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.

Applicability

The requirements described in this document shall apply to all DER applications submitted on or after 04/01/2022.

Exception: DER projects 100 kW or less will be allowed to submit applications with original ISO-NE source requirement document until 06/01/2022.
This document states the requirements for all DERs with the following sections:
Section 1-Requirement that apply to ALL DER
Section 2-Requirements that apply for DERs certified as UL1741-SB Grid Support Interactive Inverters
Section 3-Requirement 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 plots 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 DER applications in Massachusetts are required to:

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

1. Unintentional islanding for ALL DER based application

Per IEEE 1547- 2018 (as amended by IEEE-1547a-2020) Clause 8.1.1 For an unintentional islanding 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 to this requirement.

2. Frequency trip settings for ALL DER based applications

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

3. Abnormal Frequency performance capability (ride-through) requirements for ALL DER based applications

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

Frequency Range (Hz)	Operating Mode	Minimum Time(s) (design criteria)	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 ≤ 61.8	Mandatory Operation	299	Identical
58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite	Identical
57.0 ≤ f < 58.8	Mandatory Operation	299	Identical
f < 57.0	No ride-through requirements apply to this range		Identical

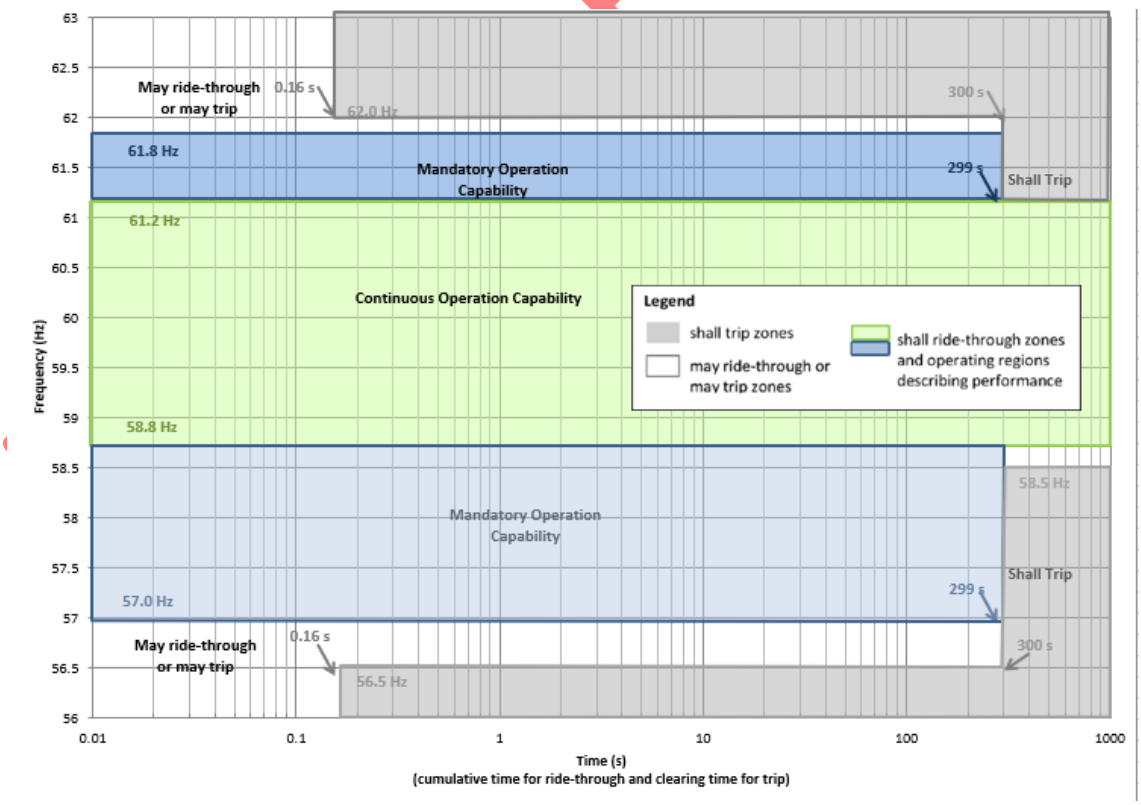

Figure 1: Frequency ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

4. Other grid support utility interactive inverter functions statuses

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

Table III: Grid Support Utility Interactive Inverter Default Functions Status

IEEE 1547-2018 Function	Default Activation State
Constant power factor mode	Unity
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

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[1]: 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] 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.

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. 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.

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 enable Voltage Phase Angle Change trip settings enabled.

Section 2-Requirements for UL1741 SB Certified Inverter-Based DER

All applicable **inverter based DER** applications are required to:

- Be compliant with the latest revision of IEEE1547-2018
- Be certified under UL1741 SB as a Grid Support Interactive Inverter
- Provide documentation verifying certification, (e.g. UL 1741 SB certification document)
- Comply with the required default settings in this document. Tighter settings are not permitted unless otherwise approved in writing by the interconnecting utility.

1. Voltage and frequency trip settings

Applications shall have the voltage and frequency trip points specified in Tables IV and V 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.

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.

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

2. Abnormal performance capability (ride-through) requirements

The inverters shall have the ride-through capability per abnormal performance category III of IEEE Std 1547-2018 as quoted in Tables III and IV.

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

Voltage Range (p.u.)	Operating Mode/ Response	Minimum Ride-through Time(s) (design criteria)	Maximum Response Time(s) (design criteria)	Comparison to IEEE Std. 1547-2018 for Category III
V > 1.20	Cease to Energize	N/A	0.16	Identical
1.10 < V ≤ 1.20	Momentary Cessation	12	0.083	Identical
0.88 ≤ V ≤ 1.10	Continuous Operation	infinite	N/A	Identical
0.70 ≤ V < 0.88	Mandatory Operation	20	N/A	Identical
0.5 ≤ V < 0.70	Mandatory Operation	10	N/A	Identical
V < 0.50	Momentary Cessation	1	0.083	Identical

*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.

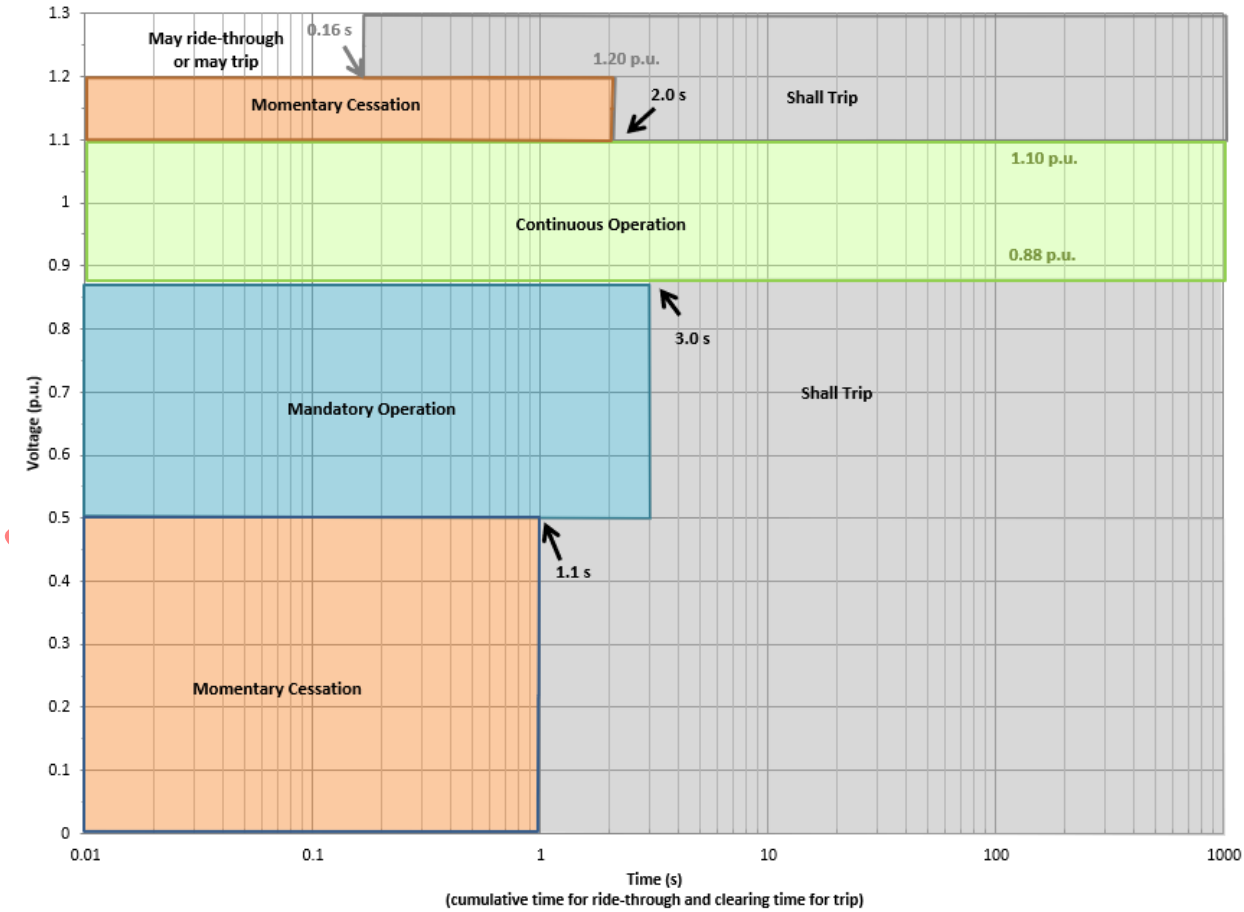

Figure 2: Voltage ride-through and trip requirements for certified Inverter abnormal operating performance Category III

3. Frequency-droop (frequency-power) capability

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

Required 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

The following requirements are applicable to Non- Inverter based DER.

1. Voltage and frequency trip settings

Applications shall have the voltage trip points specified in Tables VIII below.

Table VIII: 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

2. Abnormal 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 as quoted in Table VIII.

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

Voltage Range (p.u.)	Operating Mode/ Response	Minimum Ride-through Time(s) (design criteria)	Maximum Response Time(s) (design criteria)	Comparison to IEEE Std. 1547-2018 for Category I
V > 1.20	Cease to Energize	N/A	0.16	Identical
1.1175 < V ≤ 1.20	Permissive Operation	0.2	N/A	Identical
1.15<V ≤1.175	Permissive Operation	0.5	N/A	Identical
1.10<V ≤1.15	Permissive Operation	1	N/A	Identical
0.88 ≤ V ≤ 1.10	Continuous Operation	infinite	N/A	Identical
0.70 ≤ V < 0.88	Mandatory Operation	Linear slope of 4s/1p.u. voltage starting at 0.7s @0.7p.u.: $T_{VRT} = 0.7\ s + \frac{4s}{1\ p.u.}(V - 0.7\ p.u.)$	N/A	Identical
0.5 ≤ V < 0.70	Permissive Operation	0.16	N/A	Identical
V < 0.50	Cease to Energize	N/A	0.16	Identical

*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.

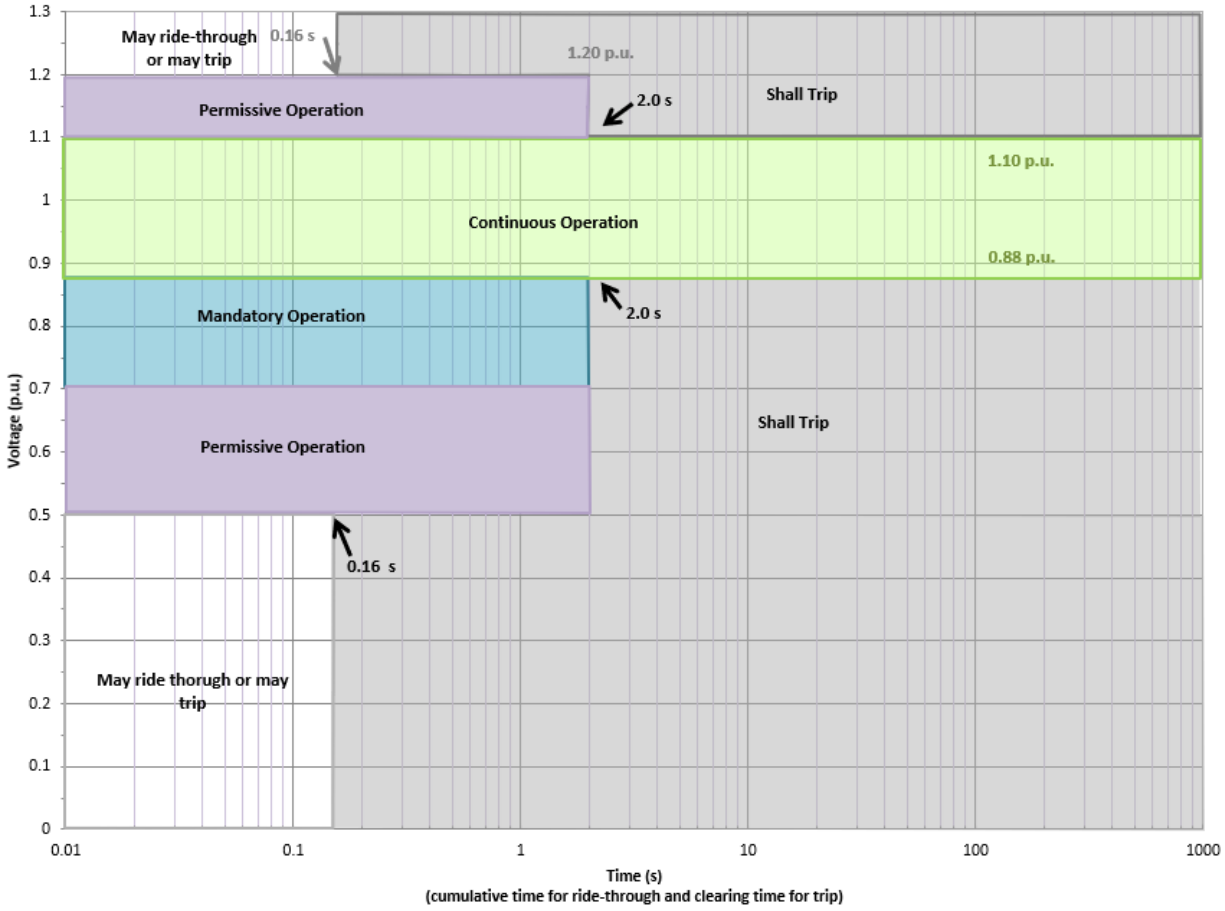

Figure 3: Voltage ride-through and trip requirements for non- Inverter based DER abnormal operating performance - Category I

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