power) default settings for non-inverter based DER-Category I

Required Settings		Comparison to IEEE Std. 1547-2018 for Category I Default Settings	
Parameter	**Settings**	**Settings**	**Within ranges of allowable settings?**
dbOF, dbUF (Hz)	1	Much higher (default is 0.036)	Yes
kOF, kUF	0.05	Identical	Yes
T-response (small-signal) (s)	10	Much higher (default is 5)	Yes