

BERMUDA ELECTRIC LIGHT COMPANY LIMITED
IEEE 1547.1-2020 STANDARD
SOURCE REQUIREMENTS DOCUMENT
VERSION 1.0

Part I – General

Inverter Manufacturers seeking approval from Bermuda Electric Light Company Limited (“BELCO”) to interconnect and interoperate Distributed Energy Resources (DER) on the Company’s grids must meet the certification testing requirements specified in this Source Requirements Document Version 1.0 (“SRD V1.0”). SRD V1.0 shall be used in conjunction with IEEE 1547.1-2020 – *Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces*.

The technical specifications and performance requirements specified herein are universally needed for interconnection and interoperability of DER on BELCO’s electric power system and will be sufficient for most installations.

Otherwise, inverters and controllers that have already been certified to the Hawaiian Electric requirements may be used. A list of certified inverters and controllers is updated from time to time and provided here:

https://www.hawaiianelectric.com/documents/products_and_services/customer_renewable_programs/customer_energy_resource_equipment/qualified_equipment_list.pdf

Normal and Abnormal Performance Category Requirement

For the application of this certification testing procedure, the following sets of performance categories are required:

1. Normal operating performance- Category B for voltage regulation performance and reactive power capability requirements (Refer to IEEE 1547-2018, Clause 5); and
2. Abnormal operating performance- Category III for disturbance ride-through requirements (Refer to IEEE 1547-2018, Clause 6)

Instructions for Certification Process

1. Use SRD V1.0 to certify to IEEE 1547.1-2020 with UL 1741 Supplement SB (or latest version) with modifications to specific requirements listed in Part II - *Non-Standardized Requirement* below.
2. All other tests not listed in Part II - *Non-Standardized Requirement*, certify to IEEE 1547- 2018 Category B of normal operating performance and Category III of abnormal operating performance requirements where applicable.
3. Inverter Manufacturers must submit “Certificates of Compliance” and Results Reporting¹ spreadsheet from nationally recognized testing laboratory (“NRTL”) to BELCO through solar@belco.bm.
4. The Certificates of Compliance must indicate certification to BELCO SRD V1.0. (See also UL 1741 Supplement SB – Ratings, Markings and Instructions².)

Part II - Non-Standardized Requirement

This section lists and describes the applicable requirements for capabilities or ranges of allowable settings that are different from IEEE 1547.1-2020 to help inverter manufacturers identify Company exceptions. Tables along with its footnotes were copied from IEEE 1547-2018. Highlighted rows show the non-standard requirements. For normative reference purposes, the 1547-2018 values are shown.

Enter Service

For certification testing purposes, the performance during entering service (IEEE 1547-2018 subclause 4.10.3), randomized delay shall not be implemented or shall have the option to be disabled if implemented as an option alongside a soft start ramping function.

For test procedures in IEEE 1547.1-2020 refer to the following section:

- 5.6.2 Procedure (*Exception 1* shall not apply)

¹ See also the 1547.1-2020 results reporting template form located at <https://standards.ieee.org>

² Grid Support Utility Interactive inverter or converter shall be rated, marked and include instructions in accordance with the applicable requirements for utility interactive inverters in accordance with UL 1741 Supplement SB.

Frequency ride-through

For certification testing purposes, the use of SRD V1.0 values are required.

IEEE 1547-2018 Table 19

**Frequency ride-through requirements for DER of abnormal operating performance
 Category III**

(see Figure H.10 from IEEE 1547-2018)

Frequency Range (Hz)		Operating Mode		Minimum time (s) (design criteria)	
1547-2018	SRD V1.0	1547-2018	SRD V1.0	1547-2018	SRD V1.0
$f > 62.0$	$f > 65.0$	No ride-through requirements apply to this range			
$61.2 < f \leq 61.8$	$63.0 < f \leq 65.0$	Mandatory Operation ^a	Mandatory Operation ^a	299	299
$58.8 \leq f \leq 61.2$	$57.0 \leq f \leq 63.0$	Continuous Operation ^{a,b}	Continuous Operation ^{a,b}	Infinite ^c	Indefinite
$57.0 \leq f < 58.8$	$50.0 \leq f < 57.0$	Mandatory Operation ^a	Mandatory Operation ^a	299	299
$f < 57.0$	$f < 50.0$	No ride-through requirements apply to this range			

^a Any DER shall provide the frequency-droop (frequency-power) operation for high-frequency conditions specified in 6.5.2.7.

^b DER of Category I may provide the frequency-droop (frequency-power) operation for low-frequency conditions specified in 6.5.2.7. DER of Category III shall provide the frequency-droop (frequency-power) operation for low-frequency conditions specified in 6.5.2.7 of IEEE 1547-2018.

^c For a per-unit ratio of Voltage/frequency limit of $V/f \leq 1.1$.

For test procedures in IEEE 1547.1-2020 refer to the following sections:

- 5.5.3 Test for low-frequency ride-through
- 5.5.4 Test for high-frequency ride-through

Frequency-droop

For certification testing purposes, the use of SRD V1.0 values are required.

IEEE 1547-2018 Table 24
Parameters of frequency-droop (frequency-power) operation for
DER of abnormal operating performance
Category III

Parameter	Ranges of allowable settings ^a	
	1547-2018 Category III	SRD V1.0
dbOF, dbUF (Hz)	0.017 ^b -1.0	0.017 -1.0
kOF, kUF	0.02-0.05	0.02 - 0.07
Tresponse (small-signal) (s)	0.2-10	0.2-10

^a For the single-sided deadband values (dbOF, dbUF) ranges, both the lower value and the upper value is a minimum requirement (wider settings shall be allowed). For the frequency droop values (kOF, kUF) ranges, the lower value is a limiting requirement (the setting shall not be set to lower values) and the upper value is a minimum requirement (the setting may be set to greater values). For the open-loop response time, T_{response} (small-signal), the upper value is a limiting requirement (the setting shall not be set to greater values) and the lower value is a minimum requirement (the setting may be set to lower values). Any settings different from the default settings in Table 24 shall be approved by the Company with due consideration of system dynamic oscillatory behavior.

^b A deadband of less than 0.017 Hz shall be permitted.

For test procedures in 1547.1-2020 refer to sections:

- 5.15.2 Test for frequency-droop (frequency-power or frequency-watt) capability-above nominal frequency
- 5.15.3 Test for frequency-droop (frequency-power or frequency-watt) capability-below nominal frequency