Recommend Bulk System Support Settings for MA

This document is a DRAFT and is solely intended to solicit stakeholder Feedback.

This Source Requirement Document applies to all DER applications and shall be IEEE 1547-2018 complaint for interconnection applications after 01/01/2022.

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

DER settings shall be certified to include a New England default settings category

The settings will be divided into three categories:
Section 1-Settings common to ALL DER
Section 2-Settings for UL1741-SB certified Inverter based DER
Section 3-Settings for non-inverter based DER

Section 1- Settings common to ALL DER

1.Unintentional islanding for ALL DER based application

Per IEEE 1547- 2018, 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

Shall Trip Function	Required Settings	
	Frequency (Hz)	Clearing Time(s)
OF2	62.0	0.16
OF1	61.2	300.0
UF1	58.5	300.0
UF2	56.5	0.16

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)
f > 62.0	No ride-through requirements apply to this range	
61.2 < f ≤ 61.8	Mandatory Operation	299
58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite
57.0 ≤ f < 58.8	Mandatory Operation	299
f < 57.0	No ride-through requirements apply to this range	

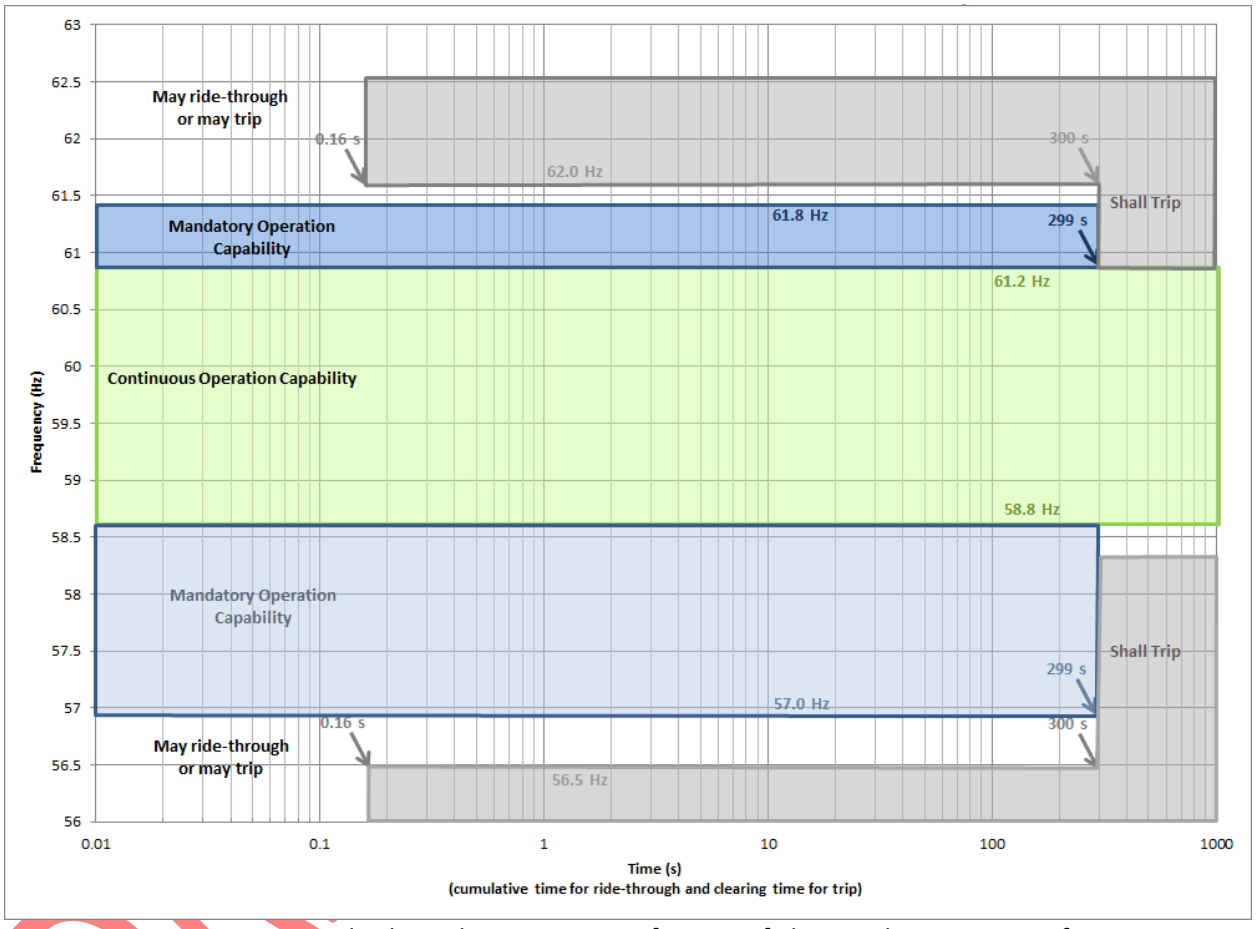

Figure 1: Frequency ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

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.

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.

Section 2-Settings for UL1741-SB certified Inverter based DER

The following requirement is applicable only to certified Inverter based DER. Non-certified inverters settings will be addressed through a detailed study with the area EPS operator.

1. Voltage and frequency trip settings for all certified Inverter based applications

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

Shall Trip – IEEE Std 1547-2018 Category III		
Shall Trip Function	**Required Settings**	
	Voltage (p.u. of nominal voltage)	**Clearing* Time(s)**
OV2	1.20	0.16
OV1	1.10	2.0
UV1	0.88	3.0
UV2	0.50	1.1

***** ALL DER device trip times shall be no less than 6 cycles less than the rated clearing times, in order to account for relay/inverter processing times + interrupting device opening 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 for DER based applications

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)
V > 1.20	Cease to Energize	N/A	0.16
1.10 < V ≤ 1.20	Momentary Cessation	12	0.083
0.88 ≤ V ≤ 1.10	Continuous Operation	infinite	N/A
0.70 ≤ V < 0.88	Mandatory Operation	20	N/A
0.5 ≤ V < 0.70	Mandatory Operation	10	N/A
V < 0.50	Momentary Cessation	N/A	0.083

*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.

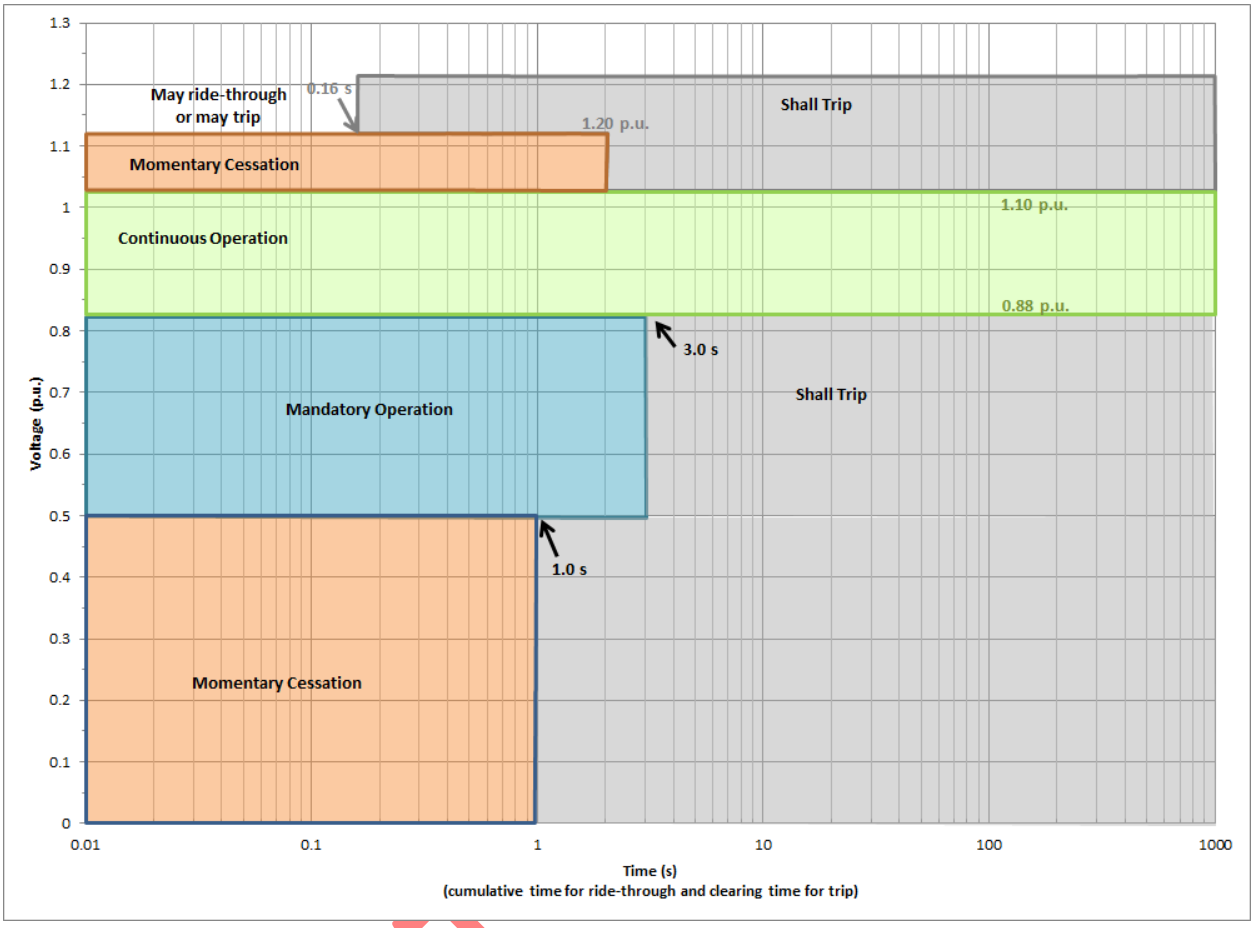

Figure 2: Voltage ride-through requirements for certified Inverter abnormal operating performance Category III

3. Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating performance Category III

Table VI: Minimum Ride Through requirements for ROCOF

Category III	3.0 Hz/s

In addition to meeting the ROCOF requirements in IEEE 1547-2018, any facility equipment not included in the UL 1741 SB certification is *not permitted* to enable any ROCOF functions.

Note: The utility reserves the right to verify protective relay settings & controller settings do not have these functions enabled. Note that this will not verify ride through, nor does it imply that verification is required. The UL 1741 SB certification shall be considered sufficient for individual inverter-based DER devices meeting ride through requirements for this function.

4.Frequency-droop (frequency-power) capability

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

Parameter	Inverter
dbOF, dbUF (Hz)	0.036
kOF, kUF	0.05
T-response (small-signal) (s)	5

5- National Grid will add language around passive anti-islanding settings such as phase jump and ride through requirements

All DERs shall meet the minimum voltage phase angle change ride through requirements in IEEE 1547-2018 clause 6.5.2.6. In addition, no site equipment (e.g relays, controllers, etc. outside the inverter) is permitted to trip using this function. The UL 1741 SB certification shall be considered sufficient for individual inverter-based DER devices meeting ride through requirements for this function.

Section 3-Settings for Non-Inverter based DER

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

1. Voltage and frequency trip settings for all non- Inverter based applications

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

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

Shall Trip – IEEE Std 1547-2018 Category I		
Shall Trip Function	**Required Settings**	
	Voltage (p.u. of nominal voltage)	**Clearing* Time(s)**
OV2	1.20	0.16
OV1	1.10	2.0
UV1	0.88	2.0
UV2	0.50	0.16

2.Abnormal performance capability (ride-through) requirements for DER based applications

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)**
V > 1.20	Cease to Energize	N/A	0.16
1.1175 < V ≤ 1.20	Permissive Operation	0.2	0.083
1.15<V ≤1.175	Permissive Operation	0.5	
1.10<V ≤1.15	Permissive Operation	1	
0.88 ≤ V ≤ 1.10	Continuous Operation	infinite	N/A
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
0.5 ≤ V < 0.70	Permissive Operation	0.16	N/A
V < 0.50	Cease to Energize	N/A	0.083

*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.

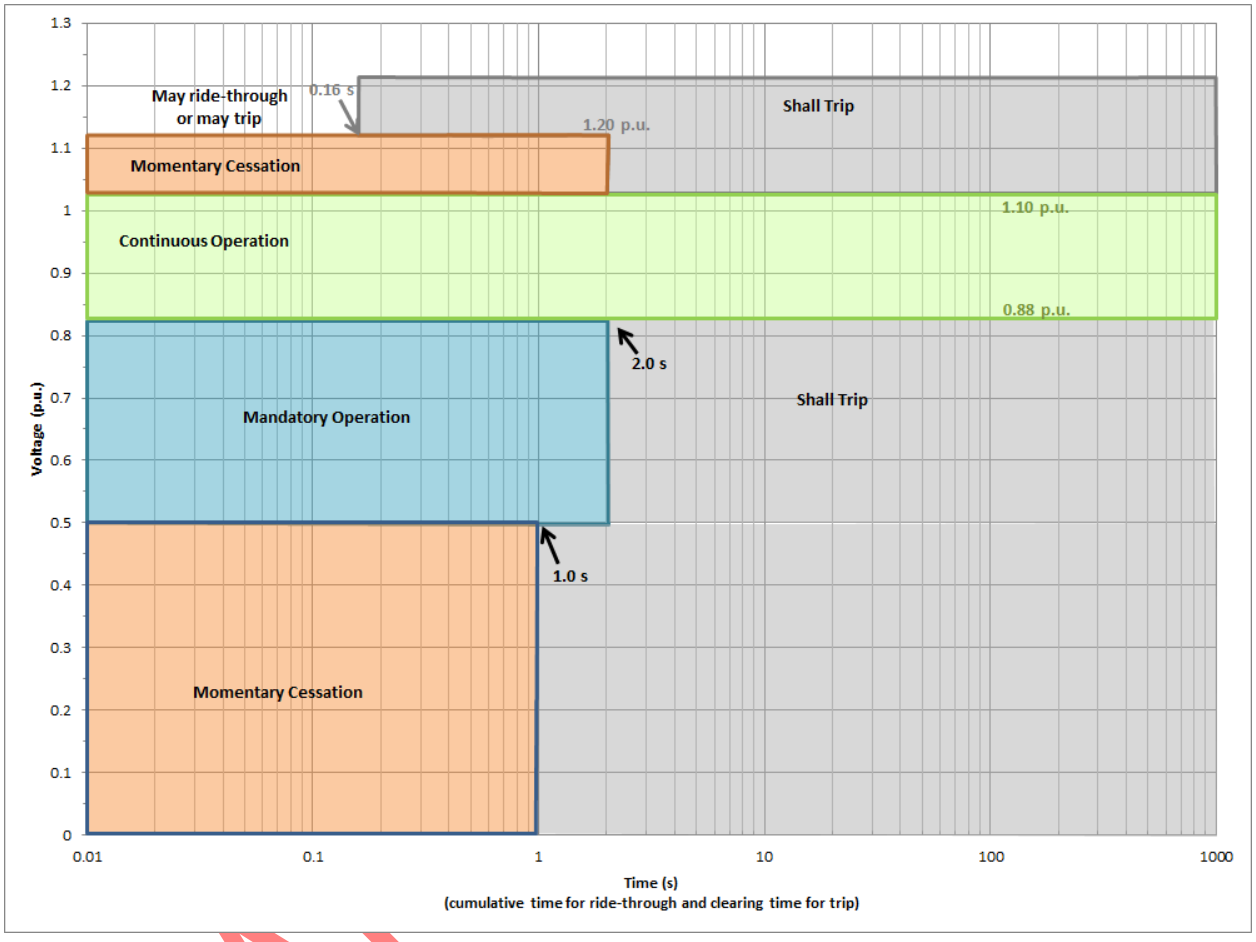

Figure 3: Voltage ride-through requirements for non- Inverter based DER abnormal operating performance - Category I

3.Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating

Rate of Change of Frequency (ROCOF) must be turned OFF/Disabled for non-inverter-based DER.

4.Frequency-droop (frequency-power) capability

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

Parameter	Settings
dbOF, dbUF (Hz)	1
kOF, kUF	0.05
T-response (small-signal) (s)	10