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July 1, 2022

Advice 6635-E
(Pacific Gas and Electric Company ID U 39 E)

Public Utilities Commission of the State of California

Subject: **Modifications to Electric Tariff Rule 21 to Incorporate IEEE 1547.1-2020 Test Procedures into Testing Regime for Phase 2 and 3 Requirements in Compliance with Resolutions E-5000 and E5036**

Purpose

The purpose of this advice letter is to modify Pacific Gas and Electric Company (PG&E) Electric Rule 21, (Rule 21) and the associated Generating Facility Interconnection process, pursuant to California Public Utilities Commission (CPUC, or Commission) Resolutions E-5000 and E-5036 to transition from UL1741SA to UL1741SB requirements (and to align with IEEE[1] 1547 2018 and IEEE 1547.1 2020 standards) for inverter-based Generating Facilities. The implementation transition proposed in this advice letter is designed to minimize disruption to existing processes, while allowing the inverter industry time to comply with the new UL1741SB requirements. This advice letter builds on what was initially proposed in Advice Letter (AL) 6093-E. The revised tariff sheets are listed on Attachment A and are attached hereto.

Background

Rulemaking 11-09-011[2]
The Commission initiated Rulemaking (R.)11-09-011 on September 22, 2011, to review and, if necessary, revise the rules and regulations governing the interconnection of generation and storage facilities to the electric distribution systems of IOU's[3]. The IOUs' rules and regulations pertaining to the interconnection of generating facilities are set forth in each of the IOU's Commission approved Rule 21.

[1] Institute of Electrical and Electronics Engineers (IEEE)
[2] R. 11-09-011 - *Order Instituting Rulemaking on the Commission's Own Motion to Improve Distribution Level Interconnection Rules and Regulations for Certain Classes of Electric Generators and Electric Storage Resources.*
[3] The Investor-Owned Utilities (IOUs) include, Pacific Gas and Electric Company (PG&E), Southern California Edison Company, and San Diego Gas & Electric Company (SDG&E).

Decision 16-06-052[4]
On June 23, 2016, the Commission adopted Decision (D.)16-06-052, which effectively established the Commission's clear policy direction toward communications capable smart inverters. The Decision directed the IOUs to file proposed revisions to Rule 21 setting forth any agreed upon technical requirements, testing and certification processes, and effective dates for the Phase 2 communications requirements and Phase 3 advanced functions.

Advice Letter 4982-E[5]
On December 20, 2016, PG&E submitted Advice Letter (AL) 4982-E establishing these requirements in its tariffs.

Resolution E-4832[6]
Resolution E-4832 approved AL 3532-E with modifications and established a mandatory effective date for Phase 2 communications that was defined as: the later of (a) March 1, 2018, or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard.

On March 31, 2017, the Smart Inverter Working Group (SIWG) issued final revisions to the Phase 3 recommendations.

Advice Letter 5129-E[7]
On August 18, 2017, PG&E submitted AL 5129-E to incorporate the recommendation with proposed Rule 21 tariff revisions that set forth agreed-upon technical requirements, testing and certification processes, and effective dates for the Phase 3 functions. In addition, the Phase 3 ALs proposed revisions to the smart inverters Phase 2 communications.

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4 **D. 16-06-052 -** *Alternate Decision Instituting Cost Certainty, Granting Joint Motions to Approve Proposed Revisions to Electric Tariff Rule 21, and Providing Smart Inverter Development a Pathway Forward for Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company*

5 AL 4982-E - *Modifications to Electric Tariff Rule 21 to Incorporate Communication Requirements for Smart Inverters (Phase 2)*

6 E-4832 - *Resolution E-4832. Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E), Approval with Modification of Revisions to Electric Tariff Rule 21 to Incorporate Smart Inverter Working Group (SIWG) Phase 2 Communications Recommendations in Compliance with Decision (D.) 16-06-052.* [SDG&E AL 3023-E, SCE AL 3532-E, and PG&E AL 4982-E]

7 AL 5129-E - *Modifications to PG&E's Electric Rule 21 Tariff and Interconnection Agreements and Forms to Incorporate Smart Inverter Phase 3 Modifications*

Resolution E-4898[8]
On April 26, 2018, the Commission issued Resolution E-4898 that approved, with modifications, the revisions to Rule 21 put forth in AL 3467-E, thereby adopting the Phase 3 recommendations.

Resolutions E-4832 and E-4898 established the compliance deadlines for the Phase 2 communication requirements and for Phase 3 Functions 1 (Monitor Key Data) and 8 (Scheduling) as nine months after the release of the SunSpec Alliance (SunSpec) communication protocol certification test standard, which set February 22, 2019, as the effective deadline.

CALSSA Extension Request
On November 19, 2018, California Solar & Storage Association (CALSSA) submitted a letter to the Executive Director requesting a six-month extension of this compliance deadline. This request was granted, extending the compliance deadline to August 22, 2019.

CALSSA Petition for Modification
CALSSA submitted a Petition for Modification (Petition) of Resolutions E-4832 and E-4898 on February 11, 2019, to request that the Commission "include more details and not exceed areas of consensus." In response to the Petition, the Commission issued Resolution E-5000 that clarified the implementation details of the smart inverter Phase 2 communications requirements and of Phase 3 Functions 1 and 8. In addition, Resolution E-5000 extended the compliance deadlines to January 22, 2020, for:

1) Phase 2 communications requirements;
2) Phase 3 Functions 1 and 8; and
3) Phase 3 Functions 2 (DER Disconnect and Reconnect) and 3 (Limit Maximum Active Power).

Resolution E-5000[9]
On July 11, 2019, Resolution E-5000, Ordering Paragraph (OP) 6 ordered the IOUs to submit a Tier 2 Advice Letter within nine months of publication of IEEE 1547.1-2020, proposing the new testing regime and reporting on which elements thereof were supported by the consensus of the SIWG. Additionally, the IOUs are required to report the items of non-consensus. The IEEE 1547.1-2020 test procedures were published May 21, 2020.

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[8] E-4898 - *Resolution E-4898. Approval, with Modifications, of Request for Modifications to Electric Rule 21 Tariff to Incorporate Smart Inverter Phase 3 Advanced Functions in Compliance with Decision 16-06-052* [Advice Letters (ALs) 5129-E (Pacific Gas and Electric) and 3647-E (Southern California Edison), Filed on August 18, 2017, and 3106-E (San Diego Gas & Electric)]

[9] Resolution E-5000 - *Resolution E-5000. Clarifies smart inverter communications requirements in response to the Petition of the California Solar & Storage Association for Modification of Resolution E-4832 and Resolutions E-4898.*

Advice Letter 6093-E[10]
On February 22, 2021, PG&E submitted Advice 6093-E proposing modifications to Electric Tariff Rule 21 to incorporate IEEE 1547.1-2020 Test Procedures into a Testing Regime for Phase 2 and 3 Requirements in compliance with Resolutions E-5000 and E-5036. The IOUs proposed that "the acceptance of attestations as sufficient evidence of compliance with Function 1 be extended until December 31, 2021, and new requirements under this AL for all Rule 21 updates to IEEE 1547-2018 and IEEE 1547.1-2020 be required as of January 1, 2022."

Due to ambiguities related to the UL174SB testing procedures, several sections of the UL1741SB required clarification to implement the requirements outlined in Advice 6093-E. To develop these clarifications, UL and interested stakeholders collaborated to develop clarifying language for various sections of UL1741SB.

On September 28, 2021, UL issued the 3rd revision of UL1741SB that included the necessary clarification to allow NRTLs to perform the required testing consistently across the industry.

Resolution E-5036[11]
On December 5, 2019, the CPUC issued Resolution E-5036 clarifying, amending and correcting Resolution E-5000.

Supplemental Advice Letter 6093-E-A[12]
On November 19, 2021, PG&E submitted supplemental Advice 6093-E-A to update and extend the attestation timeframe incorporating the IEEE 1547.1-2020 test procedures into the testing regime for Phase 2 and 3 requirements to March 28, 2023. Further, Advice 6093-E-A established that the requirements in Resolution E-5000 and subsequently modified in Resolution E-5036 would be clarified in a future advice letter, which will provide for a dual path where existing Rule 21 Section Hh will be utilized for available existing technologies and a separate section will allow technology that complies with requirements under UL1741SB. This provision will allow the industry to adapt to new requirements as requested by stakeholders in the October 28, 2021 SIWG meeting.

This Advice Letter
This advice letter incorporates in Rule 21 a transition plan from UL1741SA inverter requirements to new the UL1741SB requirements. To implement this transition and

[10] AL 6093-E - *Modifications to Electric Rule 21 Pursuant to Resolution E-5000 Ordering Paragraphs 6, 7, and 8 for IEEE 1547.1 Standards*
[11] Resolution E-5036 - *Resolution E-5036. Clarifies the testing requirements for smart inverter Phase 2 communications and corrects a typographical error in Resolution E-5000.*
[12] AL 6093-E-A – *Supplemental: Modifications to Electric Rule 21 Pursuant to Resolution E-5000 Ordering Paragraphs 6, 7, and 8 for IEEE 1547.1 Standards*

accounting for comments provided by stakeholders as part of the April 28, 2022, SIWG,[13] PG&E, in alignment with the other IOUs proposes a dual path for interconnection of inverter-based generators. In this proposal:

- the existing Rule 21 Section Hh can be utilized by customers who want to interconnect their inverter-based generator using existing requirements and
- a new Rule 21 Section P will be added to allow customers who want to interconnect their inverter-based generator using the new UL1741SB if the inverter complies with the requirements under UL1741SB.

The proposed transition schedule is as follows:

I. **August 1, 2022, to March 28, 2023,** –
During this transition period Applicants can use either of the two options below:

A. Use existing Rule 21 requirements in Rule 21 Section Hh for inverters that comply with the following requirements:
   1. U1741 and UL1741SA

   2. Attestation for Smart Inverter Phase 2 Communication requirements and Attestation for Smart Inverter Phase 3 requirements as established in Resolution E-5000 and as modified in Resolution E-5036

B. Use requirements as specified in Section P for Smart inverters that comply with the following requirements:
   1. UL1741 and UL174SB

   2. Attestation for Smart Inverter Phase 2 Communication requirements as established in Resolution E-5000 and as modified in ResolutionE-5036[14]

II. **April 1, 2023 -**
Following the transition period, full transition to UL1741 and 1741SB

A. Replace in its entirety the language in Rule 21 Section Hh with the language in Section P

[13] On May 6, 2022, as response to CPUC inquiry to the April 28, 2022, SIWG meeting, Tesla requested that the Transition Period commence on August 1, 2022, as opposed to the proposed September 1, 2022.

[14] Inverter manufacturers must continue to provide the information for CSIP certification or compatibility with a CSIP-compliant gateway as testing under UL1741SB does not account for this communication testing.

B. Retire Section P

C. Use requirements as specified in Section Hh for Smart Inverters that comply with the following requirements:
   1. UL1741 and UL174SB

   2. Attestation for Smart Inverter Phase 2 Communication requirements as established in Resolution E-5000 and as modified in ResolutionE-5036

Discussion

Aligning Rule 21 with IEEE 1547-2018

Resolution E-5000 OP 6 requires the IOUs to work with the SIWG to incorporate the new testing procedures, as appropriate, into the testing regime for Phase 2 and Phase 3 requirements.

In order to incorporate the IEEE1547.1-2020 testing procedures into Rule 21, it is necessary that the base standard requirements (IEEE1547-2018) also be incorporated into Rule 21. It is impractical and incomplete to only include the IEEE1547.1-2020 testing procedures without incorporating the base standard requirements.

In addition, as these testing procedures account for many functions within the base standard, the IOUs used this opportunity to align all the applicable technical requirements for inverter-based technology, mainly outlined in Rule 21 Section P, to the IEEE1547-2018 standard.

The proposed changes in this advice letter and in the attached Rule 21 tariff align PG&E's Rule 21 tariff to the applicable sections of IEEE1547-2018 and IEEE1547.1-2020.

Proposing the New Testing Regime

Phase 3 Function 1 – Monitor Key Data

In accordance with OP 7 of Resolution E-5000, manufacturer attestations are accepted as sufficient evidence of compliance with Phase 3 Function 1 (Monitor Key Data) until 18 months after the publication of a nationally recognized test procedure containing Phase 3 Function 1. IEEE 1547.1-2020 was published on May 21, 2020, and thus 18 months from such day is November 21, 2021. PG&E submitted Supplemental AL 6093-E-A that extended the ability to use attestations for compliance of this requirement until March 28, 2023.

Generating facilities with inverter-based generation that request interconnection during the transition period and which utilize Rule 21 Section P are not required to provide this attestation given that the testing of this functionality is incorporated in the UL1741SB testing procedure

Phase 3 Function 8 - Scheduling

OP 8 of Resolution E-5000 allows manufacturer attestations as sufficient evidence of compliance with Phase 3 Function 8 (Scheduling) until 12 months after the publication of a nationally recognized test procedure containing Phase 3 Function 8. Generating facilities that either meet CSIP IEEE 2030.5 requirements as set forth in Section Hh.5 or utilize Section P to interconnect (UL1741SB) will both comply with Phase 3 Function 8. Accordingly, PG&E no longer intends to require attestations to demonstrate compliance with Phase 3 Function 8.

Reply To Protests For Advice Letter 6093-E

PG&E received and replied to two comments for AL 6093-E. These protests and replies (with minor updates) are as follows:

A. CALSSA Protest:

CALSSA protested the timing of the new requirements as outlined in AL 6093-E and recommended that the compliance date for new inverter requirements be set for March 1, 2022. In replied to CALSSA's protest, the IOUs agreed with the recommendation. However, given the issues related to the UL174SB testing procedures, the time required to clarify the UL1741SB testing procedures, and the time required published UL1741SB 3rd edition, the IOUs now proposes that that the compliance effective day for new inverters to comply with UL1741SB requirements be set to April 1, 2023, while allowing for a transition period commencing on August 1, 2022. During the transition period, inverters can use either existing Hh requirements or UL1741SB requirement to be specified under new Rule 21 Section P. A transition plan was presented to the SIWG on December 9, 2021, where CALSSA was in attendance and no arguments against this implementation timeline were received, and thus the transition plan and compliance effective date as proposed in this advice letter should satisfy CALSSA's concerns.

B. Tesla Protest

Tesla Protest included several elements which included the use of "Distributed Energy Resources" in lieu of "Smart Inverters" and certain specific language changes to the new requirements to which IOUs responded as follows (with minor updates):

1. The term "Smart Inverter" used throughout the Advice Letters should be replaced with reference to "Distributed Energy Resources"

PG&E does not agree with Tesla on the universal replacement of the term "Smart Inverter" with "Distributed Energy Resources" for the following reasons:

a. While Tesla uses a site controller to meet the inverter performance requirements, most other inverter manufacturers still certify at the component (inverter level). Changing the term universally will negatively impact manufacturers that certify equipment at the inverter level as opposed to the controller level.

b. The approved listing[15] is based on inverters, not DER facilities, and thus existing inverter listings do not align with Tesla's proposal. PG&E utilizes the inverter listings to expedite the interconnection process of inverter-based generating facilities. Changing the term may also impact how PG&E currently utilizes the approved listing in its interconnection application tools.

c. When a requirement is not at the inverter level, PG&E has used the term "Generating Facility" to specify the requirements that are to be met by the Generating Facility and not necessary by the individual inverter component.

To address Tesla's concern as well as to address other stakeholders' comments during the March 17, 2022, SIWG meeting, a proposal was presented at the April 28, 2022, SIWG to add the following language to the introductory language of section P:

"When requirements for "Smart Inverter" are specified, those requirements can also be met by a "DER Interconnection System" as defined in this tariff"

No opposing comments during the meeting or after the meeting (such as through email) were received.

Therefore, inverter based generating systems can comply with Rule 21 Smart Inverter requirements per Rule 21 Section P at the inverter or at the DER Interconnection System. Under either option, a model number for the inverter or DER Interconnection System must be provided with UL1741 SB certificates of compliance which will allow PG&E to continue to process inverter-based generation projects in an expedited manner. Thus, when the term "Smart

[15] *Grid Support Solar Inverter List*, updated Mar. 11, 2021, *available at* https://www.energy.ca.gov/media/2366.

Inverter" is used in section P, it will be applicable to "Smart Inverter or DER Interconnection System"

PG&E would add the following definitions to Rule 21:

Distributed Energy Resource (DER): As defined in IEEE 1547-2018.

DER Interconnection System: As defined by "Interconnection System" in IEEE1547-2018

2. The Advice Letters inappropriately prescribe a "clearing time" for a device's ride through capability when it should refer to a "minimum time"

PG&E agrees that Rule 21 Table P 2.b Frequency Ride-Through Settings - 3rd column heading should be "Minimum Time(s)" consistent with IEEE 1547-2018, section 6.5.2, table 19

3. Additional information and clarification is needed regarding the proposed changes related to the reconnection ramp rate.

Additional clarifications or changes to the proposed language are not needed for the following reasons:

a. The proposed language is consistent with IEEE 1547-2018, Section 4.10.3;

b. Tesla's proposed terminology is from IEEE 1547-2018, Section 10, which is applicable to communication and not to the performance of the inverter or inverter system; and

c. The proposed language and default settings were discussed and agreed on by all Smart Inverter Working Group (SIWG) members who attended the January 14, 2021 SIWG meeting and thus changing terms now would be contrary to what the SIWG agreed on.

4. Additional information and clarification is needed regarding the proposed Frequency/Watt Settings.

PG&E agrees that additional clarification is needed on Rule 21 section P.2.l to::

- Clarify that the 36 mHz Deadband as provided in the Advice Letter applies dbOF and dbUF
- Specify the open loop response time of 5 seconds

PG&E notes definitions for dbOF, dbUF, kOF and KUF have been included in Rule 21 (section C). Those definitions are consistent with IEEE 1547-2018 section 6.5.2.7.2 (Frequency Droop).

To address this change, newly created Section P2.I will be updated.

5. **Additional information and clarification is needed regarding a number of the "Default Activation States" enumerated in the Advice Letters.**

PG&E agrees with Tesla that the term "Ram" in "Enter Ram Control" is a typographical error and should be corrected with "Ramp" and thus should instead be "Enter Ramp Control"

Regarding Tesla comments the removal of a *generic inverter ramp* rate requirement and a *new storage inverter rate requirement*, this topic was intensely discussed by the SIWG in the 12/17/2020, 1/7/2021 and 1/14/2021 meeting. On the 1/14/2021 SIWG meeting, the SIWG members who attended these meetings agreed on this change acknowledging that a general ramp control is not needed for solar systems given that based on several years of history, this general function for solar inverter has not been needed or utilized. However, with the higher utilization of storage inverters and because storage inverters can go from full charging to full discharging in a step function, the SIWG agreed that a ramp control was needed for Storage Inverters.

6. **Additional information and clarification is needed regarding the prescribed parameters governing constant reactive power**

PG&E confirms that the Open Loop Response in proposed Rule 21 section Hh.2.w is drawn from IEEE 1547-2018 and in specific from IEEE 1547-2018, 5.3.5.

To address this change, newly created Section P2.w will be updated.

7. **The IOUs should confirm that equipment manufactures can continue to select DNP3, Modbus or IEEE 2030.5 communication protocols for purposes of certifying to UL1741SB, so long as they maintain compliance to the California Smart Inverter Profile.**

PG&E confirm that the equipment manufacturers may choose any 1547-2018 protocol (DNP3, SunSpec Modbus or IEEE 2030.5) for UL1741SB certification while maintaining compliance with the Common Smart Inverter Profile (CSIP).

Proposed Tariff Changes

Consistent with the transition schedule provided above, a new Section P, entitled Smart Inverter Generating Facility Design and Operating Requirements for UL1741SB Inverters, has been added to Rule 21 and complies with IEEE 1547-2018 requirements.

Additional modifications have been made to other sections of Rule 21:

- New sections added to the Table of Contents
- References to UL 1741 Supplement B provided – see Sections L and Mm
- Sections modified to conform with IEEE 1547-2018 – see Sections B, G, H, and L
- Comments in reply to CALSSA's and Tesla's protests, as mentioned above, have been incorporated

No cost information is required for this advice letter.

This advice letter will not increase any rate or charge, cause the withdrawal of service, or conflict with any other schedule or rule.

Protests

Anyone wishing to protest this submittal may do so by letter sent electronically via E-mail, no later than **July 21, 2022**, which is 20 days after the date of this submittal. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
E-mail: EDTariffUnit@cpuc.ca.gov

The protest shall also be electronically sent to PG&E via E-mail at the address shown below on the same date it is electronically delivered to the Commission:

Sidney Bob Dietz II
Director, Regulatory Relations
c/o Megan Lawson
E-mail: PGETariffs@pge.com

Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name and e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

Effective Date

Pursuant to General Order (GO) 96-B, Rule 5.2, this advice letter is submitted with a Tier 2 designation. PG&E requests that this **Tier 2** advice submittal become effective on regular notice on **August 1, 2022,** which is the proposed start date of the first phase of the proposed transition schedule described above.

Notice

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically to parties shown on the attached list and the parties on the service list for **R.17-07-007, R. 11-09-011**. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission's Process Office at (415) 703-2021 or at Process_Office@cpuc.ca.gov. Send all electronic approvals to PGETariffs@pge.com. Advice letter submittals can also be accessed electronically at: http://www.pge.com/tariffs/.

/S/
Sidney Bob Dietz II
Director, Regulatory Relations

cc: Service List R.17-07-007, R.11-09-011

California Public Utilities Commission

ADVICE LETTER SUMMARY

ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: Pacific Gas and Electric Company (ID U39 E)

Utility type:
☑ ELC ☐ GAS ☐ WATER
☐ PLC ☐ HEAT

Contact Person: Kimberly Loo
Phone #: (415)973-4587
E-mail: PGETariffs@pge.com
E-mail Disposition Notice to: KELM@pge.com

EXPLANATION OF UTILITY TYPE
ELC = Electric GAS = Gas WATER = Water
PLC = Pipeline HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 6635-E

Tier Designation: 2

Subject of AL: Modifications to Electric Tariff Rule 21 to Incorporate IEEE 1547.1-2020 Test Procedures into Testing Regime for Phase 2 and 3 Requirements in Compliance with Resolutions E-5000 and E 5036

Keywords (choose from CPUC listing): Compliance, Rule 21

AL Type: ☐ Monthly ☐ Quarterly ☐ Annual ☑ One-Time ☐ Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #: Resolutions E-5000 and E-5036

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No

Summarize differences between the AL and the prior withdrawn or rejected AL:

Confidential treatment requested? ☐ Yes ☑ No

If yes, specification of confidential information:
Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required? ☐ Yes ☑ No

Requested effective date: 7/31/22

No. of tariff sheets: 75

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: See Attachment 1

Service affected and changes proposed[1]: N/A

Pending advice letters that revise the same tariff sheets: N/A

[1]Discuss in AL if more space is needed.

Clear Form

Protests and correspondence regarding this AL are to be sent via email and are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:

California Public Utilities Commission
Energy Division Tariff Unit Email:
EDTariffUnit@cpuc.ca.gov

Contact Name: Sidney Bob Dietz II, c/o Megan Lawson
Title: Director, Regulatory Relations
Utility/Entity Name: Pacific Gas and Electric Company

Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email: PGETariffs@pge.com

Contact Name:
Title:
Utility/Entity Name:

Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email:

CPUC
Energy Division Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102

Clear Form

Cal P.U.C. Sheet No.	Title of Sheet	Cancelling Cal P.U.C. Sheet No.
53600-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 1	42298-E
53601-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 13	52999-E
53602-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 14	53000-E
53603-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 16	42313-E
53604-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 17	42314-E
53605-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 18	42315-E
53606-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 19	42316-E
53607-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 20	50331-E
53608-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 21	42318-E
53609-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 26	50332-E
53610-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 27	50333-E
53611-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 28	42325-E
53612-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 29	42326-E
53613-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 30	52985-E

Cal P.U.C. Sheet No.	Title of Sheet	Cancelling Cal P.U.C. Sheet No.
53614-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 31	42328-E
53615-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 166	50829-E
53616-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 167	50830-E
53617-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 175	50838-E
53618-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 176	50839-E
53619-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 177	50840-E
53620-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 178	50841-E
53621-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 180	50843-E
53622-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 184	50847-E
53623-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 185	50848-E
53624-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 187	50850-E
53625-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 189	50852-E
53626-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 240	53013-E
53627-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 241	53014-E

Cal P.U.C. Sheet No.	Title of Sheet	Cancelling Cal P.U.C. Sheet No.
53628-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 245	53018-E
53629-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 246	53019-E
53630-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 247	53020-E
53631-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 249	53022-E
53632-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 269	53042-E
53633-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 284	
53634-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 285	
53635-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 286	
53636-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 287	
53637-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 288	
53638-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 289	
53639-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 290	
53640-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 291	
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ELECTRIC RULE NO. 21 Sheet 1
GENERATING FACILITY INTERCONNECTIONS

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B. APPLICABILITY (Cont'd.)

3. APPLICABLE CODES AND STANDARDS

This Rule has been harmonized with the requirements of Institute of Electrical and Electronic Engineers (IEEE) 1547-2010 Standards for Interconnecting Distributed Resources with Electric Power Systems. In some sections, IEEE 1547-2018 language has been adopted directly or by reference. In others, IEEE 1547-2018 requirements were interpreted and this Rule's language was changed to maintain the spirit of both documents. (T) (T) (T) (T) (D) (D)

The language from IEEE 1547-2018 that has been adopted directly or by reference (as opposed to paraphrased language or previous language that was determined to be consistent with IEEE 1547-2018) is followed by a citation that lists the clause from which the language derived. For example, IEEE 1547-4.1.1 is a reference to Clause 4.1.1. (T) (T)

In the event of any conflict between this Rule, any of the standards listed herein, or any other applicable standards or codes, the requirements of this Rule shall take precedence.

4. RETAIL CUSTOMER ENERGY STORAGE DEVICES

For retail customers interconnecting energy storage devices pursuant to this Rule, the load aspects of the storage devices will be treated pursuant to Rules 2, 3, 15, and 16 just like other load, using the incremental net load for non-residential customers, if any, of the storage devices.

5. APPLICABILITY OF IEEE 1547-2018 REQUIREMENTS (N)

The system's voltage at Point of Interconnection (POI) will determine the required Generating Facility operating requirements. Where voltage at the Point of Interconnection is less than 34.5 kV, for applicable generation technology, IEEE 1547-2018 and related certification requirement are required. Where POI voltage is greater than or equal to 34.5 kV, the Distribution Provider's Interconnection Handbook will outline operating and performance requirements consistent with North American Electric Reliability Corporation (NERC) and CAISO operating requirements. (N)

(L)

(Continued)

C. DEFINITIONS (T)

The definitions in this Section C are applicable only to this Rule, the Interconnection Request, Study Agreements and Generator Interconnection Agreements. (L)

Added Facilities: See Special Facilities.

Affected System: An electric system other than Distribution Provider's Distribution or Transmission System that may be affected by the proposed Interconnection. (L)

Affected System Operator: The entity that operates an Affected System.

Affiliate: With respect to a corporation, partnership or other entity, each such other corporation, partnership or other entity that directly or indirectly, through one or more intermediaries, controls, is controlled by, or is under common control with, such corporation, partnership or other entity.

Allocated Capacity: Existing aggregate generation capacity in megawatts (MW) interconnected to a substation/area bus, bank or circuit (i.e., amount of generation online).

Anti-Islanding: A control scheme installed as part of the Generating or Interconnection Facility that senses and prevents the formation of an Unintended Island.

Applicant: The entity submitting an Interconnection Request pursuant to this Rule.

Application: See Interconnection Request.

Available Capacity: Total Capacity less the sum of Allocated Capacity and Queued Capacity.

Base Case: Data including, but not limited to, base power flow, short circuit and dynamic/stability data bases, underlying load, generation, and transmission facility assumptions, contingency lists, including relevant special protection systems, and transmission diagrams used to perform the Interconnection Studies. The Base Case may include Critical Energy Infrastructure Information (as that term is defined by FERC). (Continued on next page.) (L)

(L)

(Continued)

C. DEFINITIONS (Cont'd.)

Base Case (Cont'd): The Base Case shall include (a) transmission facilities as approved by Distribution Provider or CAISO, as applicable, (b) planned Distribution Upgrades that may have an impact on the Interconnection Request, (c) Distribution Upgrades and Network Upgrades associated with generating facilities in (iv) below, and (d) generating facilities that (i) are directly interconnected to the Distribution System or CAISO Controlled Grid; (ii) are interconnected to Affected Systems and may have an impact on the Interconnection Request; (iii) have a pending request to interconnect to the Distribution System or an Affected System; or (iv) are not interconnected to the Distribution System or CAISO Controlled Grid, but are subject to a fully executed Generator Interconnection Agreement (or its equivalent predecessor agreement) or for which an unexecuted Generator Interconnection Agreement (or its equivalent predecessor agreement) has been requested to be filed with FERC. (L) I I I I I I I | | | | | (L)

Business Day: Monday through Friday, excluding Federal and State Holidays.

CAISO Controlled Grid: The system of transmission lines and associated facilities that have been placed under the CAISO's Operational Control.

CAISO Tariff: The California Independent System Operator FERC Electric Tariff.

Calendar Day: Any day, including Saturday, Sunday or a Federal and State Holiday.

Certification Test: A test pursuant to this Rule that verifies conformance of certain equipment with Commission-approved performance standards in order to be classified as Certified Equipment. Certification Tests are performed by Nationally Recognized Test Laboratories (NRTLs).

Certification; Certified; Certificate: The documented results of a successful Certification Testing.

Certified Equipment: Equipment that has passed all required Certification Tests.

Commercial Operation: The status of a Generating Facility that has commenced generating electricity, excluding electricity generated during the period which Producer is engaged in on-site test operations and commissioning of the Generating Facility prior to Commercial Operation. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Commercial Operation Date: The date on which a Generator at a Generating Facility commences Commercial Operation, as agreed to by the Parties. (L)

Commission: The Public Utilities Commission of the State of California. (L)

Commissioning Test: A test performed during the commissioning of all or part of a Generating Facility to achieve one or more of the following:

Verify specific aspects of its performance;

Calibrate its instrumentation;

Establish instrument or Protective Function set-points.

Confidential Information: See Section D.7.

Conservation Voltage Regulation (CVR): The CVR program that the Commission directed Distribution Provider to implement as applicable to the operation and design of distribution circuits and related service voltages.

Construction Activities: Actions by Distribution Provider that result in irrevocable financial commitments for the purchase of major electrical equipment or land for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades assigned to the Interconnection Customer that occur after receipt of all appropriate governmental approvals needed for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades.

Continuous Operation: The Smart Inverter operates indefinitely without tripping. Any functions that protect the Smart Inverter from damage may operate as needed.

Control Area: As defined in the CAISO Tariff.

Cost Envelope: A cost-certainty framework defined as plus or minus twenty-five (25) percent of the estimated cost of certain Interconnection Facilities and/or Distribution Upgrades identified in the Cost Envelope Estimate that is offered to an Applicant based on actual costs within such twenty-five (25) percent envelope. Applicant's cost responsibility for Interconnection Facilities and/or Distribution Upgrades subject to the Cost Envelope is set forth in Section F.7.b.

(Continued)

C. DEFINITIONS (Cont'd.)

Cost Envelope Option: A five-year pilot option described in Section F.7 applicable to Interconnection Requests for Generating Facilities that are processed under the Fast Track Process or Independent Study Process.

Cost Envelope Estimate: An estimate prepared by the Distribution Provider and delivered to Applicant pursuant to the Cost Envelope Option that contains (i) the estimated cost of Distribution Provider's required Interconnection Facilities and/or Distribution Upgrades that are offered to Applicant that are subject to the Cost Envelope, and (ii) the estimated costs of related activities and facilities that are excluded from the Cost Envelope and offered on an actual cost basis, both pursuant to Section F.7.

Customer: The entity that receives or is entitled to receive Distribution Service through Distribution Provider's Distribution System or is a retail Customer of Distribution Provider connected to the Transmission System.

db_{OF}: A single-sided deadband value for high-frequency in Hz used in Section P. (N)

db_{UF}: A single-sided deadband value for low-frequency in Hz used in Section P. (N)

Dedicated Transformer; Dedicated Distribution Transformer: A transformer that provides electricity service to a single Customer. The Customer may or may not have a Generating Facility.

Delivery Network Upgrades: The transmission facilities at or beyond the point where Distribution Provider's Distribution System interconnects to the CAISO Controlled Grid, other than Reliability Network Upgrades, as defined in the CAISO Tariff.

Detailed Study: An Independent Study, a Distribution Group Study or a WDT Transmission Cluster Study.

Detailed Study Agreement: The agreement entered into by the Interconnection Customer and Distribution Provider which sets forth the Parties' agreement to perform Interconnection Studies under the Independent Study Process or the Distribution Group Study Process.

Device: A mechanism or piece of equipment designed to serve a purpose or perform a function. The term may be used interchangeably with the terms "equipment" and function without intentional difference in meaning. See also Function and Protective Function.

(Continued)

C. DEFINITIONS (Cont'd.)

DGS Phase I Interconnection Study: Distribution Group Study (DGS) Phase I Interconnection Study performed by the Distribution Provider under the Distribution Group Study Process per Section G.3.c.i.

DGS Phase II Interconnection Study: Distribution Group Study (DGS) Phase II Interconnection Study performed by the Distribution provider under the Distribution Group Study Process per Section G.3.c.ii.

Dispute Resolution: See Section K.

Distributed Energy Resource (DER): As defined in IEEE 1547-2018. (N)

DER Interconnection System: As defined by "Interconnection System" in IEEE 1547-2018 (N)

Distribution Group Study: An interconnection engineering study of a group comprised of Interconnection Requests that pass Screen Q as a group and fail Screen R demonstrating they are electrically interdependent in accordance with Section F.3.c.

Distribution Group Study Process: The interconnection study process set forth in Section F.3.c.

Distribution Provider: Pacific Gas and Electric Company

Distribution Service: The service of delivering energy over the Distribution System pursuant to the approved tariffs of Distribution Provider other than services directly related to the Interconnection of a Generating Facility under this Rule.

Distribution Study Group: A group comprised of Interconnection Requests that fail Screen R that will be studied pursuant to Section F.3.c because the Screen R results demonstrate they are electrically interdependent.

Distribution System: All electrical wires, equipment, and other facilities owned or provided by Distribution Provider, other than Interconnection Facilities or the Transmission System, by which Distribution Provider provides Distribution Service to its Customers.

Distribution Upgrades: The additions, modifications, and upgrades to Distribution Provider's Distribution System at or beyond the Point of Interconnection to facilitate interconnection of the Generating Facility and render the Distribution Service. Distribution Upgrades do not include Interconnection Facilities.

(Continued)

C. DEFINITIONS (Cont'd.)

Interconnection Facilities Study: A study conducted by Distribution Provider for an Interconnection Customer under the Independent Study Process to determine a list of facilities (including Distribution Provider's Interconnection Facilities, Distribution Upgrades, and Network Upgrades as identified in the Interconnection System Impact Study), the cost of those facilities, and the time required to interconnect the Generating Facility with Distribution Provider's Distribution or Transmission System. The scope of the study is defined in Section G.3.c. (P/(L)

Interconnection Financial Security: Any of the financial instruments listed in Section F.4.a. (P/L)

Interconnection Request: An Applicant's request to interconnect a new Generating Facility, or to increase the capacity of, or make a Material Modification to the operating characteristics of, an existing Generating Facility that is interconnected with Distribution Provider's Distribution or Transmission System.

Interconnection Study: A study to establish the requirements for Interconnection of a Generating Facility with Distribution Provider's Distribution System or Transmission System, pursuant to this Rule.

Interconnection System Impact Study: An engineering study conducted by Distribution Provider for an Interconnection Customer under the Independent Study Process that evaluates the impact of the proposed interconnection on the safety and reliability of Distribution Provider's Distribution and/or Transmission System and, if applicable, an Affected System. The scope of the study is defined in Section G.3.c.i.

Island; Islanding: A condition on Distribution Provider's Distribution System in which one or more Generating Facilities deliver power to Customers using a portion of Distribution Provider's Distribution System that is electrically isolated from the remainder of Distribution Provider's Distribution System.

k_{OF}: The per-unit frequency change corresponding to 1 per-unit power output change (frequency droop), unitless used in Section P. (N)

k_{UF}: The per-unit frequency change corresponding to 1 per-unit power output change (frequency droop), unitless used in Section P. (N)

Large Generating Facility: A Generating Facility having a Generating Facility Capacity of more than 20 MW. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Like for like: For inverters, like-for-like means certified, same nameplate or smaller, same fault current or smaller. For solar panels, like-for-like means certified, same CEC-AC rating of the system or smaller. For batteries, like-for-like means same or less kWh & kW rating and same operating profile. For transformers, like-for-like means same connection type, same or smaller impedance and capacity. (L)

Line Section: That portion of Distribution Provider's Distribution or Transmission System connected to a Customer bounded by automatic sectionalizing devices or the end of the distribution line. (P/L)

Local DER Generating Facility Communication Interface: Interface at the Generating Facility capable of communicating to support the information exchange requirements specified in this rule and as required in IEEE 1547-2018 for all applicable functions that are in Section P. (N)

Local Furnishing Bond: Tax-exempt bonds utilized to finance facilities for the local furnishing of electric energy, as described in Internal Revenue Code, 26 U.S.C. § 142(f). (P/L)

Local Furnishing Distribution Provider: Any Distribution Provider that owns facilities financed by Local Furnishing Bonds. (P/L)

Mandatory Operation: The Smart Inverter operates at maximum available current without tripping during Distribution Provider's Transmission or Distribution System excursions outside the region of continuous operation. Any functions that protect the Smart Inverter from damage may operate as needed.

Material Modification: Those modifications that have a material impact on cost or timing of any Interconnection Request with a later queue priority date or a change in Point of Interconnection. A Material Modification does not include a change in ownership of a Generating Facility, (ii) a modification described in Table F.1, nor (iii) a modification described in Tables Ee.1, 2 or 3 that does not require a new interconnection request.

Metering: The measurement of electrical power in kilowatts (kW) and/or energy in kilowatt-hours (kWh), and if necessary, reactive power in kVAR at a point, and its display to Distribution Provider, as required by this Rule.

Metering Equipment: All equipment, hardware, software including meter cabinets, conduit, etc., that are necessary for Metering. (L)

(L)

(Continued)

C. DEFINITIONS (Cont'd.)

Momentary Cessation: The Smart Inverter momentarily reduces current output to the Distribution Provider's Transmission or Distribution System to below 10% of the maximum continuous output current rating. The Smart Inverter is allowed to increase current output to the Distribution Provider's Transmission or Distribution System without any intentional reconnection delay once voltage exits the Momentary Cessation region and enters a Permissive Operation region or Continuous Operation region. (L)

Momentary Parallel Operation: The Interconnection of a Generating Facility to the Distribution and Transmission System for one second (60 cycles) or less. (P/L)

Nationally Recognized Testing Laboratory (NRTL): A laboratory accredited to perform the Certification Testing requirements under this Rule.

Net Energy Metering (NEM): Metering for the receipt and delivery of electricity between Producer and Distribution Provider pursuant to California Public Utilities Code (PUC) sections 2827, 2827.1 (as currently implemented by Commission Decision (D.)16-01-044), 2827.8, or 2827.10.

NEM-1: Refers to Interconnection Requests for service pursuant to Schedules NEM, NEMV, and NEMVMASH.

NEM-2: Refers to Interconnection Requests for service pursuant to Schedules NEM2, NEM2V, NEM2VMSH, and NEM2VSOM. (P/L)

Net Rating or Net Nameplate Rating: The Gross Rating minus the consumption of electrical power of the auxiliary load.

Network Upgrades: Delivery Network Upgrades and Reliability Network Upgrades.

Networked Secondary System: An AC distribution system where the secondaries of the distribution transformers are connected to a common bus for supplying electricity directly to consumers. There are two types of secondary networks: grid networks (also referred to as area networks or street networks) and Spot Networks. Synonyms: Secondary Network. Refer to IEEE 1547.6 for additional detail.

Non-Emergency: Conditions or situations that are not Emergencies, including but not limited to meter reading, inspection, testing, routine repairs, replacement, and maintenance.

Nominal: Standard frequency and voltage. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Non-Export; Non-Exporting: When the Generating Facility is sized and designed such that the Generator output is used for Host Load only and is designed to prevent the transfer of electrical energy from the Generating Facility to Distribution Provider's Distribution or Transmission System. (L) | | (L)

Non-Export AC/DC Converter: A one-way only device that takes alternating current (AC) power from the Distribution System and converts it into direct current (DC) power for DC loads in the Customer's facility. A Non-Export AC/DC Converter must be certified by a Nationally Recognized Test Lab as non-export, meaning it must be certified to not export power back into the grid (i.e. exports less than 0.5% of its rated current towards the grid under steady–state conditions or after 5 cycles of an induced fault condition) and it must meet IEEE 1547-4.3.3 harmonic requirements. Until a national certification standard is approved and the Non-Export AC/DC Converter can be certified by a NRTL, the requirement can be satisfied through Distribution Provider's interim approval process. An interim approval will apply to devices that complete the Distribution Provider's testing procedure described in Section L.7.a.v. The interim approval will be effective upon the Distribution Provider acknowledging that the test results for a particular model of Non-Export AC/DC Converter confirm satisfactory completion of the testing procedures. Twelve months after the UL 1741 Non-Export Certification Requirement Document (CRD) standard is available, new interconnections requests for non-export using an AC/DC converter must use an NRTL certified non-export converter.

Non-Islanding: Designed to detect and disconnect from a stable Unintended Island with matched load and generation. Reliance solely on under/over voltage and frequency trip is not considered sufficient to qualify as Non-Islanding.

Open Loop Response Time: The duration from a step change in control signal input (reference value) until the output changes to 90 percent of its final change, before any overshoot.

Parallel Operation: The simultaneous operation of a Generator with power delivered or received by Distribution Provider while Interconnected. For the purpose of this Rule, Parallel Operation includes only those Generating Facilities that are Interconnected with Distribution Provider's Distribution or Transmission System for more than 60 cycles (one second).

Paralleling Device: An electrical device, typically a circuit breaker, operating under the control of a synchronization relay or by a qualified operator to connect an energized generator to an energized electric power system or two energized power systems to each other.

(Continued)

C. DEFINITIONS (Cont'd.)

Party, Parties: Applicant or Distribution Provider.

Periodic Test: A test performed on part or all of a Generating Facility/Interconnection Facilities at pre-determined time or operational intervals to achieve one or more of the following: 1) verify specific aspects of its performance; 2) calibrate instrumentation; and 3) verify and re-establish instrument or Protective Function set-points.

Permissive Operation: The Smart Inverter is allowed, but not required, to operate at any current level.

Point of Common Coupling (PCC): The transfer point for electricity between the electrical conductors of Distribution Provider and the electrical conductors of Producer.

Point of Interconnection (POI): The point where the Interconnection Facilities connect with Distribution Provider's Distribution or Transmission System. This may or may not be coincident with the Point of Common Coupling. (T)

Point of Generating Resource Connection (POC): The point where a DER unit is electrically connected in a Generating Facility and meets the requirements of this rule. (N) | (N)

Pre-Construction Activities: The actions by Distribution Provider, other than those required by an Engineering and Procurement Agreement under Section F.3.f, undertaken prior to Construction Activities in order to prepare for the construction of Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades assigned to the Interconnection Customer, including, but not limited to, preliminary engineering, permitting activities, environmental analysis, or other activities specifically needed to obtain governmental approvals for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades.

(Continued)

C. DEFINITIONS (Cont'd.)

Producer: The entity that executes a Generator Interconnection Agreement with Distribution Provider. Producer may or may not own or operate the Generating Facility, but is responsible for the rights and obligations related to the Generator Interconnection Agreement.

Production Test: A test performed on each device coming off the production line to verify certain aspects of its performance.

Protective Function(s): The equipment, hardware and/or software in a Generating Facility (whether discrete or integrated with other functions) whose purpose is to protect against Unsafe Operating Conditions.

Prudent Electrical Practices: Those practices, methods, and equipment, as changed from time to time, that are commonly used in prudent electrical engineering and operations to design and operate electric equipment lawfully and with safety, dependability, efficiency, and economy.

Queue Position: See Section E.5.C.

Queued Capacity: Aggregate queued generation capacity (in MW) for a substation/area bus, bank or circuit (i.e., amount of generation in the queue).

Reasonable Efforts: With respect to an action required to be attempted or taken by a Party under this Rule, efforts that are timely and consistent with Good Utility Practice and are otherwise substantially equivalent to those a Party would use to protect its own interests.

Reference Point of Applicability (RPA): The location where the Generating Facility interconnection and interoperability performance requirements shall be met. (N) | (N)

Reliability Network Upgrades: The transmission facilities at or beyond the point where Distribution Provider's Distribution System interconnects to the CAISO Controlled Grid, necessary to interconnect one or more Generating Facility(ies) safely and reliably to the CAISO Controlled Grid, as defined in the CAISO Tariff.

Section 218 Load: Electrical power that is supplied in compliance with California PUC section 218. PUC section 218 defines an "Electric Corporation" and provides conditions under which a transaction involving a Generating Facility would not classify a Producer as an Electric Corporation. These conditions relate to "over-the-fence" sale of electricity from a Generating Facility without using Distribution Provider's Distribution or Transmission System.

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

a. Screen N: Penetration Test (Cont'd.)

Note 4: Distribution Provider will not consider as part of the aggregate Generating Facility capacity for purposes of this screen Generating Facility capacity known to be already reflected in the minimum load data.

Note 5: NEM Generating Facilities with net export less than or equal to 500 kW that may flow across the Point of Common Coupling into Distribution Provider's Distribution or Transmission System will not be studied in the WDT Transmission Cluster Study Process, but may be studied under the Independent Study Process.

Significance: Penetration of Generating Facility capacity that does not result in power flow from the circuit back toward the substation will have a minimal impact on equipment loading, operation, and protection of the Distribution System.

b. Screen O: Power Quality and Voltage Tests

In aggregate with existing Generating Facility capacity on the Line Section, distribution circuit, and/or substation.

i) Can it be determined within the Supplemental Review that the voltage regulation on the line section can be maintained in compliance with Commission Rule 2 and/or Conservation Voltage Regulation voltage requirements under all system conditions?

ii) Can it be determined within the Supplemental Review that the voltage fluctuation is within acceptable limits as defined by IEEE 1547-2018 or utility practice similar to IEEE 1547-2018? (T)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

b. Screen O: Power Quality and Voltage Tests (Cont'd.)

In aggregate with existing Generating Facility capacity on the Line Section, distribution circuit, and/or substation. (Cont'd.)

iii) Can it be determined within the Supplemental Review that the harmonic levels meet IEEE 1547-2018, 7.3 limits at the Point of Common Coupling (PCC)? (T)

iv) Can it be determined within the Supplemental Review that the Generating Facility will not cause any voltage impacts considering the settings of the Volt-Var function and the characteristics of the circuit segment?

- If yes to all of the above (pass), continue to Screen P.
- If no to any of the above (fail), a quick review of the failure may determine the requirements to address the failure; otherwise Electrical Independence Tests and Detailed Studies are required. Continue to Screen P. (Note: If Electrical Independence tests and Detailed Studies are required, Applicants will continue to the Electrical Independence Tests and Detailed Studies after review of the remaining Supplemental Review Screens.)

Significance: Adverse voltages and undesirable interference may be experienced by other Customers on Distribution Provider's Distribution System caused by operation of the Generating Facility(ies).

c. Screen P: Safety and Reliability Tests

Does the location of the proposed Generating Facility or the aggregate generation capacity on the Line Section create impacts to safety or reliability that cannot be adequately addressed without Detailed Study?

- If yes (fail), review of the failure may determine the requirements to address the failure; otherwise Electrical Independence Tests and Detailed Studies are required. Continue to Section G.3.
- If no (pass), Supplemental Review is complete.

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

3. DETAILED STUDY SCREENS (Cont'd.)

c. Independent Study Process and Distribution Group Study Process Interconnection Studies (Cont'd.)

ii) Interconnection Facilities Study and DGS Phase II Interconnection Study. (Cont'd.)

(1) Scope and Purpose of the Interconnection Facilities and DGS Phase II Interconnection Study. (Cont'd.)

Good Utility Practice to physically and electrically connect the Generating Facility to the Distribution or Transmission System. The Interconnection Facilities Study or DGS Phase II Interconnection Study shall also identify (i) the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Distribution Provider's Interconnection Facilities, Distribution Upgrades, and Network Upgrades necessary to accomplish the interconnection; and an estimate of the time required to complete the construction and installation of such facilities. The analyses in the Interconnection System Impact Study (or DGS Phase I Interconnection Study in the case of the Distribution Group Study Process) will be updated as necessary in the Interconnection Facilities Study (or DGS Phase II Interconnection Study), to account for withdrawal of interconnection requests in the interconnection queue.

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

Section H shall be used for interconnection of non-inverter based technologies.

(D)
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(D)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS

This section is consistent with the requirements of IEEE 1547-2018. In the event of conflicts, this Rule shall take precedence. (T) (C)

The Protective Functions and requirements of this Rule are designed to protect Distribution Provider's Distribution and Transmission System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. Producer's Protective Functions shall not impact the operation of other Protective Functions on Distribution Provider's Distribution and Transmission System in a manner that would affect Distribution Provider's capability of providing reliable service to its customers.

a. Protective Functions Required

Generating Facilities operating in parallel with Distribution Provider's Distribution or Transmission System shall be equipped with the following Protective Functions to sense abnormal conditions on Distribution Provider's Distribution or Transmission System and cause the Generating Facility to be automatically disconnected from Distribution Provider's Distribution or Transmission System or to prevent the Generating Facility from being connected to Distribution Provider's Distribution or Transmission System inappropriately:

i) Over and under voltage trip functions and over and under frequency trip functions;

ii) A voltage and frequency sensing and time-delay function to prevent the Generating Facility from energizing a de-energized Distribution or Transmission System circuit and to prevent the Generating Facility from reconnecting with Distribution Provider's

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

a. Protective Functions Required (Cont'd.)

ii) Distribution or Transmission System unless Distribution Provider's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B voltage Range of 106 volts to 127 volts (on a 120 volt basis), inclusive, and a frequency range of 59.3 Hz to 60.5 Hz, inclusive, and are stable for at least 60 seconds; and

iii) A function to prevent the Generating Facility from contributing to the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution System within two seconds of the formation of an Unintended Island.

iv) Open-phase condition: Generating Facility shall detect and cease to energize and trip all phases within 2 seconds of any open phase condition in accordance with IEEE 1547-2018, 6.2.2. (N) | (N)

The Generating Facility shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-2018, 6.2.1). The Generating Facility shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-2018, 6.3). (T) (T)

b. Momentary Paralleling Generating Facilities

With Distribution Provider's approval, the transfer switch or scheme used to transfer Producer's loads from Distribution Provider's Distribution or Transmission System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

Generating facilities which operate using a momentary parallel scheme are not required to comply with the functional requirements as required in the IEEE 1547 2018 standard. (N) | (N)

(L) | (L)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

c. Suitable Equipment Required (T)

Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Generating Facility and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of Distribution Provider's Distribution and Transmission System. The Generating Facility paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE 1547-2018, 4.11). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in L.3.e (IEEE 1547-2018, 4.11). (L) (L) (T) (T)

d. Visible Disconnect Required

When required by Distribution Provider's operating practices, Producer shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by Distribution Provider and Producer) near the Point of Interconnection to isolate the Generating Facility from Distribution Provider's Distribution or Transmission System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

i) allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)

ii) include markings or signage that clearly indicates open and closed positions.

iii) be capable of being reached:

a) for Emergency purposes quickly and conveniently 24 hours a day by Distribution Provider personnel for construction,

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

f. Generating Facility Conditions Not Identified

In the event this Rule does not address the Interconnection conditions for a particular Generating Facility, Distribution Provider and Producer may agree upon other arrangements

2. PREVENTION OF INTERFERENCE

Producer shall not operate Generating or Interconnection Facilities that superimpose a voltage or current upon Distribution Provider's Distribution or Transmission System that interferes with Distribution Provider operations, service to Distribution Provider Customers, or communication facilities. If such interference occurs, Producer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by Distribution Provider. If Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, Distribution Provider may, without liability, disconnect Producer's facilities from Distribution Provider's Distribution or Transmission System, in accordance with Section D.9 of this Rule. To eliminate undesirable interference caused by its operation, each Generating Facility shall meet the following criteria:

Except as otherwise stated, the RPA for all performance requirements shall be met at the PCC. (N)

When the Generating Facility is less than 500KVA or when the Generating Facility operates under one of the non-exporting options or inadvertent export of no longer than 30 seconds, the RPA may be the POC. (N)

a. Voltage Regulation

The Generating Facility shall not actively regulate the voltage at the PCC while in parallel with Distribution Provider's Distribution System. The Generating Facility shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A. (T)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

c. Paralleling

The Generating Facility shall parallel with Distribution Provider's Distribution or Transmission System without causing a voltage fluctuation at the PCC greater than plus/minus 5% of the prevailing voltage level of Distribution Provider's Distribution or Transmission System at the PCC, and meet the flicker requirements of Section H.2.d. Section L, Certification and Testing Criteria, provides technology-specific tests for evaluating the paralleling Function. (IEEE 1547-2018, 4.10) (T)

d. Flicker

The Generating Facility shall not create objectionable flicker for other customers on Distribution Provider's Distribution or Transmission System. To minimize the adverse voltage effects experienced by other customers, flicker at the PCC caused by the Generating Facility should not exceed the limits of IEEE 1547-2018, 7.2.3. This requirement is necessary to minimize the adverse voltage affects experienced by other Customers on Distribution Provider's Distribution or Transmission System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded. (T) (T)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

e. Integration with Distribution Provider's Distribution System Grounding

The grounding scheme of the Generating Facility shall not cause over-voltages that exceed the rating of the equipment connected to Distribution Provider's Distribution System and shall not disrupt the coordination of the ground fault protection on Distribution Provider's Distribution System (IEEE 1547-2018, 4.10) (See Section G.1.i, line configuration). (T)

f. Frequency

Distribution Provider controls system frequency, and the Generating Facility shall operate in synchronism with Distribution Provider's Distribution or Transmission System. Whenever Distribution Provider's Distribution or Transmission System frequency at the PCC varies from and remains outside normal (nominally 60 Hz) by the predetermined amounts set forth in Table H.2, the Generating Facility's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time.

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

g. Harmonics

When the Generating Facility is serving balanced linear loads, harmonic current injection into Distribution Provider's Distribution or Transmission System at the PCC shall not exceed the limits stated in IEEE 1547-2018, 7.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in Distribution Provider's Distribution or Transmission System without the Generating Facility connected. The harmonic distortion of a Generating Facility shall be evaluated using the same criteria as for the Host Loads. (T) (T)

(D) (D)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

3. TECHNOLOGY SPECIFIC REQUIREMENTS

a. Technology Specific Requirements

Three-Phase Synchronous Generators: For three phase Generators, the Generating Facility circuit breakers shall be three-phase devices with electronic or electromechanical control. Producer shall be responsible for properly synchronizing its Generating Facility with Distribution Provider's Distribution or Transmission System by means of either manual or automatic synchronous equipment. Automatic synchronizing is required for all synchronous Generators that have a Short Circuit Contribution Ratio (SCCR) exceeding 0.05. Loss of synchronism protection is not required except as may be necessary to meet Section H.2.d (Flicker) (IEEE 1547-2018, 7.3). Unless otherwise agreed upon by Producer and Distribution Provider, synchronous Generators shall automatically regulate power factor, not voltage, while operating in parallel with Distribution Provider's Distribution System. A power system stabilization Function is specifically not required for Generating Facilities under 10 MW Net Rating. (T)

b. Induction Generators

Induction Generators (except self-excited Induction Generators) do not require a synchronizing Function. Starting or rapid load fluctuations on induction Generators can adversely impact Distribution Provider's Distribution or Transmission System voltage. Corrective step-switched capacitors or other techniques may be necessary and may cause undesirable ferro-resonance. When these counter measures (e.g. additional capacitors) are installed on Producer's side of the PCC, Distribution Provider must review these measures. Additional equipment may be required as determined in a Supplemental Review or an Interconnection Study.

(Continued)

K. DISPUTE RESOLUTION PROCESS (Cont'd.)

5. PERFORMANCE DURING DISPUTE

Pending resolution of any dispute under this Section, the Parties shall proceed diligently with the performance of their respective obligations under this Rule and the Implementing Agreements, unless the Implementing Agreements have been terminated. Applicant and Distribution Provider may by mutual agreement suspend performance of their respective obligations under this Rule and any Implementing Agreements while the dispute is active.

Disputes as to the Interconnection Request and implementation of this Section shall be subject to resolution pursuant to the procedures set forth in this Section.

L. CERTIFICATION AND TESTING CRITERIA

1. INTRODUCTION

This Section describes the test procedures and requirements for equipment used for the Interconnection of Generating Facilities to Distribution Provider's Distribution or Transmission System. Included are Type Testing, Production Testing, Commissioning Testing, and Periodic Testing. The procedures listed rely heavily on those described in appropriate Underwriters Laboratory (UL), Institute of Electrical and Electronic Engineers (IEEE), and International Electrotechnical Commission (IEC) documents—most notably UL 1741(including UL 1741-Supplement A or B as appropriate). (T) (T) (D) | (D)

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

1. INTRODUCTION (Cont'd.)

The tests described here, together with the technical requirements in Section H, Hh, and P of this Rule, are intended to provide assurance that the Generating Facility's equipment will not adversely affect Distribution Provider's Distribution or Transmission System and that a Generating Facility will cease providing power to Distribution Provider's Distribution or Transmission System under abnormal conditions. The tests were developed assuming a low level of Generating Facility penetration or number of connections to Distribution Provider's Distribution or Transmission System. At high levels of Generating Facility penetration, additional requirements and corresponding test procedures may need to be defined. (T)

Section L also provides criteria for "Certifying" Generators, inverters or converters. Once a Generator, inverter or converter has been Certified per this Rule, it may be considered suitable for Interconnection with Distribution Provider's Distribution or Transmission System. Subject to the exceptions described in Section L, Distribution Provider will not repeat the design review or require retesting of such Certified Equipment. It should be noted that the Certification process is intended to facilitate Generating Facilities Interconnections. Certification is not a prerequisite to interconnect a Generating Facility for Section H, except for Non-Export AC/DC Converters seeking an expedited process, but it is a prerequisite for inverters installed after September 8, 2017, pursuant to Section Hh and P of this Rule. (T) (T)

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

a. Type Tests and Criteria for Interconnection Equipment Certification (Cont'd.)

Table L.1, Type Test and Requirements for Interconnection Equipment Certification

Type Test	Reference 1	Inverter (6)	Smart Inverter (7)	Synchronous Generators	Induction Generators
Utility Interaction	UL 1741 – 39, 40	X	X	X	X
Utility Compatibility (Required testing to 1547 & 1547.1)	UL 1741 - 46	X	X	X	X
DC Isolation	IEEE 1547.1(8) -5.6	X	X	-	-
Dielectric Voltage Withstand	IEEE 1547.1(8) -5.5.3	X	X	X	X
Harmonic Distortion	IEEE 1547.1(8) -5.11	X	X	X	X
DC Injection	IEEE 1547.1(8) -5.6	X	X	-	-
Distribution Provider Voltage Variation	IEEE 1547.1(8) -5.2	X	-	X	X
Distribution Provider Frequency Variation	IEEE 1547.1(8) -5.3	X	-	X	X
Abnormal Tests	UL 1741 – 47				
Loss of Control Circuit	UL 1741 – 47.8	X	X	X	X
Short Circuit	UL 1741 - 47.3	X	X	X	X
Load Transfer	UL 1741 - 47.7	X	X	X	X
Surge Withstand Capability	L.3.e	X	X	X	X
Anti-Islanding (non-Smart Inverters)	L.3.b	(2)	-	(2)	(2)
Non-Export	L.3.c	(3)	(3)	(3)	(3)
In-rush Current	L.3.d	-	-	-	(4)
Synchronization	L.3.f	(5)	(5)	X	(5)
Anti-islanding (Smart Inverters)	UL 1741 SA - SA8	-	X	-	-
Low and High Voltage Ride-through (L/H VRT)	UL 1741 SA – SA9	-	X	-	-
Low and High Frequency Ride-through (L/H FRT)	UL 1741 SA - SA10	-	X	-	-
Normal and Soft-Start Ramp Rate (RR)	UL 1741 SA - SA11	-	X	-	-
Specified Power Factor	UL 1741 SA - SA12	-	X	-	-
Volt/Var Mode (Q(V))	UL 1741 SA - SA13	-	X	-	-
Frequency-Watt(FW) - optional	UL 1741 SA - SA14	-	X	-	-
Volt-Watt (VW) - optional	UL 1741 SA - SA15	-	X	-	-
Markings and Instructions	UL 1741 SA6, SA16	-	X	-	-

Table Notes:

(1) References are to section numbers in either UL 1741 and/or UL 1741-Supplement SA (Inverters, Converters and Charge Controllers for Use in Independent Power Systems) or this Rule. References in UL 1741 to "photovoltaics" or "inverter" may have to be adapted to the other technologies by the testing laboratory to appropriately apply in the tests to other technologies.
(2) Required only if Non-Islanding designation.
(3) Required only if Non-Export designation is desired.
(4) Required for Generators that use Distribution Provider power to motor to speed.
(5) Required for all self-excited induction Generators as well as Inverters that operate as voltage sources when connected to Distribution Provider's Distribution or Transmission System.
(6) Inverters compliant with Section H.
(7) Inverters compliant with Sections Hh or P.
(8) IEEE 1547.1 refers to 2005 revision.
(9) Smart Inverter which have tested under UL1741SB and IEEE 1547.1-2020
(10) Effective August 1, 2022.

"X" = Required "-" = Not Required

(T)
(N)
(N)

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

a. Type Tests and Criteria for Interconnection Equipment Certification (Cont'd.)

Table L.2 Type Tests Sequence for Interconnection Equipment Certification

Test No.	Type Test
1	Distribution Provider Voltage and Frequency Variation
2	Synchronization
3	Surge Withstand Capability
4	Distribution Provider Voltage and Frequency Variation, including ride through
5	Synchronization
6	Other Required and Optional Tests

Tests 1, 2, and 3 must be done first and in the order shown. Tests 4 and on follow in order convenient to the test agency.

b. Anti-Islanding Test

Devices that pass the Anti-Islanding test procedure described in UL 1741 Supplemental SB will be considered Non-Islanding for the purposes of these Interconnection requirements. The test is required only for devices for which a Certified Non-Islanding designation is desired. (T)

c. Non-Export Test

Equipment that passes the Non-Export test procedure described in Section L.7.a will be considered Non-Exporting for the purposes of these Interconnection requirements. This test is required only for devices for which a Certified Non-Export designation is desired.

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

d. In-rush Current Test

Generation equipment that utilizes Distribution Provider power to motor up to speed will be tested using the procedure defined in Section L.7.b to determine the maximum current drawn during this startup process. The resulting In-rush Current is used to estimate the Starting Voltage Drop.

e. Surge Withstand Capability Test

The interconnection equipment shall be tested for the surge withstand requirement in Section H.1.c in all normal operating modes in accordance with IEEE Std C62.45-2002 for equipment rates less than 1000 V to confirm that the surge withstand capability is met by using the selected test level(s) from IEEE Std C62.41.2-2002. Interconnection equipment rated greater than 1000 V shall be tested in accordance with manufacturer or system integrator designated applicable standards. For interconnection equipment signal and control circuits, use IEEE Std C37.90.1-2002. These tests shall confirm the equipment did not fail, did not misoperate, and did not provide misinformation (IEEE 1547-2018, 4.11.2). (T)

The location/exposure category for which the equipment has been tested shall be clearly marked on the equipment label or in the equipment documentation. External surge protection may be used to protect the equipment in harsher location/exposure categories.

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

f. Synchronization Test (Cont'd.)

Table L.3
***Synchronization Parameter Limits* [1]**

Aggregate Rating of Generator Units (kVA)	Frequency Difference (Δf, Hz)	Voltage Difference Phase Angle (ΔV, %)	Difference (ΔΦ,°)
0-500	0.3	10	20
> 500-1,500	0.2	5	15
> 1,500-10,000	0.1	3	10

[1] – IEEE 1547-2018, 4.10 (T)

g. Paralleling Device Withstand Test

The di-electric voltage withstand test specified in Section L.1 shall be performed on the paralleling device to ensure compliance with those requirements specified in Section H.1.c (IEEE 1547-2018, 4.11.3). (T)

h. Backfeed Test

Non-Export AC/DC Converters must satisfy the requirements in its definition in Section C.

4. PRODUCTION TESTING

At a minimum, each interconnection system shall be subjected to Distribution Provider Voltage and Frequency Variation Test procedure described in UL1741 under Manufacturing and Production Tests, Section 68 and the Synchronization test specified in Section L.3.f. Interconnection systems with adjustable set points shall be tested at a single set of set points as specified by the manufacturer. This test may be performed in the factory or as part of a Commissioning Test (Section L.5).

(Continued)

Mm. INADVERTENT EXPORT FOR INTERCONNECTION REQUESTS UTILIZING UL-1741 CERTIFIED OR SA/SB LISTED GRID SUPPORT (NON-ISLANDING) INVERTERS (T)

The following are the minimum requirements for Inadvertent Export systems that meet the criteria specified below. Other factors relevant to the interconnection study process (e.g., 15% screen results, short circuit current ratio, etc.) may necessitate additional technical requirements (e.g., reclose block, transfer trip, ground bank, etc.) that are not explicitly noted here. Inadvertent Export may not be available for interconnections to Networked Secondary Systems.

The certified control functions internal to the inverter control or external control system may be used to replace the discrete reverse/under power relay functions described in Section M provided the requirements outlined below are met.

1) All of the following requirements must be met by the Generating Facility to qualify for Inadvertent Export under this Section.

   a. The Generating Facility must utilize only UL-1741 certified or UL-1741 SB listed grid support non-islanding inverters; and, (T)

   b. The Generating Facility must have an aggregate maximum nameplate capacity of 500 kVA or less; and,

   c. The Generating Facility's total energy export must not exceed its nameplate rating (kVA-gross) multiplied by 0.1 hours per day over a rolling 30-day period (e.g., for a 100 kVA-gross nameplate Generating Facility, the maximum energy allowed to be exported for a 30-day period is 300 kWh) ; and,

   d. Export from the Generating Facility across the PCC to the Distribution System is less than 100 kVA.

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (N)

When requirements for “Smart Inverter” are specified in this section, those requirements can also be met by a “DER Interconnection System” as defined in this tariff

The inverter requirements are intended to be consistent with UL 1741 – Supplement SB using as the source requirement document ANSI/IEEE 1547-2018 and IEEE 1547.1-2020Standard for Interconnecting Distributed Resources with Electric Power Systems where possible. In the event of conflict between this Rule and UL 1741 – Supplement SB and/or IEEE 1547-2018 or IEEE 1547.1-2020, this Rule shall take precedence.

The Smart Inverter default settings and default activation states may be modified upon mutual agreement between Applicant or Producer and Distribution Provider.

Process for changing default settings for new Interconnection Requests:

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the reactive power settings, including changes to the reactive power default settings (Example: Deactivate Volt/Var and activate Fixed Power Factor at given power factor).

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the Ramp Rate settings depending on the Generating Facility technology (such as solar, storage).

Distribution Provider, in the study process for new Generating Facilities, may determine the optimum Smart Inverter Settings for the volt/watt settings, including changes to the default settings (Example: Change the volt/watt set points). The Applicant may select to agree on the new settings or select to perform upgrades to operate using the existing default volt/watt settings. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

Default settings for voltage ride-through, frequency ride-through requirements, and Frequency/Watt should not be modified on an individual project basis unless the Interconnection Studies have determined that the default settings may not meet grid reliability requirements.

Process for changing default settings for Generating Facilities with an executed Interconnection Agreement:

When grid changes or Generating Facility changes require that the Smart Inverter operating parameters be reevaluated, the Distribution Provider or Producer may request changes to the Smart Inverter operating parameters. The request must include the reason for and timing of the proposed changes. The requested changes must be within the Smart Inverter function adjustability limits, must be within the limits specified in this tariff, and must be mutually agreed upon.

1. General Interconnection and Protective Function Requirements

The Protective Functions and requirements of this Rule are designed to protect Distribution Provider's Distribution and Transmission System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. Producer's Protective Functions shall not impact the operation of other Protective Functions on Distribution Provider's Distribution and Transmission System in a manner that would affect Distribution Provider's capability of providing reliable service to its customers. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

a. Protective Functions Required

Smart Inverters operating in parallel with Distribution Provider's Distribution or Transmission System shall be equipped with the following Protective Functions to sense abnormal conditions on Distribution Provider's Distribution or Transmission System and cause the Smart Inverter to be automatically disconnected from Distribution Provider's Distribution or Transmission System or to prevent the Smart Inverter from being connected to Distribution Provider's Distribution or Transmission System inappropriately:

(i) Over and under voltage trip functions and over and under frequency trip functions;

(ii) A voltage and frequency sensing and time-delay function to prevent the Smart Inverter from energizing a de-energized Distribution or Transmission System circuit and to prevent the Smart Inverter from reconnecting with Distribution Provider's Distribution or Transmission System unless Distribution Provider's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B voltage Range of 106 volts to 127 volts (on a 120 volt basis), inclusive, and a frequency range of 58.8 Hz to 61.2 Hz, inclusive, and are stable for at least 15 seconds; and

(iii) A function to prevent the Smart Inverter from contributing to the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution System within two seconds of the formation of an Unintended Island.

The Smart Inverter shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-2018, 6.2.1). The Smart Inverter shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-2018, 6.3). (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

a. Protective Functions Required (Cont'd)

(iv) Open-phase condition: Generating Facility shall detect and cease to energize and trip all phases within 2 seconds of any open phase condition in accordance with IEEE1547 2018, 6.2.2.

The Smart Inverter Facility shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-2018, 6.2.1). The Generating Facility shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-2018, 6.3).

b. Momentary Paralleling Smart Inverter Generating Facilities

With Distribution Provider's approval, the transfer switch or scheme used to transfer Producer's loads from Distribution Provider's Distribution or Transmission System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

Smart Inverters which operate using a momentary parallel scheme are not required to comply with the functional requirements as required in the IEEE 1547-2018 standard. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

c. Suitable Equipment Required

Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Smart Inverter and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of Distribution Provider's Distribution and Transmission System. The Smart Inverter paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE 1547-2018, 4.11.3). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in L.3.e (IEEE 1547-2018, 4.11.4).

d. Visible Disconnect Required

When required by Distribution Provider's operating practices, Producer shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by Distribution Provider and Producer) near the Point of Interconnection to isolate the Smart Inverter from Distribution Provider's Distribution or Transmission System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

(i) allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)
(ii) Include markings or signage that clearly indicates open and closed positions.
(iii) be capable of being reached: (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

d. Visible Disconnect Required (Cont'd)

(iii) be capable of being reached (Cont'd):

a) for Emergency purposes quickly and conveniently 24 hours a day by Distribution Provider personnel for construction, operation, maintenance, inspection, testing or to isolate the Smart Inverter from Distribution Provider's Distribution or Transmission System without obstacles or requiring those seeking access to obtain keys, special permission, or security clearances.
b) for Non-Emergency purposes during normal business hours. Distribution Provider, where possible, will provide notice to Customer for gaining access to Customer's premises.

(iv) be capable of being locked in the open position.

(v) be clearly marked on the submitted single line diagram and its type and location approved by Distribution Provider prior to installation. If the device is not adjacent to the PCC, permanent signage must be installed at a Distribution Provider approved location providing a clear description of the location of the device. If the switch is not accessible outside the locked premises, signage with contact information and a Distribution Provider approved locking device for the premises shall be installed.

Generating Facilities with Non-Islanding inverters totaling one (1) kilovolt-ampere (kVA) or less are exempt from this requirement.

e. Drawings Required

Prior to Parallel Operation or Momentary Parallel Operation of the Smart Inverter, Distribution Provider shall approve Producer's Protective Function and control diagrams. Generating Facilities equipped with Protective Functions and a control scheme previously approved by Distribution Provider for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

   f. Generating Facility Conditions Not Identified

      In the event this Rule does not address the Interconnection conditions for a particular Smart Inverter, Distribution Provider and Producer may agree upon other arrangements.

   g. Generating Facilities that use certified Power Control Systems (PCS) must use PCS listed in a Distribution Provider pre-approved list.

2. Prevention of Interference

   Producer shall not operate Smart Inverters that superimpose a voltage or current upon Distribution Provider's Distribution or Transmission System that interferes with Distribution Provider operations, service to Distribution Provider Customers, or communication facilities. If such interference occurs, Producer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by Distribution Provider. If Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, Distribution Provider may, without liability, disconnect Producer's facilities from Distribution Provider's Distribution or Transmission System, in accordance with Section D.9 of this Rule. To eliminate undesirable interference caused by its operation, each Smart Inverter shall meet the following criteria:

   Except as otherwise stated, the RPA for all performance requirements shall be met at the PCC.

   When the Generating Facility is less than 500KVA or when the Generating Facility operates under one of the non-exporting options or inadvertent export of no longer than 30 seconds, the RPA may be the Point of Generating Resource Connection (POC) (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

a. Voltage Regulation

The Generating Facility shall not actively regulate the voltage at the PCC while in parallel with Distribution Provider's Distribution System. The Generating Facility shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A.

b. Voltage Trip and Ride-Through Setting

The voltage ranges in Table P-1 define protective trip limits for the Protective Function and are not intended to define or imply a voltage regulation Function. Generating Facilities shall cease to energize Distribution Provider's Distribution System within the prescribed trip time whenever the voltage at the PCC deviates from the allowable voltage operating range. The Protection Function shall detect and respond to voltage on all phases to which the Generating Facility is connected.

i) Smart Inverters

Smart Inverters shall be capable of operating within the voltage range normally experienced on Distribution Provider's Distribution System from plus to minus 5% of the nominal voltage (e.g. 114 volts to 126 volts, on a 120 volt base), at the service panel or PCC. The trip settings at the generator terminals may be selected in a manner that minimizes nuisance tripping in accordance with Table P-1 to compensate for voltage drop between the generator terminals and the PCC. Voltage may be detected at either the PCC or the Point of Interconnection. However, the voltage range at the PCC, with the generator on-line, shall stay within +/-5% of nominal. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

b. Voltage Trip and Ride-Through Setting (Cont'd)

ii) Voltage Disturbances

Whenever Distribution Provider's Distribution System voltage at the RPA varies from and remains outside the Continuous Operation region for the predetermined parameters set forth in Table P-1b, the Smart Inverter's Protective Functions shall cause the Smart Inverter(s) to trip and become isolated from Distribution Provider's Distribution System as required in table P-1a:

1. The Smart Inverter shall stay connected to the Distribution Provider's Transmission or Distribution System while the grid remains within the "Voltage Range (p.u.)" and must stay connected in the corresponding "Operating Mode."

2. If the distribution system voltage does not exit the ride-through region and recovers to normal system voltage, the Smart Inverter shall restore continuous operation within 2 sec.

3. If the Distribution Provider's Transmission or Distribution System voltage does not exit the ride-through region and returns from the V<0.5 pu region to the 0.5≤V< 0.7 or 0.7≤V< 0.88 pu region, the Smart Inverter shall restore available current within 2 seconds.

4. Different voltage-time settings could be permitted by the Distribution Provider.

(N)

(Continued)

ELECTRIC RULE NO. 21 Sheet 293
GENERATING FACILITY INTERCONNECTIONS

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

b. Voltage Trip and Ride-Through Setting (Cont'd)

ii) Voltage Disturbances (Cont'd)

Table P-1a: Smart Inverter Voltage Trip

Shall Trip Function	Voltage Trip Default Settings (p.u. of nomnial voltage)	Voltage Range of Shall Trip Function (p.u. of nominal voltage)	Default Clearing Time (s)
OV2	1.20	$V \geq 1.20$	0.16
OV1	1.10	$1.10 \leq V < 1.20$	13.0
Continuous Operation	NA	$0.88 < V < 1.10$	NA
UV1	0.88	$0.50 < V \leq 0.88$	21.0
UV2	0.50	$V \leq 0.50$	2.0

Table P-1b – Smart Inverter Voltage Ride-through Settings

Voltage Range (p.u.)	Operating mode/response	Minimum ride-through time (s)	Maximum response time (s)
$V > 1.20$	Cease to Energize	NA	0.16
$1.10 < V \leq 1.20$	Momentary Cessation	12	0.083
$0.88 \leq V \leq 1.10$	Continuous Operation	Infinite	NA
$0.70 \leq V < 0.88$	Mandatory Operation	20	NA
$0.50 \leq V < 0.70$	Mandatory Operation	10	NA
$V < 0.50$	Momentary Cessation	1	0.083

iii) Voltage Phase Angle Change Ride-Through

Voltage phase angle change ride-through as specified in IEEE 1547-2018, 6.5.2.6. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

c. Paralleling

The Smart Inverter shall parallel with Distribution Provider's Distribution or Transmission System without causing a voltage fluctuation at the PCC greater than plus/minus 5% of the prevailing voltage level of Distribution Provider's Distribution or Transmission System at the PCC, and meet the flicker requirements of Section H.2.d. Section L, Certification and Testing Criteria, provides technology-specific tests for evaluating the paralleling Function. (IEEE 1547-2018, 4.10.4)

d. Flicker

The Generating Facility shall not create objectionable flicker for other Customers on Distribution Provider's Distribution or Transmission System. To minimize the adverse voltage effects experienced by other Customers, flicker at the P caused by the Generating Facility should not exceed the limits of IEEE 1547-2018, 7.2.3. This requirement is necessary to minimize the adverse voltage affects experienced by other Customers on Distribution Provider's Distribution or Transmission System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

e. Integration with Distribution Provider's Distribution System Grounding

The grounding scheme of the Smart Inverter shall not cause over-voltages that exceed the rating of the equipment connected to Distribution Provider's Distribution System and shall not disrupt the coordination of the ground fault protection on Distribution Provider's Distribution System (IEEE 1547-2018, 4.10.4) (See Section G.1.i, line configuration). (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

f. Frequency

Distribution Provider controls system frequency, and the Smart Inverter shall operate in synchronism with Distribution Provider's Distribution or Transmission System. Whenever Distribution Provider's Distribution or Transmission System frequency at the PCC-2a, the Smart Inverter's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time. Inverter's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time.

i) Frequency Ride-Through Requirements

Smart Inverter based systems shall remain connected to the Distribution Provider's Distribution or Transmission System while the grid is within the frequency-time range indicated in Table P-2b, and shall disconnect from the electric grid during a high or low frequency event that is outside that frequency-time range as indicated in Table P-2a.

Table P-2a: Frequency Trip Settings Table

Shall Trip Function	Frequency Trip Default Setting (Hz)	Resulting Range of Shall Trip Function (Hz)	Default Clearing Time (s)
OF2	62.0	f≥62.0	0.16
OF1	61.2	61.2≤f<62	300
Continuous Operation	NA	58.5<f<61.2	NA
UF1	58.5	56.5<f≤58.5	300
UF2	56.5	f≤56.5	0.16

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

f. Frequency (Cont'd)

i) Frequency Ride-Through Requirements (Cont'd)

Table P-2b: Frequency Ride-Through Settings Table

Frequency (Hz)	Operating Mode	Minimum time(s)
f>62.0	No Ride-Through requirements apply to this range	NA
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	NA

ii) Rate of Change of Frequency (ROCOF) Ride-through

Smart Inverter shall not trip for frequency excursion having magnitude rates of change of frequency (ROCOF) that is less than or equal to 3.0Hz per second as specified in IEEE 1547-2018, section 6.5.2.5 category III. For ROCOF greater than 3Hz per second, it is preferred for Smart Inverter to ride-through as long as frequency remains in the continuous operating region, low frequency ride-though region(and corresponding duration times), or high frequency region (and corresponding duration times). (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

g. Harmonics

When the Smart Inverter is serving balanced linear loads, harmonic current injection into Distribution Provider's Distribution or Transmission System at the PCC shall not exceed the limits stated in IEEE 1547-2018, 7.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in Distribution Provider's Distribution or Transmission System without the Smart Inverter connected. The harmonic distortion of a Smart Inverter shall be evaluated using the same criteria as for the Host Loads.

h. Direct Current Injection

Smart Inverter should not inject direct current greater than 0.5% of rated output current into Distribution Provider's Distribution or Transmission System.

i. Smart Inverter Reactive Power Requirements

Smart Inverter Reactive Power capabilities shall comply with IEEE 1547-2018, Section 5.2 Category B requirement.

j. Dynamic Volt/Var Operations

The Smart Inverter shall be capable of supporting dynamic reactive power compensation (dynamic Volt/Var operation) within the following constraints:

- The Smart Inverter shall be able to consume reactive power in response to an increase in line voltage, and produce reactive power in response to a decrease in line voltage as indicated in Table P-4.

(N)

(Continued)

ELECTRIC RULE NO. 21 Sheet 298
GENERATING FACILITY INTERCONNECTIONS

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

j. Dynamic Volt/Var Operations (Cont'd)

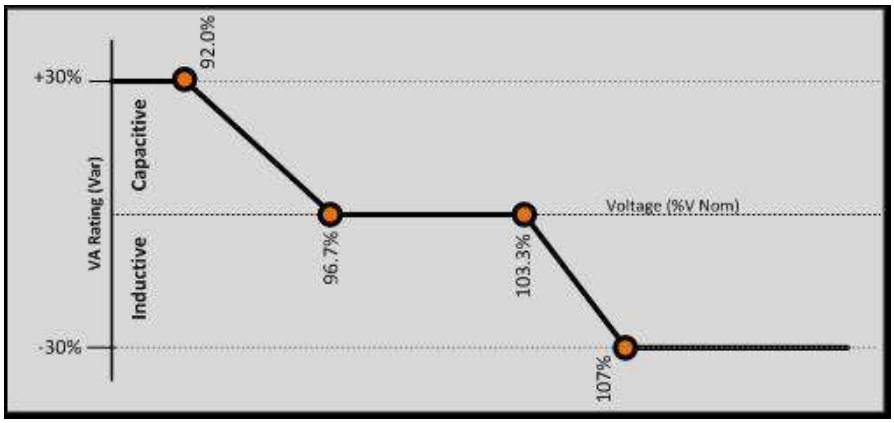
Table P-4 and Figure P-1 depict the default setting, which should be applied for all inverter size. Specific volt/var settings may be required for larger generating facilities (such as 100 kW or greater) or for specific areas with the Distribution System as determined by the Distribution Provider.

Default Open Loop Response Time for volt/var operation setting should be five (5) seconds.

Table P-4: Voltage and Reactive Default Settings

Voltage Setpoint	Voltage Value	Reactive Setpoint	Reactive Value	Operation
V1	92.0%	Q1	30%	Reactive Power Injection
V2	96.7%	Q2	0	Unity Power Factor
V3	103.3%	Q3	0	Unity Power Factor
V4	107.0%	Q4	30%	Reactive Power Absorption

Figure P-1: Voltage and Reactive Default Settings



(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

k. Enter Service Ramp Rate Requirements

The Smart Inverter is required to have the following ramp controls.

- Enter Service ramp control requirements as outlined in IEEE 1547-2018 section 4.10.3 with following default settings:
  - Delay enter service shall be 15 seconds per P.1.a.ii
  - Default Enter Service Duration shall be 50 seconds

l. Frequency Droop (Frequency Power, Frequency Watt) Requirements

Smart Inverters shall change their real power production as function of system frequency in accordance with IEEE 1547-2018, 6.5.2.7 with the following default settings: Deadband 36 mHz, db_{OF} and db_{UF}. k_{OF} and k_{UF} would be 0.05, open loop response time of 5 seconds. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

m. Voltage-Watt Default Settings Requirements

Smart Inverters shall reduce their real power production as a function measured voltage at the inverter terminal or at the Generating Facility Point of Common Coupling (PCC) in accordance with the following:

When the measured voltage is greater than 106% of nominal voltage (Example: 127.2 volts on a 120 volts nominal), the export of active power at the PCC or the production of active power by the Smart Inverter shall be reduced at a rate of 25% of active power nameplate rating per one percent of nominal voltage. Figure Hh-3 Volt-Watt Requirements illustrate the required rate of reduction. When export of active power is controlled, a certified inverter and control system shall be used. (N)

(Continued)

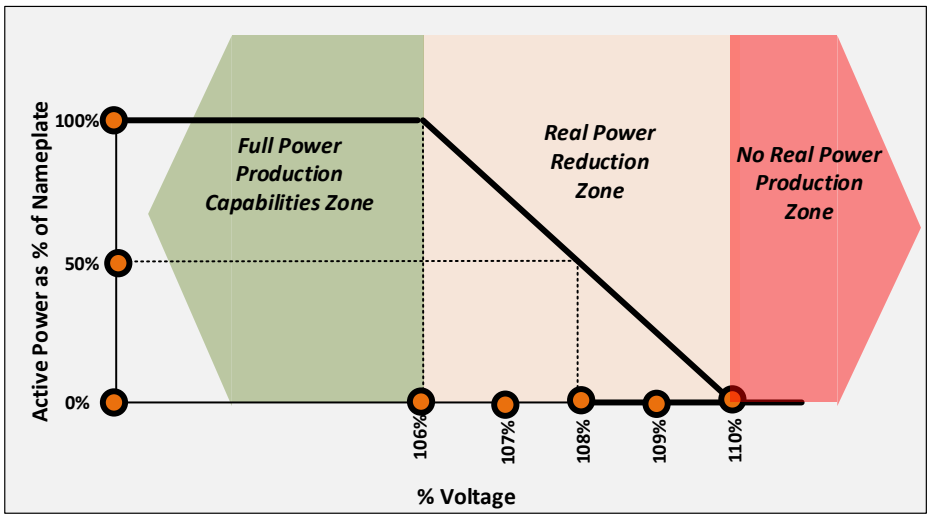
P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

m. Voltage-Watt Default Settings Requirements

- When the measured voltage is greater than 110% of nominal voltage (Example: 132 volts on a 120 volts nominal), the export of active power to the grid at the PCC or the production of active power by the Smart Inverter shall be reduced to 0 watts.
- Open Loop response time shall be 5 seconds.

Figure P-3: Volt-Watt Requirements



n. Dynamic Reactive Power Support Function

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

o. Default Activation States

Unless otherwise provided by Distribution Provider, pursuant to Distribution Provider's Distribution Generation Interconnection Handbook, the default settings will be as follows:

Table P-4: Default Activation States

Function	State
Anti-islanding	Activated
Low/High Voltage Ride Through	Activated
Low/High Frequency Ride Through	Activated
Dynamic Volt/Var operations	Activated
Enter Service Ramp Control	Activated
Storage Inverter Normal Operation Ramp Control	Activated
Fixed power factor	Deactivated
Reconnect by "soft-start" methods	Activated
Frequency/Watt	Activated
Volt/Watt	Activated
Constant Reactive Power Mode	Deactivated
Set Active Power Function Mode(Optional)	Activated under mutual agreement
Dynamic Reactive Power Support Mode (Optional)	Activated under mutual agreement

These default activation states may be modified by mutual agreement between Distribution Provider and Producer.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

p. Load Shedding or Transfer

The voltage and frequency ride-through requirements of P.2.b.ii) and P.2.f.i) shall not apply if either: a) The real power across the Point of Common Coupling is continuously maintained at a value less than 10% of the aggregate rating of the Smart Inverters connected to the Generating Facility prior to any voltage disturbance, and the Generation Facility disconnects from the Distribution Provider's Distribution or Transmission System, along with Generating Facility load, such that the net change in real power flow from or to the Distribution Provider's Distribution or Transmission System is less than 10% of the aggregate Smart Inverter capacity; or b) Generating Facility load real power demand equal to 90% to 120% of the predisturbance aggregate Smart Inverter real power is shed within 0.1 seconds of Smart Inverter disconnection.

q. Measurement and Calculation Accuracy

Smart Inverter shall meet minimum steady-state and transient measurement and calculation accuracy as required in IEEE 1547-2018, Section 4.4.

r. Prioritization of Smart Inverter Responses

a) The response to disable permit to service as specified in section Hh.8.a shall take precedence over any other tripping requirements.

b) Prioritization of tripping requirements not related to disabling permit to service shall meet IEEE 1547-2018 section 4.7.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

s. Storage Inverter Normal Operation Ramp Control Requirements

Smart Inverters used for energy storage applications shall include ramp-up rate control. The default value shall be 100% of maximum current output per second or slower if required by Applicant. Other ramp-up control settings can be used, when required, as mutually agreed by the Distribution Provider and the Applicant.

t. Ride-through of Conservative Voltage Disturbances

Ride-through of consecutive voltage disturbances shall be in accordance with IEEE 1547-2018, 6.4.2.5.

u. Restore output without dynamic voltage support

Restore output without dynamic voltage support shall be in accordance with IEEE 1547-2018, 6.4.2.5.

v. Transition between performance operating regions:

Transition between performance operating regions should be in accordance with IEEE 1547-2018, 6.4.2.7.3.

w. Constant Reactive Power Mode

When in this mode, the Smart Inverter shall maintain a constant reactive power. The target reactive power level and mode (injection or absorption) shall be specified by the Distribution Provider and shall be within the same range specified in IEEE 1547-2018 section 5.2. The reactive power settings are allowed to be adjusted locally and/or remotely as specified by the Distribution Provider. The maximum Smart Inverter response time to maintain constant reactive power shall be 10 seconds or less. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

x. Generating Facility Rapid Voltage Changes (RVC)

Generating step or ramp changes shall meet the requirements as specified in IEEE 1547-2018 section 7.2.2.

y. Limitations of Overvoltage Over One Fundamental Frequency Period

Generating Facility shall not contribute to instantaneous or fundamental frequency overvoltage conditions per IEEE 1547-2018, 7.4.1.

z. Limitation of Cumulative Instantaneous Overvoltage

Generating Facility shall not cause the instantaneous voltage on any portion of the Distribution or Transmission System to exceed the magnitudes per IEEE 1547-2018, 7.4.2.

3. Technology Specific Requirements

Grid-interactive inverters do not require separate synchronizing equipment. Non grid-interactive or "stand-alone" inverters shall not be used for Parallel Operation with Distribution Provider's Distribution or Transmission System. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

4. Supplemental Smart Inverter Requirements

a. Fault Detection

A Smart Inverter with an SCCR exceeding 0.1 or one that does not cease to energize Distribution Provider's Distribution or Transmission System within two seconds of the formation of an Unintended Island shall be equipped with Protective Functions designed to detect Distribution or Transmission System faults, both line-to-line and line-to-ground, and cease to energize Distribution Provider's Distribution or Transmission System within two seconds of the initiation of a fault.

b. Transfer Trip

For a Generating Facility that cannot detect Distribution or Transmission System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution or Transmission System within two seconds, Distribution Provider may require a Transfer Trip system or an equivalent Protective Function.

c. Reclose Blocking

Where the aggregate Generating Facility capacity exceeds 15% of the peak load on any automatic reclosing device, Distribution Provider may require additional Protective Functions, including, but not limited to recluse-blocking on some of the automatic reclosing devices. (N)

(Continued)

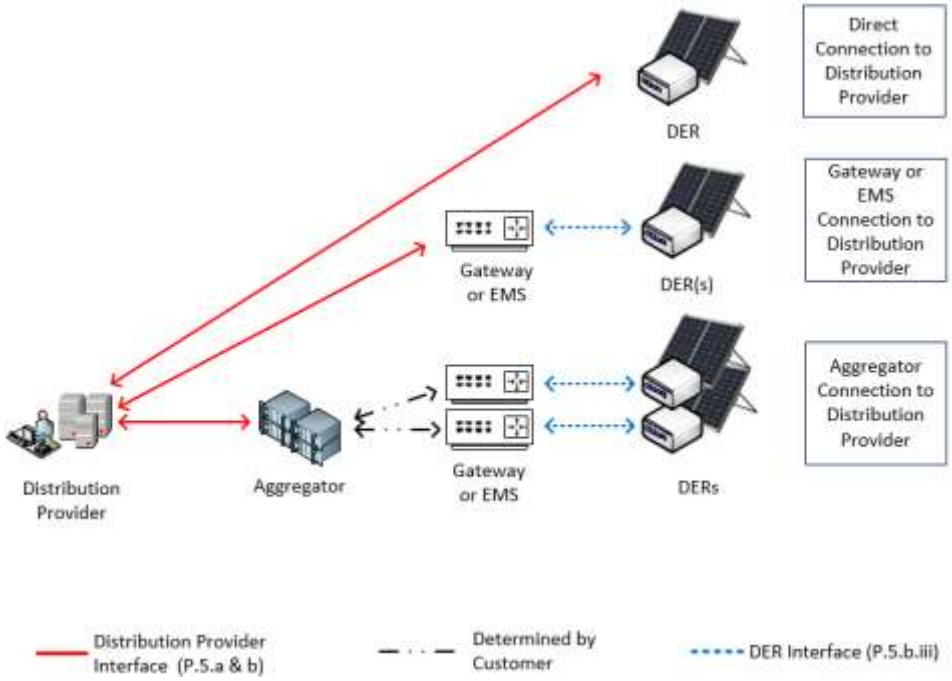
ELECTRIC RULE NO. 21 Sheet 307
GENERATING FACILITY INTERCONNECTIONS

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements

Should communications to the Distribution Provider be required, Generating Facilities utilizing inverter-based technologies must adhere to the following communication requirements for communications between the Distribution Provider and the Generating Facility. The diagram below shows the interface requirements as applicable for section P.5. The Distribution Provider Interface (solid red line) is described in Sections P.5.a and P.5.b. The local DER interface at the Generating Facility (dotted blue line) is described in Section P.5.b.iii. The top row shows a direct connection between the Distribution Provider and the DER. The middle row shows a connection between the Distribution Provider and a gateway (GW) or Energy Management System (EMS). The lower row shows a connection between the Distribution Provider and an aggregator.

Figure P-5: Generating Facility Communications



(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

The communications requirements herein shall be between

(i) the Distribution Provider and the individual DER, GW, or EMS;

(ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or

(iii) other communication options as mutually agreed to by Applicant and Distribution Provider.

a. The communications requirements in this Section pertain to communications between the Distribution Provider and communications option selected, or required, from section P.5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by compliance with this Rule:

i. Shall be capable of communications;

ii. Software shall be updateable via communications remotely;

iii. The transport level protocol shall be TCP/IP; and,

The default application-level protocol shall be IEEE 2030.5 as defined in the latest final version of the Common Smart Inverter Profile (CSIP), the Interconnection Handbook, Cyber Security Requirements or Programs and Contracts. Other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:

i. Distribution Provider Generation Interconnection Handbook, which shall include:

A. Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;

B. Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide (e.g., CSIP); and,

C. Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these additionally or alternatively may be included in the application-level protocol implementation guide); and

D. Conditions under which communication functions are mandatory.

ii. Application-Level Protocol Implementation Guide, which shall provide:

A. Detailed communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission's jurisdiction.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents (Cont'd):

iii. Communication Protocol and Performance Requirements

A. Communication performance requirements for the interface to the Generating Facility shall comply with IEEE 1547-2018, 10.8.

B. The protocol requirements at the Generating Facility shall be per IEEE 1547-2018, 10.7.

a. If choosing IEEE 2030.5 as the protocol, then CSIP certification is required.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

6. Scheduling Capability Requirements

Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with minimum scheduling memory capability of at least 24 events. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function:

- Modifications to the voltage and reactive set-points of the Dynamic volt/var function.
- Modifications to the reactive power set-points for the fixed power factor function.
- Modifications to the voltage and watt-reduction level set-points for the volt/watt function.

The Generating Facility's scheduling capability requirement herein shall be met by one or more of the following options:

- Scheduling capability requirements may be implemented at the GW/EMS. The GW/EMS shall communicate the necessary commands to the Smart Inverters within 10 minutes, or by mutual agreement, from when the GW/EMS receives the scheduling information.
- Scheduling capability requirements may be implemented at the DER within the Generating Facility.
- Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverter within 15 minutes of the aggregator receiving the scheduling information.
- Other options may be utilized by mutual agreement between the Applicant and Distribution Provider (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

6. Scheduling Capability Requirements (Cont'd)

The selected scheduling control system shall store the schedules and shall send operational commands to the Smart Inverters as required by the schedule received from the Distribution Provider. The Smart Inverter shall respond by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.

Each scheduled mode of operation shall include and start-time and duration The Smart Inverter should return to its default settings at the end of the duration time or shall enter a new operational mode as directed by the scheduling control system.

7. Monitoring and Telemetry Requirements

The Smart Inverter shall have the capability to communicate its performance information per IEEE 1547-2018, 10.5 Table 29, unless otherwise provided by PG&E, pursuant to its Distribution Generation Interconnection Handbook:

a. Smart Inverter production or consumption of active power (watts).

b. Smart Inverter consumption or production of reactive power (vars)

c. Phase measured at the AC terminals of the Smart Inverter (volts)

d. Frequency measured at the AC terminals of the Smart Inverter (Hz)

e. Connection Status

f. Alarm Status

When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability is required:

The Smart Inverter shall be capable of communicating the operational state of charge as a percent of energy storage capacity. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

7. Monitoring and Telemetry Requirements (Cont'd)

Operational State as In-Service or not In-service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:

- In-Service

  An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section P.6

- Not In-Service

  An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section P.6

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:

- When the Generating Facility includes only Smart Inverters, the production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.

- When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility shall communicate the following:

  - The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility.
  - The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

7. Monitoring and Telemetry Requirements (Cont'd)

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows (Cont'd):

- When the Generating Facility with Smart Inverters includes one or multiple energy storage systems. The available operational energy should be communicated as an aggregate of all the energy storage systems.

- Nameplate information shall be available through a local Generating Facility Interface as required in IEEE 1547-2018, 10.3 and must include the information as required in IEEE 1547-2018, Table 28.

- Configuration information shall be available through a Local Generating Facility Interface as required in IEEE 1547-2018, 10.4. This information represents the present capacity and ability of the Generating Facility. When a configuration update changes the Generating Facility nameplate information, it may require a study depending on the change.

(N)

(Continued)

ELECTRIC RULE NO. 21 Sheet 315
GENERATING FACILITY INTERCONNECTIONS

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

8. Control through communication capabilities

The utilization of these functions are permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Smart Inverters shall have the capabilities of accepting operational controls through communications in accordance to the following:

a. Disable permit to service control command

When the Smart Inverter receives a disable permit service command through communication, the Smart Inverter must cease-to energize and trip within 2 seconds or initiate the opening of the switch referenced in the inverter terminal in order to galvanically isolate the Smart Inverter from the Distribution System.

b. Return to service control command

When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6. This shall be accomplished by enabling permit service as required in IEEE 1547-2018, 4.10.3.

c. Limit Active Power command

When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value. In no more than 30 seconds or in the time it takes for the primary energy source to reduce its active power output to achieve the requirements of the active power limit set point, whichever is greater.

Where the Smart Inverter operates under a non-export provision, the active power limit set point may be implemented as a maximum active power to serve the host customer load. Under mutual agreement, the Smart Inverter may be required to reduce active power below the level needed to support host customer load. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

8. Control through communication capabilities (Cont'd)

d. Set Active Power Level Mode Function

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date.

e. Suspension of Active Power restriction

When the Smart Inverter receives a command to suspend the command for active power reduction, the Smart Inverter may return to normal operation as required by Generating Facility operator or as required by the scheduling control system as required by Section P.6.

f. Transition between operating modes

Transition between modes shall commence in no more than 30 seconds after the mode setting change is received at the local Generating Facility communication interface.

Changes of control functional modes shall be executed such that the Smart Inverter output is transitioned smoothly over a time period between 5 s and 300 s.

Ramping of Smart Inverter output is not required for control parameter setting changes.

For all control and protective function parameter settings, the time following the input to the local Generating Facility communication interface and preceding the point in time when the invoked action begins shall be no greater than 30 s. (N)

(Continued)

ELECTRIC RULE NO. 21 Sheet 317
GENERATING FACILITY INTERCONNECTIONS

(L)

Appendix A Forms Associated with Rule 21 Generating Facility Interconnections			
Form Number	Title	Associated Tariffs	Use Guidance
Pre-Application Request			
79-1181	Rule 21 Pre-Application Report Request	Rule 21	For Generator Developer to request basic info about local distribution circuit
Study Agreement			
79-1162	Rule 21 Detailed Study Agreement	Rule 21	Independent Study and Distribution Group Study Process Study Agreement
NEM and Non-Export Interconnection Forms			
79-978	Interconnection Agreement for Net Energy Metering of Solar or Wind Electric Generating Facilities of 1,000 kW or Less, Other Than Facilities of 30 kW or Less	NEM, Rule 21	Solar and/or Wind > 30 kW and ≤ 1 MW expanded NEM used with Form 79-1174-02
79-978-02	Interconnection Agreement for Net Energy Metering (NEM2) of Solar or Wind Electric Generating Facilities of 1,000 Kilowatts or Less, Other than Facilities of 30 Kilowatts or Less	NEM2, Rule 21	Solar and/or Wind > 30 kW and ≤ 1 MW expanded NEM2 used with Form 79-1174-02
79-997	Interconnection Agreement for Net Energy Metering of Biogas Digester Generating Facilities	NEM, Rule 21	NEMBIO (Closed to new applicants), NEMBIOA Interconnection Agreement used with Form 79-1174
79-1010	Interconnection Agreement for Net Energy Metering of Fuel Cell Generating Facilities	NEM, Rule 21	NEMFC Interconnection Agreement used with Form 79-1174
79-1069	Generating facility Interconnection Agreement (Multiple Tariff)	NEM, Rule 21	NEMMT Interconnection Agreement used with Form 79-1174
79-1069-02	Generating Facility Interconnection Agreement (Multiple Tariff NEM2MT)	NEM2, Rule 21	NEM2MT Interconnection Agreement used with Form 79-1174-02
79-1109 ***	Virtual Net Energy Metering Application and Interconnection Agreement For The Building Owner of Multifamily Affordable Housing With A Solar Generating Facility of 1 Megawatt or Less	NEM, Rule 21	NEMV Interconnection Agreement used with Form 79-974

(L)

(Continued)

Appendix A (Cont'd.)
Forms Associated with Rule 21
Generating Facility Interconnections

Form Number	Title	Associated Tariffs	Use Guidance
NEM and Non-Export Interconnection Forms (Cont'd.)			
79-1193	AGREEMENT AND CUSTOMER AUTHORIZATION Net Energy Metering (NEM) Interconnection For Solar And/Or Wind Electric Generating Facilities Of 30 Kilowatts Or Less with Energy Storage of 10 Kilowatts Or Less or Energy Storage with Power Control System Certification	NEM	For NEM pair storage scenarios using Power Control Systems to ensure NEM integrity
79-1193-02	AGREEMENT AND CUSTOMER AUTHORIZATION Net Energy Metering (NEM2) Interconnection For Solar And/Or Wind Electric Generating Facilities Of 30 Kilowatts Or Less with Energy Storage of 10 Kilowatts Or Less or Energy Storage with Power Control System Certification	NEM2	For NEM2 pair storage scenarios using Power Control Systems to ensure NEM integrity
79-1109-02***	NEM2VMSH Virtual Net Energy Metering Application and Interconnection Agreement for the Building Owner of Multifamily Affordable Housing with a Solar Generating Facility of 1 Megawatt or Less	NEM2VMSH, Rule 21	NEM2VMSH Interconnection Agreement used with Form 79-1174-02
79-1151A	Net Energy Metering Interconnection for Solar And/or Wind Electric Generating Facilities Of 30 Kilowatts Or Less Agreement and Customer Authorization	NEM, Rule 21	NEMS Interconnection Agreement be used with 79-1151B Application
79-1151A-02	Agreement And Customer Authorization - Net Energy Metering (NEM2) Internconnection For Solar And/Or Wind Electric Generating Facilities Of 30 Kilowatts Or Less	NEM2, Rule 21	NEM2S Application to be used with 79-1151A Interconnection Agreement
79-1151B	Net Energy Metering Interconnection For Solar And/or Wind Electric Generating Facilities Of 30 Kilowatts Or Less Application	NEM, Rule 21	NEMS Application to be used with 79-1151A Interconnection Agreement
79-1151B-02	Application - Net Energy Metering (NEM2) Interconnection For Solar And/Or Wind Electric Generating Facilities Of 30 Kilowatts Or Less	NEM2, Rule 21	NEM2S Application to be used with 79-1151A-02 Interconnection Agreement
79-1124 ***	Eligible Low Income Development Virtual Net Energy Metering Application and Interconnection Agreement for Multifamily Affordable Housing with Solar Generation Totaling 1 Megawatt or Less	NEMVMASH, Rule 21	NEMVMASH Interconnection Agreement

(L)

(L)

(Continued)

Appendix A (Cont'd.) Forms Associated with Rule 21 Generating Facility Interconnections				
Form Number	Title	Associated Tariffs	Use Guidance	(L)
NEM and Non-Export Interconnection Forms (Cont'd.)				
79-1124-02***	Eligible Low Income Development Virtual Net Energy Metering (NEM2VMSH) Application and Interconnection Agreement for Multifamily Affordable Housing with Solar Generation Totaling 1 Megawatt or Less	NEM2VMSH, Rule 21	NEM2VMSH Interconnection Agreement	
79-1131 ***	NEMV Application and Interconnection Agreement for a Solar (PV) or Wind Generating Facility of 1 MW or Less *Serving Multiple Tenants Served at a Single Property Delivery Point*	NEM, Rule 21	NEMV Interconnection Agreement	
79-1131-02***	NEM2V Application and Interconnection Agreement for a Solar (PV) or Wind Generating Facility of 1 MW or Less *Serving Multiple Tenants Served at a Single Property Delivery Point*	NEM2V, Rule 21	NEM2V Interconnection Agreement	
79-1137	Interconnection Agreement for Net Energy Metering for a Renewable Electrical Generation Facility of 1,000 kW or Less, Except Solar or Wind (SB 489)	NEM, Rule 21	NEMV, NEMEXP, NEMEXPM Interconnection Agreement typically used with Forms 79-974 and 79-1142 Applications	
79-1137-02	Interconnection Agreement for Net Energy Metering (NEM2/NEM2V) for a Renewable Electricity Generation Facility of 1,000 Kilowatts or Less, Except Solar or Wind	NEM2, NEM2V, Rule 21	NEM2V, NEM2EXP, NEM2EXPM Interconnection Agreement typically used with Forms 79-1174-02	
79-1142 ***	NEMV Interconnection Application for a Renewable Electrical Generation Facility of 1 Megawatt or Less	NEM, Rule 21	Used with Form 79-1137 (L)	
79-973	Generating Facility Interconnection Agreement For Non-Export Generating Facilities (Rule 21 Interconnection Agreement)	Rule 21	Interconnection Agreement used for RESBCT and non-NEM generation with Application 79-974 and 79-1112	
79-992	Customer Generation Agreement (Third party Generator on Premises, Non-Exporting)	Rule 21	Used with Forms 79-1174	
79-1070	Export Addendum to Generating Facility Interconnection Agreement for Non-Export Generating Facilities (Form 79-973) Sized 2 Megawatts or Less	Rule 21	Export addendum used with Form 79-973	
79-1136	PG&E Interconnection Agreement For an Existing Small Generating Facility Interconnecting to the Distribution System under Rule 21	Rule 21	Used for existing QFs with Form 79-974 (L)	(L)

(Continued)

Appendix A (Cont'd.)
Forms Associated with Rule 21
Generating Facility Interconnections

Form Number	Title	Associated Tariffs	Use Guidance
Other NEM and Non-Export Forms (Cont'd.)			
79-1192	Interconnection Agreement for Non-Export Storage Generating Facilities 500KW or Less	Rule 21	Used for expedited interconnection of non-export energy storage, pursuant to Rule 21 Section N, PG&E AL 4941-E & E-A and D.16-06-052, & Attachment C, Section II.1
79-1199	Agreement And Customer Authorization Non-Export Stand-Alone Energy Storage Of 30 Kilowatts Or Less	Rule 21	Interconnection Agreement For non-export storage ≤ 30 kW
79-1206-02	Eligible Low-Income Development Virtual Net Energy Metering (NEM2VSOM) Interconnection Agreement For The Solar On Multifamily Affordable Housing (SOMAH) Program With Solar Generation Totaling 1 Mw Or Less	NEM2VSOM	NEM2VSOM Interconnection agreement for solar 1 MW or less.
79-1130	Request to Opt-out of / Opt-in to Compensation for Surplus Electricity	NEM	AB 920- Opt not to receive compensation for net annual excess energy
79-1202 ****	Load Aggregation Appendix	NEM, NEM2, Rule 21	Use as an Appendix with Form 79-1151A, 79-1151A-02, 79-978, 79-978-02,79-1137, 79-1137-02, 79-1069 or 79-1069-02
79-1155	Schedules NEM, NEMV, NEMVMASH, Net Surplus Electricity (NSE) Renewable Energy Credits Compensation	NEM, Rule 21	
79-1155-02	Schedules NEM2, NEM2V, NEM2VMSH, Net Surplus Electricity (NSE) Renewable Energy Credits Compensation	NEM2 NEM2V NEM2VMSH, Rule 21	
79-1174	Rule 21 Generator Interconnection Application	NEM (NEMEXP, NEMMT and NEMA), NEMFC, NEMV, NEMVMASH, RES-BCT, Rule 21	Rule 21 customer interconnection application form for expanded net-energy metered (all NEM > 30 kw and all non-Solar/Wind NEM), NEMFC, NEMV, NEMVMASH, RES-BCT, and non-export and limited export Rule 21 generation. (Standard NEM for solar and/or wind ≤ 30 kw will continue to use the 79-1151B application.)

(L)

(L)

(Continued)

ELECTRIC RULE NO. 21 Sheet 321
GENERATING FACILITY INTERCONNECTIONS

Appendix A (Cont'd.)
Forms Associated with Rule 21
Generating Facility Interconnections

Form Number	Title	Associated Tariffs	Use Guidance
Other NEM and Non-Export Forms (Cont'd.)			
79-1174-02	Rule 21 Generator Interconnection Application	NEM2 (NEM2EXP, NEM2MT and NEM2A), NEMFC, NEM2V, NEM2VMSH, RES-BCT, Rule 21	Rule 21 customer interconnection application form for expanded net-energy metered (all NEM2 > 30 kw and all non-Solar/Wind NEM), NEMFC, NEM2V, NEM2VMSH, RES-BCT, and non-export and limited export Rule 21 generation. (Standard NEM for solar and/or wind ≤ 30 kw will continue to use the 79-1151B application.)
Export for Sale Interconnection Forms			
79-1145	Rule 21 Exporting Generator Interconnection Request	Rule 21	Preferred online application: https://www.pge.com/en_US/large-business/services/alternatives-to-pge/electric-generation-interconnection.page
79-1197	Local Government Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) Re-Allocation Request	RES-BCT	Use to establish RES-BCT benefiting account re-allocations
79-1198-02	Interconnection Agreement For Net Energy Metering (NEM2) And Renewable Electrical Generating Facility Sized Greater Than 1,000 Kw	NEM2	FT and Detailed Study Interconnection Agreement for >1MW NEM2 Generating Facilities
79-1200	Rule 21 Generator Interconnection Agreement For Exporting Generating Facilities	Rule 21	FT and Detailed Study Interconnection Agreement for Exporting Generating Facilities
Other Agreements			
79-280	Agreement for Installation of Allocation of Special Facilities for Parallel Operation of Non-Utility-Owned Generation and/or Electrical Standby Service (Electric Rules 2 and 21)	Rule 21	Special Facilities Agreement to be used with Form 79-702
79-702	Appendix A: Detail of Special Facilities Charges to be used in concert with form 79-280	Rule 21	Used with Form 79-280

(L)

*** The application section of these forms is replaced by 79-1174.
**** For NEMA expanded customers, use the online 79-1174 form.

(L)

(Continued)

APPENDIX B (L)

Unit Cost Guide

Distribution Provider shall publish a Unit Cost Guide for facilities generally required to interconnect generation in Distribution Provider's Distribution System. The Unit Cost Guide shall not be binding for actual facility costs and is provided only for additional cost transparency, developer reference, and Distribution Provider's reference when preparing the cost estimate provided in any applicable studies. The Unit Cost Guide shall not replace the estimated cost provided by Distribution Provider in an Interconnection Study or an initial or supplemental review under the Fast Track Process.

The Unit Cost Guide shall include the anticipated cost of procuring and installing Interconnection Facilities and Distribution Upgrades generally utilized by the Applicant. An annual adjustment shall be performed within the Unit Cost Guide for five (5) years to account for the anticipated timing of procurement to accommodate a potential range of Commercial Operation Dates.

The Unit Cost Guide shall be updated annually in accordance with the process set forth in D.16-06-052. (L)

(Continued)

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Advice 6635-E
July 1, 2022

Attachment B

Redline Tariff Revisions

For convenience of the reader, PG&E has included redline revisions in Attachment 2. Where Electric Rule 21 has been revised, the affected sheets are included in Attachment 1.

In this advice letter and accordance to CPUC General Order 96B, Section 9.5.3, PG&E has implemented the use of the "(P)" symbol to signify material subject to change under a pending advice letter. The redlines in Attachment 2 are color coded to the specific advice letter. The color coding is as follows:

Redline Text Color	Advice Letter	Subject	Comments
	5915-E-B	Second Supplemental: Advice Letter Modifying Electric Rule 21 Pursuant to Decision 20-09-035 for Working Group 2 and 3 (due 120 Days from Issuance) for Ordering Paragraphs 6 and 11	Pending final disposition.
	6635-E	Modifications to Electric Tariff Rule 21 to Incorporate IEEE 1547.1-2020 Test Procedures into Testing Regime for Phase 2 and 3 Requirements in Compliance with Resolutions E-5000 and E 5036	In this advice letter, revisions are made pursuant to Resolutions E-5000 and E-5036.

ELECTRIC RULE NO. 21 Sheet 1
GENERATING FACILITY INTERCONNECTIONS

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B. APPLICABILITY (Cont'd.)

3. APPLICABLE CODES AND STANDARDS

This Rule has been harmonized with the requirements of ~~American National Standards Institute/~~Institute of Electrical and Electronic Engineers (~~ANSI/~~IEEE) 1547-~~2003 Standards for Interconnecting Distributed Resources with Electric Power Systems~~2018. In some sections, IEEE 1547-2018 language has been adopted directly or by reference.~~,~~ ~~I~~in others, IEEE 1547-2018 requirements were interpreted and this Rule's language was changed to maintain the spirit of both documents. (T)

~~UL1741- Supplement SA has been utilized for certification of phase I Smart Inverters (Phase 1 Smart Inverter Functions) as outlined in section Hh.~~ (D)

The language from IEEE 1547-2018 that has been adopted directly or by reference (as opposed to paraphrased language or previous language that was determined to be consistent with IEEE 1547-2018) is followed by a citation that lists the clause from which the language derived. For example, IEEE 1547-4.1.1 is a reference to Clause 4.1.1. (T)

In the event of any conflict between this Rule, any of the standards listed herein, or any other applicable standards or codes, the requirements of this Rule shall take precedence.

4. RETAIL CUSTOMER ENERGY STORAGE DEVICES

For retail customers interconnecting stationary or mobile energy storage devices pursuant to this Rule, the load aspects of the storage devices will be treated pursuant to Rules 2, 3, 15, and 16 just like other load, using the incremental net load for non-residential customers, if any, of the storage devices.

5. APPLICABILITY OF IEEE 1547-2018 REQUIREMENTS

The system's voltage at Point of Interconnection (POI) will determine the required Generating Facility operating requirements. Where voltage at the Point of Interconnection is less than 50 kV, [HH(1)]for applicable generation technology, IEEE 1547-2018 and related certification requirement are required. Where POI voltage is greater than or equal to 50 KV[KELM2], the Distribution Provider's Interconnection Handbook will outline operating and performance requirements consistent with North American Electric Reliability Corporation (NERC) and CAISO operating requirements. (L) (L)

(Continued)

C. DEFINITIONS ~~(Cont'd.)~~

The definitions in this Section C are applicable only to this Rule, the Interconnection Request, Study Agreements and Generator Interconnection Agreements. (L)

Added Facilities: See Special Facilities.

Affected System: An electric system other than Distribution Provider's Distribution or Transmission System that may be affected by the proposed Interconnection. (L)

Affected System Operator: The entity that operates an Affected System.

Affiliate: With respect to a corporation, partnership or other entity, each such other corporation, partnership or other entity that directly or indirectly, through one or more intermediaries, controls, is controlled by, or is under common control with, such corporation, partnership or other entity.

Allocated Capacity: Existing aggregate generation capacity in megawatts (MW) interconnected to a substation/area bus, bank or circuit (i.e., amount of generation online).

Anti-Islanding: A control scheme installed as part of the Generating or Interconnection Facility that senses and prevents the formation of an Unintended Island.

Applicant: The entity submitting an Interconnection Request pursuant to this Rule.

Application: See Interconnection Request.

Available Capacity: Total Capacity less the sum of Allocated Capacity and Queued Capacity.

Base Case: Data including, but not limited to, base power flow, short circuit and dynamic/stability data bases, underlying load, generation, and transmission facility assumptions, contingency lists, including relevant special protection systems, and transmission diagrams used to perform the Interconnection Studies. The Base Case may include Critical Energy Infrastructure Information (as that term is defined by FERC). (Cont'd on next page) (L) (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Base Case (Cont'd): The Base Case shall include (a) transmission facilities as approved by Distribution Provider or CAISO, as applicable, (b) planned Distribution Upgrades that may have an impact on the Interconnection Request, (c) Distribution Upgrades and Network Upgrades associated with generating facilities in (iv) below, and (d) generating facilities that (i) are directly interconnected to the Distribution System or CAISO Controlled Grid; (ii) are interconnected to Affected Systems and may have an impact on the Interconnection Request; (iii) have a pending request to interconnect to the Distribution System or an Affected System; or (iv) are not interconnected to the Distribution System or CAISO Controlled Grid, but are subject to a fully executed Generator Interconnection Agreement (or its equivalent predecessor agreement) or for which an unexecuted Generator Interconnection Agreement (or its equivalent predecessor agreement) has been requested to be filed with FERC. (L)

Business Day: Monday through Friday, excluding Federal and State Holidays.

CAISO Controlled Grid: The system of transmission lines and associated facilities that have been placed under the CAISO's Operational Control.

CAISO Tariff: The California Independent System Operator FERC Electric Tariff.

Calendar Day: Any day, including Saturday, Sunday or a Federal and State Holiday.

Certification Test: A test pursuant to this Rule that verifies conformance of certain equipment with Commission-approved performance standards in order to be classified as Certified Equipment. Certification Tests are performed by Nationally Recognized Test Laboratories (NRTLs).

Certification; Certified; Certificate: The documented results of a successful Certification Testing.

Certified Equipment: Equipment that has passed all required Certification Tests.

Commercial Operation: The status of a Generating Facility that has commenced generating electricity, excluding electricity generated during the period which Producer is engaged in on-site test operations and commissioning of the Generating Facility prior to Commercial Operation. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Commercial Operation Date: The date on which a Generator at a Generating Facility commences Commercial Operation, as agreed to by the Parties. (L)

Commission: The Public Utilities Commission of the State of California. (L)

Commissioning Test: A test performed during the commissioning of all or part of a Generating Facility to achieve one or more of the following:

Verify specific aspects of its performance;

Calibrate its instrumentation;

Establish instrument or Protective Function set-points.

Confidential Information: See Section D.7.

Conservation Voltage Regulation (CVR): The CVR program that the Commission directed Distribution Provider to implement as applicable to the operation and design of distribution circuits and related service voltages.

Construction Activities: Actions by Distribution Provider that result in irrevocable financial commitments for the purchase of major electrical equipment or land for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades assigned to the Interconnection Customer that occur after receipt of all appropriate governmental approvals needed for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades.

Continuous Operation: The Smart Inverter operates indefinitely without tripping. Any functions that protect the Smart Inverter from damage may operate as needed.

Control Area: As defined in the CAISO Tariff.

Cost Envelope: A cost-certainty framework defined as plus or minus twenty-five (25) percent of the estimated cost of certain Interconnection Facilities and/or Distribution Upgrades identified in the Cost Envelope Estimate that is offered to an Applicant based on actual costs within such twenty-five (25) percent envelope. Applicant's cost responsibility for Interconnection Facilities and/or Distribution Upgrades subject to the Cost Envelope is set forth in Section F.7.b.

(Continued)

C. DEFINITIONS (Cont'd.)

Cost Envelope Option: A five-year pilot option described in Section F.7 applicable to Interconnection Requests for Generating Facilities that are processed under the Fast Track Process or Independent Study Process.

Cost Envelope Estimate: An estimate prepared by the Distribution Provider and delivered to Applicant pursuant to the Cost Envelope Option that contains (i) the estimated cost of Distribution Provider's required Interconnection Facilities and/or Distribution Upgrades that are offered to Applicant that are subject to the Cost Envelope, and (ii) the estimated costs of related activities and facilities that are excluded from the Cost Envelope and offered on an actual cost basis, both pursuant to Section F.7.

Customer: The entity that receives or is entitled to receive Distribution Service through Distribution Provider's Distribution System or is a retail Customer of Distribution Provider connected to the Transmission System.

db_{OF}: A single-sided deadband value for high-frequency in Hz used in Section P. (N)

db_{UF}: A single-sided deadband value for low-frequency in Hz used in Section P. (N)

Dedicated Transformer; Dedicated Distribution Transformer: A transformer that provides electricity service to a single Customer. The Customer may or may not have a Generating Facility.

Delivery Network Upgrades: The transmission facilities at or beyond the point where Distribution Provider's Distribution System interconnects to the CAISO Controlled Grid, other than Reliability Network Upgrades, as defined in the CAISO Tariff.

Detailed Study: An Independent Study, a Distribution Group Study or a WDT Transmission Cluster Study.

Detailed Study Agreement: The agreement entered into by the Interconnection Customer and Distribution Provider which sets forth the Parties' agreement to perform Interconnection Studies under the Independent Study Process or the Distribution Group Study Process.

Device: A mechanism or piece of equipment designed to serve a purpose or perform a function. The term may be used interchangeably with the terms "equipment" and function without intentional difference in meaning. See also Function and Protective Function.

(Continued)

C. DEFINITIONS (Cont'd.)

DGS Phase I Interconnection Study: Distribution Group Study (DGS) Phase I Interconnection Study performed by the Distribution Provider under the Distribution Group Study Process per Section G.3.c.i.

DGS Phase II Interconnection Study: Distribution Group Study (DGS) Phase II Interconnection Study performed by the Distribution provider under the Distribution Group Study Process per Section G.3.c.ii.

Dispute Resolution: See Section K.

Distributed Energy Resource (DER): As defined in IEEE 1547-2018. (N)

DER Interconnection System: As defined by "Interconnection System" in IEEE 1547-2018 (N)

Distribution Group Study: An interconnection engineering study of a group comprised of Interconnection Requests that pass Screen Q as a group and fail Screen R demonstrating they are electrically interdependent in accordance with Section F.3.c.

Distribution Group Study Process: The interconnection study process set forth in Section F.3.c.

Distribution Provider: Pacific Gas and Electric Company

Distribution Service: The service of delivering energy over the Distribution System pursuant to the approved tariffs of Distribution Provider other than services directly related to the Interconnection of a Generating Facility under this Rule.

Distribution Study Group: A group comprised of Interconnection Requests that fail Screen R that will be studied pursuant to Section F.3.c because the Screen R results demonstrate they are electrically interdependent.

Distribution System: All electrical wires, equipment, and other facilities owned or provided by Distribution Provider, other than Interconnection Facilities or the Transmission System, by which Distribution Provider provides Distribution Service to its Customers.

Distribution Upgrades: The additions, modifications, and upgrades to Distribution Provider's Distribution System at or beyond the Point of Interconnection to facilitate interconnection of the Generating Facility and render the Distribution Service. Distribution Upgrades do not include Interconnection Facilities.

(Continued)

C. DEFINITIONS (Cont'd.)

Interconnection Facilities Study: A study conducted by Distribution Provider for an Interconnection Customer under the Independent Study Process to determine a list of facilities (including Distribution Provider's Interconnection Facilities, Distribution Upgrades, and Network Upgrades as identified in the Interconnection System Impact Study), the cost of those facilities, and the time required to interconnect the Generating Facility with Distribution Provider's Distribution or Transmission System. The scope of the study is defined in Section G.3.c. (L)

Interconnection Financial Security: Any of the financial instruments listed in Section F.4.a. (L)

Interconnection Request: An Applicant's request to interconnect a new Generating Facility, or to increase the capacity of, or make a Material Modification to the operating characteristics of, an existing Generating Facility that is interconnected with Distribution Provider's Distribution or Transmission System.

Interconnection Study: A study to establish the requirements for Interconnection of a Generating Facility with Distribution Provider's Distribution System or Transmission System, pursuant to this Rule.

Interconnection System Impact Study: An engineering study conducted by Distribution Provider for an Interconnection Customer under the Independent Study Process that evaluates the impact of the proposed interconnection on the safety and reliability of Distribution Provider's Distribution and/or Transmission System and, if applicable, an Affected System. The scope of the study is defined in Section G.3.c.i.

Island; Islanding: A condition on Distribution Provider's Distribution System in which one or more Generating Facilities deliver power to Customers using a portion of Distribution Provider's Distribution System that is electrically isolated from the remainder of Distribution Provider's Distribution System.

k_{OF}: The per-unit frequency change corresponding to 1 per-unit power output change (frequency droop), unitless used in Section P.[HH(3] (N)

k_{UF}: The per-unit frequency change corresponding to 1 per-unit power output change (frequency droop), unitless used in Section P. (N)

Large Generating Facility: A Generating Facility having a Generating Facility Capacity of more than 20 MW. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Like for like: For inverters, like-for-like means certified, same nameplate or smaller, same fault current or smaller. For solar panels, like-for-like means certified, same CEC-AC rating of the system or smaller. For batteries, like-for-like means same or less kWh & kW rating and same operating profile. For transformers, like-for-like means same connection type, same or smaller impedance and capacity. (L)

Line Section: That portion of Distribution Provider's Distribution or Transmission System connected to a Customer bounded by automatic sectionalizing devices or the end of the distribution line. (P/L)

Local DER Generating Facility Communication Interface: Interface at the Generating Facility capable of communicating to support the information exchange requirements specified in this rule and as required in IEEE 1547-2018 for all applicable functions that are in Section P. (N)

Local Furnishing Bond: Tax-exempt bonds utilized to finance facilities for the local furnishing of electric energy, as described in Internal Revenue Code, 26 U.S.C. § 142(f). (P/L)

Local Furnishing Distribution Provider: Any Distribution Provider that owns facilities financed by Local Furnishing Bonds. (P/L)

Mandatory Operation: The Smart Inverter operates at maximum available current without tripping during Distribution Provider's Transmission or Distribution System excursions outside the region of continuous operation. Any functions that protect the Smart Inverter from damage may operate as needed.

Material Modification: Those modifications that have a material impact on cost or timing of any Interconnection Request with a later queue priority date or a change in Point of Interconnection. A Material Modification does not include a change in ownership of a Generating Facility, (ii) a modification described in Table F.1, nor (iii) a modification described in Tables Ee.1, 2 or 3 that does not require a new interconnection request.

Metering: The measurement of electrical power in kilowatts (kW) and/or energy in kilowatt-hours (kWh), and if necessary, reactive power in kVAR at a point, and its display to Distribution Provider, as required by this Rule.

Metering Equipment: All equipment, hardware, software including meter cabinets, conduit, etc., that are necessary for Metering. (L)

(L)

(Continued)

C. DEFINITIONS (Cont'd.)

Momentary Cessation: The Smart Inverter momentarily reduces current output to the Distribution Provider's Transmission or Distribution System to below 10% of the maximum continuous output current rating. The Smart Inverter is allowed to increase current output to the Distribution Provider's Transmission or Distribution System without any intentional reconnection delay once voltage exits the Momentary Cessation region and enters a Permissive Operation region or Continuous Operation region. (L)

Momentary Parallel Operation: The Interconnection of a Generating Facility to the Distribution and Transmission System for one second (60 cycles) or less. (P/L)

Nationally Recognized Testing Laboratory (NRTL): A laboratory accredited to perform the Certification Testing requirements under this Rule.

Net Energy Metering (NEM): Metering for the receipt and delivery of electricity between Producer and Distribution Provider pursuant to California Public Utilities Code (PUC) sections 2827, 2827.1 (as currently implemented by Commission Decision (D.)16-01-044), 2827.8, or 2827.10.

NEM-1: Refers to Interconnection Requests for service pursuant to Schedules NEM, NEMV, and NEMVMASH.

NEM-2: Refers to Interconnection Requests for service pursuant to Schedules NEM2, NEM2V, NEM2VMSH, and NEM2VSOM. (P/L)

Net Rating or Net Nameplate Rating: The Gross Rating minus the consumption of electrical power of the auxiliary load.

Network Upgrades: Delivery Network Upgrades and Reliability Network Upgrades.

Networked Secondary System: An AC distribution system where the secondaries of the distribution transformers are connected to a common bus for supplying electricity directly to consumers. There are two types of secondary networks: grid networks (also referred to as area networks or street networks) and Spot Networks. Synonyms: Secondary Network. Refer to IEEE 1547.6 for additional detail.

Non-Emergency: Conditions or situations that are not Emergencies, including but not limited to meter reading, inspection, testing, routine repairs, replacement, and maintenance.

Nominal: Standard frequency and voltage. (L)

(Continued)

C. DEFINITIONS (Cont'd.)

Non-Export; Non-Exporting: When the Generating Facility is sized and designed such that the Generator output is used for Host Load only and is designed to prevent the transfer of electrical energy from the Generating Facility to Distribution Provider's Distribution or Transmission System. (L) | | (L)

Non-Export AC/DC Converter: A one-way only device that takes alternating current (AC) power from the Distribution System and converts it into direct current (DC) power for DC loads in the Customer's facility. A Non-Export AC/DC Converter must be certified by a Nationally Recognized Test Lab as non-export, meaning it must be certified to not export power back into the grid (i.e. exports less than 0.5% of its rated current towards the grid under steady–state conditions or after 5 cycles of an induced fault condition) and it must meet IEEE 1547-4.3.3 harmonic requirements. Until a national certification standard is approved and the Non-Export AC/DC Converter can be certified by a NRTL, the requirement can be satisfied through Distribution Provider's interim approval process. An interim approval will apply to devices that complete the Distribution Provider's testing procedure described in Section L.7.a.v. The interim approval will be effective upon the Distribution Provider acknowledging that the test results for a particular model of Non-Export AC/DC Converter confirm satisfactory completion of the testing procedures. Twelve months after the UL 1741 Non-Export Certification Requirement Document (CRD) standard is available, new interconnections requests for non-export using an AC/DC converter must use an NRTL certified non-export converter.

Non-Islanding: Designed to detect and disconnect from a stable Unintended Island with matched load and generation. Reliance solely on under/over voltage and frequency trip is not considered sufficient to qualify as Non-Islanding.

Open Loop Response Time: The duration from a step change in control signal input (reference value) until the output changes to 90 percent of its final change, before any overshoot.

Parallel Operation: The simultaneous operation of a Generator with power delivered or received by Distribution Provider while Interconnected. For the purpose of this Rule, Parallel Operation includes only those Generating Facilities that are Interconnected with Distribution Provider's Distribution or Transmission System for more than 60 cycles (one second).

Paralleling Device: An electrical device, typically a circuit breaker, operating under the control of a synchronization relay or by a qualified operator to connect an energized generator to an energized electric power system or two energized power systems to each other.

(Continued)

C. DEFINITIONS (Cont'd.)

Party, Parties: Applicant or Distribution Provider.

Periodic Test: A test performed on part or all of a Generating Facility/Interconnection Facilities at pre-determined time or operational intervals to achieve one or more of the following: 1) verify specific aspects of its performance; 2) calibrate instrumentation; and 3) verify and re-establish instrument or Protective Function set-points.

Permissive Operation: The Smart Inverter is allowed, but not required, to operate at any current level.

Point of Common Coupling (PCC): The transfer point for electricity between the electrical conductors of Distribution Provider and the electrical conductors of Producer.

Point of Interconnection (POI): The point where the Interconnection Facilities connect with Distribution Provider's Distribution or Transmission System. This may or may not be coincident with the Point of Common Coupling. (T)

Point of Generating Resource Connection (POC): The point where a DER unit is electrically connected in a Generating Facility and meets the requirements of this rule. (N)

Pre-Construction Activities: The actions by Distribution Provider, other than those required by an Engineering and Procurement Agreement under Section F.3.f, undertaken prior to Construction Activities in order to prepare for the construction of Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades assigned to the Interconnection Customer, including, but not limited to, preliminary engineering, permitting activities, environmental analysis, or other activities specifically needed to obtain governmental approvals for Distribution Provider's Interconnection Facilities, Distribution Upgrades, or Network Upgrades.

(Continued)

C. DEFINITIONS (Cont'd.)

Producer: The entity that executes a Generator Interconnection Agreement with Distribution Provider. Producer may or may not own or operate the Generating Facility, but is responsible for the rights and obligations related to the Generator Interconnection Agreement.

Production Test: A test performed on each device coming off the production line to verify certain aspects of its performance.

Protective Function(s): The equipment, hardware and/or software in a Generating Facility (whether discrete or integrated with other functions) whose purpose is to protect against Unsafe Operating Conditions.

Prudent Electrical Practices: Those practices, methods, and equipment, as changed from time to time, that are commonly used in prudent electrical engineering and operations to design and operate electric equipment lawfully and with safety, dependability, efficiency, and economy.

Queue Position: See Section E.5.C.

Queued Capacity: Aggregate queued generation capacity (in MW) for a substation/area bus, bank or circuit (i.e., amount of generation in the queue).

Reasonable Efforts: With respect to an action required to be attempted or taken by a Party under this Rule, efforts that are timely and consistent with Good Utility Practice and are otherwise substantially equivalent to those a Party would use to protect its own interests.

Reference Point of Applicability (RPA): The location where the Generating Facility interconnection and interoperability performance requirements shall be met. (N)

Reliability Network Upgrades: The transmission facilities at or beyond the point where Distribution Provider's Distribution System interconnects to the CAISO Controlled Grid, necessary to interconnect one or more Generating Facility(ies) safely and reliably to the CAISO Controlled Grid, as defined in the CAISO Tariff.

Section 218 Load: Electrical power that is supplied in compliance with California PUC section 218. PUC section 218 defines an "Electric Corporation" and provides conditions under which a transaction involving a Generating Facility would not classify a Producer as an Electric Corporation. These conditions relate to "over-the-fence" sale of electricity from a Generating Facility without using Distribution Provider's Distribution or Transmission System.

(Continued)

F. REVIEW PROCESS FOR INTERCONNECTION REQUESTS (Cont'd.)

2. FAST TRACK INTERCONNECTION REVIEW PROCESS

a. Initial Review

Upon receipt of a complete and valid Interconnection Request, Distribution Provider shall perform Initial Review using the process in Section G.1. The Initial Review determines if (i) the Generating Facility qualifies for Fast Track Interconnection through Initial Review, or (ii) the Generating Facility requires a Supplemental Review. Absent extraordinary circumstances, Distribution Provider shall notify Applicant in writing of the results of Initial Review within fifteen (15) Business Days following validation of an Interconnection Request.

(N)

As part of the evaluation of Screen M, when Integration Capacity Analysis Values are available at the requested Point of Interconnection, Distribution Provider will determine if Integration Capacity Analysis Values at the proposed Point of Interconnection need to be updated. If Distribution Provider determines that the Integration Capacity Analysis Values at the proposed Point Interconnection need to be updated, the Distribution Provider will update the values for the proposed Point of Interconnection using the Integration Capacity Analysis tool on the specific electrical node or by running the Integration Capacity Analysis on all the electrical nodes in the circuit. Distribution Provider shall not perform additional Integration Capacity Analysis as part of the interconnection process of projects with less than 30 kilovolt amperes nameplate capacity. Distribution Provider shall share the results of any Integration Capacity Analysis updates with the Applicant and provide an explanation of changes to grid conditions or the interconnection queue which led to the need to obtain updated Integration Capacity Analysis Values. Distribution Provider shall comply with confidentiality provisions and data redaction policies.

(N)

(L)

(L)

(Continued)

F. REVIEW PROCESS FOR INTERCONNECTION REQUESTS (Cont'd.) (L)

2. FAST TRACK INTERCONNECTION REVIEW PROCESS

a. Initial Review (Cont'd)

For all Interconnection Requests that pass Initial Review and do not require Interconnection Facilities or Distribution Upgrades, Distribution Provider shall provide Applicant with a Generator Interconnection Agreement within fifteen (15) Business Days of providing notice of Initial Review results. For Interconnection Requests that pass Initial Review but do require Interconnection Facilities or Distribution Upgrades, within fifteen (15) Business Days of providing notice of Initial Review results, Distribution Provider shall provide Applicant with a non-binding cost estimate of the Interconnection Facilities or Distribution Upgrades. For those Interconnection Requests where Applicant has selected the Cost Envelope Option, within ten (10) Business Days of providing Applicant the non-binding cost estimate for the required Interconnection Facilities and/or Distribution Upgrades, Applicant shall provide the Distribution Provider the Cost Envelope Option deposit, in accordance with Section F.7.a.i.3. If Applicant fails to provide the Cost Envelope Option deposit in accordance with Section F.7.a.i.3, Applicant's request for the Cost Envelope Option shall be deemed withdrawn and the Interconnection Request shall not be eligible for the Cost Envelope Option.

For all Interconnection Requests that pass Initial Review, refer to Section F.2.e for cost responsibility and time frames for completing the Generator Interconnection Agreement. (L)

(Continued)

F. REVIEW PROCESS FOR INTERCONNECTION REQUESTS (Cont'd.)

7. COST ENVELOPE OPTION (Cont'd.)

f. Modifications

Under the Independent Study Process, any requested modifications, including required updates to costs under the Cost Envelope Option, shall be made in accordance with Section F.3.b.v. If Applicant elects to proceed with re-evaluation of the costs under the Cost Envelope Option pursuant to Section F.3.b.v, Distribution Provider shall complete the re-evaluation within the sum of the time allowed for each step utilized by the Distribution Provider for preparation of the initial Cost Envelope Estimate pursuant Section F.3.b from receipt of all required technical data related to the proposed changes and payment of the estimated cost of the re-evaluation.

g. Tender of the Generator Interconnection Agreement Under the Cost Envelope Option

Negotiation and execution of the Generator Interconnection Agreement shall be in accordance with Section F.2.e for Interconnection Requests evaluated under the Fast Track Process, and in accordance with Section F.3.e.ii for Interconnection Requests evaluated under the Independent Study Process.

8. DESIGN AND CONSTRUCTION TIMELINE (N)

Subject to emergencies, delays from other agencies, and other reasons, the standard timeline for design and construction of interconnection-related Distribution Upgrades is as follows:

i) 60 business days for design and 60 business days for construction, or
ii) Design and construction timelines as agreed to between Applicant and Distribution Provider.

The 60-day clock commences upon payment and after Applicant has done everything necessary on its end to prepare for construction. (N)

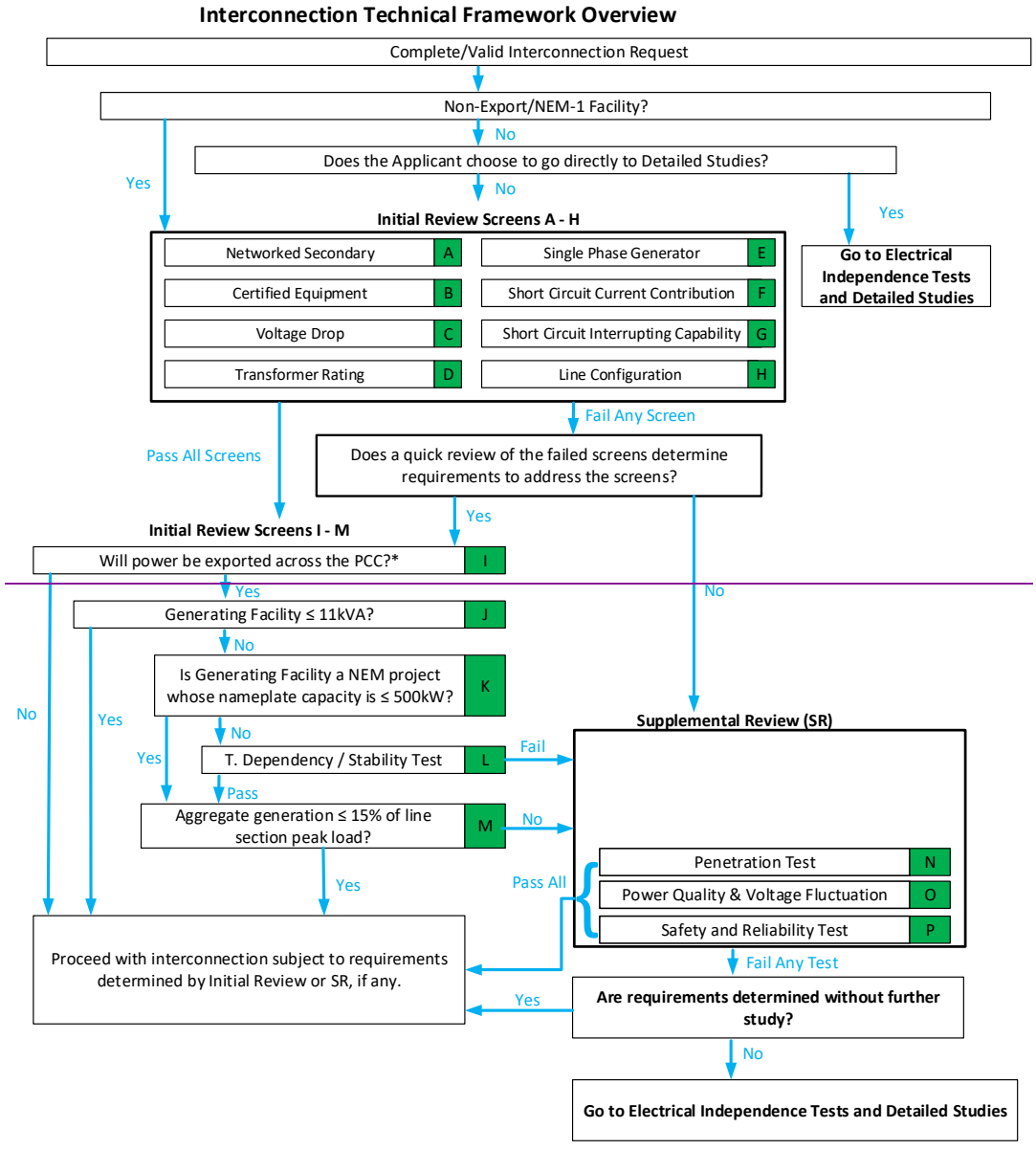
(Continued)

G. ENGINEERING REVIEW DETAILS

Delete table below:

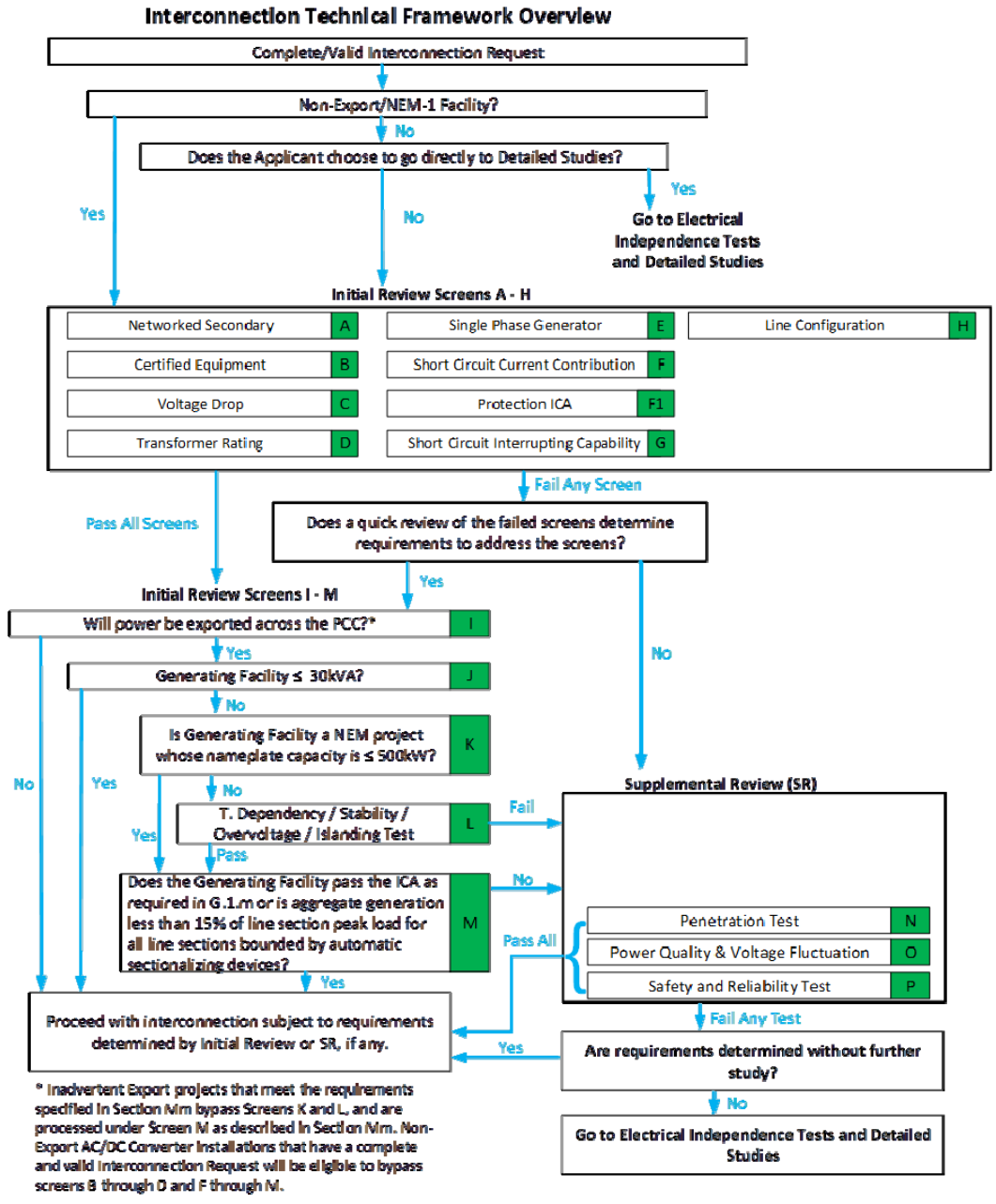
(P)

Delete pending table below:



(Continued)

Add new table below



(P)

(Continued)

* ~~If Generating Facility meets the conditions in Screen I below (Section G.1.i), skip Screens K, L, and M.~~

(T)

(T)

~~(P)~~
~~(P)~~

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

1. INITIAL REVIEW SCREENS (Cont'd.)

e. Screen E: Does the Single-Phase Generator cause unacceptable imbalance? (Cont'd.)

Significance: Generating Facilities connected to a single-phase transformer with 120/240 V secondary voltage must be installed such that the aggregated gross output is as balanced as practicable between the two phases of the 240 volt service. When Distribution Provider's analysis determines a transformer change is required. Distribution Provider will furnish the customer with an explanation of why the change is needed.

f. Screens F and F1: (P)

Screen F: Is the Short Circuit Current Contribution Ratio within acceptable limits? (P) (P)

- If Yes (pass), continue to Screen F1. (P)
- If No (fail), continue to Screen F1 pursuant to Section G.1. (P)

Note: This Screen does not apply to Generating Facilities with a Gross Rating of 3011 ~~11~~ kVA or less. (T)

When measured at primary side (high side) of the Dedicated Distribution Transformer serving a Generating Facility, the sum of the Short Circuit Contribution Ratios of all Generating Facilities connected to Distribution Provider's Distribution System circuit that serves the Generating Facility must be less than or equal to 0.1.

Significance: If the Generating Facility passes this screen, it can be expected that it will have no significant impact on Distribution Provider's Distribution System's short circuit duty, fault detection sensitivity, relay coordination or fuse-saving schemes. (P)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

1. INITIAL REVIEW SCREENS (Cont'd.)

g. Screen G: Is the Short Circuit Interrupting Capability Exceeded? (Cont'd) (L)

Note: This Screen does not apply to Generating Facilities with a Gross Rating of 3011 ~~11~~ kVA or less. (T)/(L)

Significance: If the Generating Facility passes this screen, it can be expected that it will not cause any of Distribution Provider's equipment to be overstressed.h. Screen H: Is the line configuration compatible with the Interconnection type? (L)

- If Yes (pass), continue to Screen I.
- If No (fail), continue to Screen I pursuant to Section G.1.

Note: This Screen does not apply to Generating Facilities with a Gross Rating of 3011 ~~11~~ kVA or less

Line Configuration Screen: Identify primary distribution line configuration that will serve the Generating Facility. Based on the type of Interconnection to be used for the Generating Facility, determine from Table G.1 if the proposed Generating Facility passes the Screen. (T)

Table G-1
Type of Interconnection

Primary Distribution Line Type Configuration	Type of Interconnection to be made to Primary Distribution Line	Result/Criteria
Three-phase, three-wire	Any type	Pass Screen
Three-phase, four-wire	Single-phase, line-to-neutral	Pass Screen
Three-phase, four-wire (For any line that has such a section OR mixed three-wire & four-wire)	All others	To pass, aggregate Generating Facility nameplate rating must be less than or equal to 10% of Line Section peak load

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

1. INITIAL REVIEW SCREENS (Cont'd.)

j. Screen J: Is the Gross Rating of the Generating Facility 30~~11~~ kVA or less? (T)

- If Yes (pass), skip Screens K, L and M; Initial Review is complete.
- If No (fail), continue to Screen K.[i]

Significance: The Generating Facility will have a minimal impact on fault current levels and any potential line overvoltages from loss of Distribution Provider's Distribution System neutral grounding.

k. Screen K: Is the Generating Facility a Net Energy Metering (NEM) Generating Facility with nameplate capacity less than or equal to 500 kW?

- If Yes (pass), skip screen L and continue to screen M.
- If No (fail), continue to screen L.

Significance: The purpose of this Screen is solely to facilitate interconnection of NEM facilities below this size threshold by allowing such facilities to bypass Screen M. The use of nameplate capacity expedites the Initial Review analysis. In Supplemental Review, the net export will be analyzed.

[i] Inadvertent Export systems that meet the requirements specified in Section Mm bypass Screens K and L, and are processed under Screen M as described in Section Mm.

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.) (N)

1. INITIAL REVIEW SCREENS (Cont'd.)

m. Screen M: When ICA Values are available at the requested Point of Interconnection, the Distribution Provider shall compare the ICA Values to the Gross Nameplate Rating or typical PV Generation Profile.

For Interconnection Requests based on Gross Nameplate Rating:

a. Is the Generating Facility aggregate Gross Nameplate Rating greater than 90% of the lowest value in the ICA-SG 576 Profile? or

b. Is the Generating Facility aggregate Gross Nameplate Rating greater than 90% of the lowest value in the ICA-OF 576 Profile?

If the response is "yes" to either a) or b), the Interconnection Request fails Screen M and must be evaluated under the Supplemental Review to determine mitigation requirements.

For Interconnection Requests based on typical PV Generation Profile:

a. Is the Generating Facility Generation Profile based on PV Watts or equivalent greater than 90% of the ICA-SG 576 value in any hour? or

b. Is the Generating Facility Generation Profile based on PV Watts or equivalent greater than 90% of the ICA-OF 576 value in any hour?

If the response is "yes" to either a) or b), the Interconnection Request fails Screen M and must be evaluated under the Supplemental Review to determine mitigation requirements. (N)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

1. INITIAL REVIEW SCREENS (Cont'd.)

m. Screen M (Cont'd):

Is the aggregate Generating Facility capacity on the Line Section less than 15% of Line Section peak load for all line sections bounded by automatic sectionalizing devices? ~~(Cont'd.)~~

- If Yes (pass), Initial Review is complete.
- If No (fail), Supplemental Review is required.

When ICA information is not available at the requested Point of Interconnection, Screen M should be evaluated as follows:

Significance:

1. Low penetration of Generating Facility capacity will have a minimal impact on the operation and load restoration efforts of Distribution Provider's Distribution System.

2. The operating requirements for a high penetration of Generating Facility capacity may be different since the impact on Distribution Provider's Distribution System will no longer be minimal, therefore requiring additional study or controls.

The purpose of this Screen is solely to identify if the Generating Facility needs additional study and is not intended as justification for limiting the penetration of generation on a line section.

2. SUPPLEMENTAL REVIEW SCREENS

The Supplemental Review consists of Screens N through P. If any of the Screens are not passed, a quick review of the failed Screen(s) will determine the requirements to address the failure(s) or that Detailed Studies are required. In certain instances, Distribution Provider may be able to identify the necessary solution and determine that Detailed Studies are unnecessary. Some examples of solutions that may be available to mitigate the impact of a failed Screen are:

1. Replacing a fixed capacitor bank with a switched capacitor bank.

2. Adjustment of line regulation settings.

(Continued)

3. Simple reconfiguration of the distribution circuit.

[ii] ~~Inadvertent Export systems that meet the requirements specified in Section Mm are processed under Screen M as described in Section Mm.~~

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

a. Screen N: Penetration Test

(N)

If Integration Capacity Analysis Values are available at the requested Point of Interconnection, evaluate Screen N as follows:

i) Penetration Level Using Generating ICA Profile:

For Interconnection Requests based on Gross Nameplate Rating: Is the Generating Facility aggregate Gross Nameplate Rating equal to or below 90% of the lowest value in the ICA-SG 576 Profile?

For Interconnection Requests based on typical PV Generation Profile: Is the Generating Facility Generation Profile, based on PV Watts or equivalent, equal to or below 90% the ICA-SG value at each hour in the ICA-SG 576 Profile?

ii) Screen F1: Did the Interconnection Request pass Screen F1?

If yes to both of the above (pass), continue to Screen O.

If "no" to either or both of the above (fail), a quick review of the failure within Supplemental Review may determine the requirements to address the failure; otherwise Electrical Independence Tests or Detailed Studies are required.

- If the failure(s) that cannot be addressed in Supplemental Review, the Distribution Provider will conduct a review to identify the reasons why further studies are required.

(N)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.) (N)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

a. Screen N: Penetration Test (Cont'd)

ii) Screen F1: Did the Interconnection Request pass Screen F1 (Cont'd)?

- If the failure(s) cannot be addressed in Supplemental Review, and generation is 100% or less of the applicable ICA value (lowest value of the ICA-SG profile or lowest value at each hour) the Distribution Provider must identify a reason why a specific technical constraint is not captured by the ICA and the why the project must proceed to Electrical Independence Tests and Detailed Studies.

- If voltage is a prevailing constraint, then the smart inverter default volt/var function will be used in power flow analysis for the evaluation of the proposed project. This will reveal if the proposed project causes any voltage impacts of concern. If concerns related to steady state voltage, thermal, or protection exist and the Distribution Provider can identify simple upgrades through power flow analysis (e.g., installation of voltage regulator devices or protection devices to mitigate reduction of reach), then the Distribution Provider will determine the mitigation requirements within Screen N. When larger upgrades or complex protection evaluation is required, Screen N will fail, and the technical evaluation will be conducted under the Detailed Study process.

- If no reason for further study is identified, or if requirements to address the failure can be identified in screen N, proceed to Screen O.

- Note: If Electrical Independence tests and Detailed Studies are required, Applicants will continue to the Electrical Independence Tests and Detailed Studies after review of the remaining Supplemental Review Screens if Applicant elects to proceed.

(N)

- If Integration Capacity Analysis Values are not available, evaluate Screen N as follows:

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.) (N)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

a. Screen N: Penetration Test (Cont'd) (N)

Where 12 months of line section minimum load data is available, can be calculated, can be estimated from existing data, or determined from a power flow model, is the aggregate Generating Facility capacity on the Line Section less than 100% of the minimum load for all line sections bounded by automatic sectionalizing devices upstream of the Generating Facility? (L)

- If yes (pass), continue to Screen O.
- If no (fail), a quick review of the failure may determine the requirements to address the failure; otherwise Electrical Independence Tests and Detailed Studies are required. Continue to Screen O. (Note: If Electrical Independence tests and Detailed Studies are required, Applicants will continue to the Electrical Independence Tests and Detailed Studies after review of the remaining Supplemental Review Screens, if Applicant elects to proceed.)

Note 1: If none of the above options are available, this screen defaults to Screen M.

Note 2: The type of Generating Facility technology will be taken into account when calculating, estimating, or determining circuit or Line Section minimum load relevant for the application of this screen. For solar Generating Facilities with no battery storage, daytime minimum load will be used (i.e., 10 am to 4 pm for fixed panel solar Generating Facilities and 8 am to 6 pm for solar Generating Facilities utilizing tracking systems), while absolute minimum load will be used for all other Generating Facility technologies.

Note 3: When this screen is being applied to a NEM Generating Facility, the net export in kW, if known, that may flow across the Point of Common Coupling into Distribution Provider's Distribution System will be considered as part of the aggregate generation. (L)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

a. Screen N: Penetration Test (Cont'd.)

Note 4: Distribution Provider will not consider as part of the aggregate Generating Facility capacity for purposes of this screen Generating Facility capacity known to be already reflected in the minimum load data.

Note 5: NEM Generating Facilities with net export less than or equal to 500 kW that may flow across the Point of Common Coupling into Distribution Provider's Distribution or Transmission System will not be studied in the WDT Transmission Cluster Study Process, but may be studied under the Independent Study Process.

Significance: Penetration of Generating Facility capacity that does not result in power flow from the circuit back toward the substation will have a minimal impact on equipment loading, operation, and protection of the Distribution System.

b. Screen O: Power Quality and Voltage Tests

In aggregate with existing Generating Facility capacity on the Line Section, distribution circuit, and/or substation.

i) Can it be determined within the Supplemental Review that the voltage regulation on the line section can be maintained in compliance with Commission Rule 2 and/or Conservation Voltage Regulation voltage requirements under all system conditions?

ii) Can it be determined within the Supplemental Review that the voltage fluctuation is within acceptable limits as defined by IEEE ~~1453~~ 1547-2018 or utility practice similar to ~~IEEE1453~~IEEE 1547-2018? (T) (T)

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

2. SUPPLEMENTAL REVIEW SCREENS (Cont'd.)

b. Screen O: Power Quality and Voltage Tests (Cont'd.)

In aggregate with existing Generating Facility capacity on the Line Section, distribution circuit, and/or substation. (Cont'd.)

iii) Can it be determined within the Supplemental Review that the harmonic levels meet IEEE ~~519~~ 1547-2018, 7.3 limits at the Point of Common Coupling (PCC)? (T)

iv) Can it be determined within the Supplemental Review that the Generating Facility will not cause any voltage impacts considering the settings of the Volt-Var function and the characteristics of the circuit segment?

- If yes to all of the above (pass), continue to Screen P.
- If no to any of the above (fail), a quick review of the failure may determine the requirements to address the failure; otherwise Electrical Independence Tests and Detailed Studies are required. Continue to Screen P. (Note: If Electrical Independence tests and Detailed Studies are required, Applicants will continue to the Electrical Independence Tests and Detailed Studies after review of the remaining Supplemental Review Screens.)

Significance: Adverse voltages and undesirable interference may be experienced by other Customers on Distribution Provider's Distribution System caused by operation of the Generating Facility(ies).

c. Screen P: Safety and Reliability Tests

Does the location of the proposed Generating Facility or the aggregate generation capacity on the Line Section create impacts to safety or reliability that cannot be adequately addressed without Detailed Study?

- If yes (fail), review of the failure may determine the requirements to address the failure; otherwise Electrical Independence Tests and Detailed Studies are required. Continue to Section G.3.
- If no (pass), Supplemental Review is complete.

(Continued)

G. ENGINEERING REVIEW DETAILS (Cont'd.)

3. DETAILED STUDY SCREENS (Cont'd.)

c. Independent Study Process and Distribution Group Study Process Interconnection Studies (Cont'd.)

ii) Interconnection Facilities Study and DGS Phase II Interconnection Study. (Cont'd.)

(1) Scope and Purpose of the Interconnection Facilities and DGS Phase II Interconnection Study. (Cont'd.)

Good Utility Practice to physically and electrically connect the Generating Facility to the Distribution or Transmission System. The Interconnection Facilities Study or DGS Phase II Interconnection Study shall also identify (i) the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Distribution Provider's Interconnection Facilities, Distribution Upgrades, and Network Upgrades necessary to accomplish the interconnection; and an estimate of the time required to complete the construction and installation of such facilities. The analyses in the Interconnection System Impact Study (or DGS Phase I Interconnection Study in the case of the Distribution Group Study Process) will be updated as necessary in the Interconnection Facilities Study (or DGS Phase II Interconnection Study), to account for withdrawal of interconnection requests in the interconnection queue.

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

Section H shall be used for interconnection of non-inverter based technologies.

~~Section H shall also continue to be used for interconnection of inverter based technologies until September 8, 2017. Following such date, Section Hh shall apply for interconnection of inverter based technologies. Until such date, Section Hh may be used in all or in part, for inverter based technologies by mutual agreement of the Distribution Provider and the Applicant.~~ (D)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

This section is consistent with the requirements of ~~ANSI/~~IEEE 1547-~~2003~~ 2018~~Standard for Interconnecting Distributed Resources with Electric Power Systems (IEEE 1547). Exceptions are taken to IEEE 1547 Clauses 4.1.4.2 Distribution Secondary Spot Networks and Clauses 4.1.8.1 or 5.1.3.1, which address Protection from Electromagnetic Interference. These are being studied for inclusion in a subsequent version of this Rule. Also, Rule 21 does not adopt the Generating Facility power limitation of 10 MW incorporated in IEEE 1547.~~ In the event of conflicts, this Rule shall take precedence. (C) (C) (D) (D) (C) (C)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS

The Protective Functions and requirements of this Rule are designed to protect Distribution Provider's Distribution and Transmission System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. Producer's Protective Functions shall not impact the operation of other Protective Functions on Distribution Provider's Distribution and Transmission System in a manner that would affect Distribution Provider's capability of providing reliable service to its customers.

a. Protective Functions Required

Generating Facilities operating in parallel with Distribution Provider's Distribution or Transmission System shall be equipped with the following Protective Functions to sense abnormal conditions on Distribution Provider's Distribution or Transmission System and cause the Generating Facility to be automatically disconnected from Distribution Provider's Distribution or Transmission System or to prevent the Generating Facility from being connected to Distribution Provider's Distribution or Transmission System inappropriately:

i) Over and under voltage trip functions and over and under frequency trip functions;

ii) A voltage and frequency sensing and time-delay function to prevent the Generating Facility from energizing a de-energized Distribution or Transmission System circuit and to prevent the Generating Facility from reconnecting with Distribution Provider's

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

a. Protective Functions Required (Cont'd.)

ii) Distribution or Transmission System unless Distribution Provider's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B voltage Range of 106 volts to 127 volts (on a 120 volt basis), inclusive, and a frequency range of 59.3 Hz to 60.5 Hz, inclusive, and are stable for at least 60 seconds; and

iii) A function to prevent the Generating Facility from contributing to the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution System within two seconds of the formation of an Unintended Island.

iv) Open-phase condition: Generating Facility shall detect and cease to energize and trip all phases within 2 seconds of any open phase condition in accordance with IEEE 1547-2018, 6.2.2. (N)

The Generating Facility shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-~~4.2.1~~2018, 6.2.1). (T)
The Generating Facility shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-~~4.2.2~~2018, 6.3). (T)

b. Momentary Paralleling Generating Facilities

With Distribution Provider's approval, the transfer switch or scheme used to transfer Producer's loads from Distribution Provider's Distribution or Transmission System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

Generating facilities which operate using a momentary parallel scheme are not required to comply with the functional requirements as required in the IEEE 1547 2018 standard. (N)

(L)
(L)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

c. Suitable Equipment Required ~~(Cont'd.)~~ (T)

Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Generating Facility and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of Distribution Provider's Distribution and Transmission System. The Generating Facility paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE 1547-~~4.1.8.3~~2018, 4.11). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in L.3.e (IEEE 1547-~~4.1.8.2~~2018, 4.11). (L) (L) (T) (T)

d. Visible Disconnect Required

When required by Distribution Provider's operating practices, Producer shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by Distribution Provider and Producer) near the Point of Interconnection to isolate the Generating Facility from Distribution Provider's Distribution or Transmission System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

i) allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)

ii) include markings or signage that clearly indicates open and closed positions.

iii) be capable of being reached:

a) for Emergency purposes quickly and conveniently 24 hours a day by Distribution Provider personnel for construction,

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS (Cont'd.)

f. Generating Facility Conditions Not Identified

In the event this Rule does not address the Interconnection conditions for a particular Generating Facility, Distribution Provider and Producer may agree upon other arrangements

2. PREVENTION OF INTERFERENCE

Producer shall not operate Generating or Interconnection Facilities that superimpose a voltage or current upon Distribution Provider's Distribution or Transmission System that interferes with Distribution Provider operations, service to Distribution Provider Customers, or communication facilities. If such interference occurs, Producer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by Distribution Provider. If Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, Distribution Provider may, without liability, disconnect Producer's facilities from Distribution Provider's Distribution or Transmission System, in accordance with Section D.9 of this Rule. To eliminate undesirable interference caused by its operation, each Generating Facility shall meet the following criteria:

Except as otherwise stated, the RPA for all performance requirements shall be met at the PCC. (N)

When the Generating Facility is less than 500KVA or when the Generating Facility operates under one of the non-exporting options or inadvertent export of no longer than 30 seconds, the RPA may be the POC. (N)

a. Voltage Regulation

The Generating Facility shall not actively regulate the voltage at the PCC while in parallel with Distribution Provider's Distribution System. The Generating Facility shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A ~~(IEEE 1547-4.1.1)~~. (T)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

c. Paralleling

The Generating Facility shall parallel with Distribution Provider's Distribution or Transmission System without causing a voltage fluctuation at the PCC greater than plus/minus 5% of the prevailing voltage level of Distribution Provider's Distribution or Transmission System at the PCC, and meet the flicker requirements of Section H.2.d. Section L, Certification and Testing Criteria, provides technology-specific tests for evaluating the paralleling Function. (IEEE 1547-~~4.1.3~~2018, 4.10) (T)

d. Flicker

The Generating Facility shall not create objectionable flicker for other customers on Distribution Provider's Distribution or Transmission System. To minimize the adverse voltage effects experienced by other customers, flicker at the PCC caused by the Generating Facility should not exceed the limits of ~~(~~IEEE 1547-~~4.3.2~~2018, 7.2.3~~), flicker at the PCC caused by the Generating Facility should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519-1992 (IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE STD 519-1992)~~. This requirement is necessary to minimize the adverse voltage affects experienced by other Customers on Distribution Provider's Distribution or Transmission System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded. (T) (T)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

e. Integration with Distribution Provider's Distribution System Grounding

The grounding scheme of the Generating Facility shall not cause over-voltages that exceed the rating of the equipment connected to Distribution Provider's Distribution System and shall not disrupt the coordination of the ground fault protection on Distribution Provider's Distribution System (IEEE 1547-~~4.1.2~~2018, 4.10) (See Section G.1.i, line configuration). (T)

f. Frequency

Distribution Provider controls system frequency, and the Generating Facility shall operate in synchronism with Distribution Provider's Distribution or Transmission System. Whenever Distribution Provider's Distribution or Transmission System frequency at the PCC varies from and remains outside normal (nominally 60 Hz) by the predetermined amounts set forth in Table H.2, the Generating Facility's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time.

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

g. Harmonics

When the Generating Facility is serving balanced linear loads, harmonic current injection into Distribution Provider's Distribution or Transmission System at the PCC shall not exceed the limits stated in ~~Table H.3~~IEEE 1547-2018, 7.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in Distribution Provider's Distribution or Transmission System without the Generating Facility connected ~~(IEEE 1547-4.3.3.)~~. The harmonic distortion of a Generating Facility shall be evaluated using the same criteria as for the Host Loads. (T) (T) (T)

(D)

~~***Table H.3***~~

~~***Maximum harmonic current distortion in percent of current (I) [1,2]***~~

~~Individual harmonic order, h~~	~~h<11~~	~~11≤ h<17~~	~~17≤ h<23~~	~~23≤ h<35~~	~~35≤ h~~	~~Total demand distortion~~
~~(odd harmonics) [3]~~						
~~Max Distortion (%)~~	~~4.0~~	~~2.0~~	~~1.5~~	~~0.6~~	~~0.3~~	~~5.0~~

~~[1] IEEE1547-4.3.3~~
~~[2] I = the greater of the maximum Host Load current average demand over 15 or 30 minutes without the GF, or the GF rated current capacity (transformed to the PCC when a transformer exists between the GF and the PCC).~~
~~[3] Even harmonics are limited to 25% of the odd harmonic limits above.~~

(D)

(Continued)

H. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

3. TECHNOLOGY SPECIFIC REQUIREMENTS

a. Technology Specific Requirements

Three-Phase Synchronous Generators: For three phase Generators, the Generating Facility circuit breakers shall be three-phase devices with electronic or electromechanical control. Producer shall be responsible for properly synchronizing its Generating Facility with Distribution Provider's Distribution or Transmission System by means of either manual or automatic synchronous equipment. Automatic synchronizing is required for all synchronous Generators that have a Short Circuit Contribution Ratio (SCCR) exceeding 0.05. Loss of synchronism protection is not required except as may be necessary to meet Section H.2.d (Flicker) (IEEE1547-~~4.2.5~~2018, 7.3). Unless otherwise agreed upon by Producer and Distribution Provider, synchronous Generators shall automatically regulate power factor, not voltage, while operating in parallel with Distribution Provider's Distribution System. A power system stabilization Function is specifically not required for Generating Facilities under 10 MW Net Rating. (T)

b. Induction Generators

Induction Generators (except self-excited Induction Generators) do not require a synchronizing Function. Starting or rapid load fluctuations on induction Generators can adversely impact Distribution Provider's Distribution or Transmission System voltage. Corrective step-switched capacitors or other techniques may be necessary and may cause undesirable ferro-resonance. When these counter measures (e.g. additional capacitors) are installed on Producer's side of the PCC, Distribution Provider must review these measures. Additional equipment may be required as determined in a Supplemental Review or an Interconnection Study.

(Continued)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

The inverter requirements are intended to be consistent with UL 1741 - Supplement SA* using Section Hh of Rule 21 as the source requirement document and ANSI/IEEE 1547-2003 and 1547a Standard for Interconnecting Distributed Resources with Electric Power Systems (IEEE 1547 including amendment 1547a), where possible. In the event of conflict between this Rule, and UL 1741 - Supplement SA, and/or IEEE 1547-2003 or IEEE 1547a, this Rule shall take precedence. Exceptions are taken to IEEE 1547 Clauses 4.1.4.2 Distribution Secondary Spot Networks and Clauses 4.1.8.1 or 5.1.3.1, which address Protection from Electromagnetic Interference. Rule 21 does not adopt the Generating Facility power limitation of 10 MW incorporated in IEEE 1547. (T)

The Smart Inverter default settings and default activation states may be modified upon mutual agreement between Applicant or Producer and Distribution Provider. (P)

Process for changing default settings for new Interconnection Requests:

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the reactive power settings, including changes to the reactive power default settings (Example: Deactivate Volt/Var and activate Fixed Power Factor at given power factor).

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the Ramp Rate settings depending on the Generating Facility technology (such as solar, storage).

Distribution Provider, in the study process for new Generating Facilities, may determine the optimum Smart Inverter Settings for the volt/watt settings including changes to the default settings (Example: Change the volt/watt set points). The Applicant may select to agree on the new settings or select to perform upgrades to operate using the existing default volt/watt settings.

(N)

* Any DC V2G Electric Vehicle Service Equipment (EVSE) that has UL 1741 certification - but not UL 1741 SA certification, any subsequent UL 1741 supplement certification required in Rule 21, or Smart Inverter Working Group-recommended smart inverter functions - may interconnect initially for the purpose of participating in the Emergency Load Reduction Program (ELRP), subject to all other Rule 21 interconnection requirements.

PG&E may request the termination of this interconnection pathway after the 2024 ELRP season if the market has developed to provide multiple V2G capable EVSEs that meet the full smart inverter certification standards required in Rule 21. Termination of this pathway would not affect previously interconnected EVSE, and they may continue to operate parallel to the grid as per their Interconnection Agreement. (N)

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

1. INTRODUCTION (Cont'd.)

The tests described here, together with the technical requirements in Section H, Hh, and P of this Rule, are intended to provide assurance that the Generating Facility's equipment will not adversely affect Distribution Provider's Distribution or Transmission System and that a Generating Facility will cease providing power to Distribution Provider's Distribution or Transmission System under abnormal conditions. The tests were developed assuming a low level of Generating Facility penetration or number of connections to Distribution Provider's Distribution or Transmission System. At high levels of Generating Facility penetration, additional requirements and corresponding test procedures may need to be defined. (T)

Section L also provides criteria for "Certifying" Generators, inverters or converters. Once a Generator, inverter or converter has been Certified per this Rule, it may be considered suitable for Interconnection with Distribution Provider's Distribution or Transmission System. Subject to the exceptions described in Section L, Distribution Provider will not repeat the design review or require retesting of such Certified Equipment. It should be noted that the Certification process is intended to facilitate Generating Facilities Interconnections. Certification is not a prerequisite to interconnect a Generating Facility for Section H, except for Non-Export AC/DC Converters seeking an expedited process, but it is a prerequisite for inverters installed after September 8, 2017, pursuant to Section Hh and P of this Rule. (T) (T)

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

a. Type Tests and Criteria for Interconnection Equipment Certification (Cont'd.)

Table L.1, Type Test and Requirements for Interconnection Equipment Certification[KELM7]

Type Test	Reference 1	Inverter (6)	Smart Inverter (7)	Synchronous Generators	Induction Generators
Utility Interaction	UL 1741 – 39, 40	X	X	X	X
Utility Compatibility (Required testing to 1547 & 1547.1)	UL 1741 - 46	X	X	X	X
DC Isolation	IEEE 1547.1(8) -5.6	X	X	-	-
Dielectric Voltage Withstand	IEEE 1547.1(8) -5.5.3	X	X	X	X
Harmonic Distortion	IEEE 1547.1(8) -5.11	X	X	X	X
DC Injection	IEEE 1547.1(8) -5.6	X	X	-	-
Distribution Provider Voltage Variation	IEEE 1547.1(8) -5.2	X	-	X	X
Distribution Provider Frequency Variation	IEEE 1547.1(8) -5.3	X	-	X	X
Abnormal Tests	UL 1741 – 47				
Loss of Control Circuit	UL 1741 – 47.8	X	X	X	X
Short Circuit	UL 1741 - 47.3	X	X	X	X
Load Transfer	UL 1741 - 47.7	X	X	X	X
Surge Withstand Capability	L.3.e	X	X	X	X
Anti-Islanding (non-Smart Inverters)	L.3.b	(2)	-	(2)	(2)
Non-Export	L.3.c	(3)	(3)	(3)	(3)
In-rush Current	L.3.d	-	-	-	(4)
Synchronization	L.3.f	(5)	(5)	X	(5)
Anti-islanding (Smart Inverters)	UL 1741 SA - SA8	-	X	-	-
Low and High Voltage Ride-through (L/H VRT)	UL 1741 SA – SA9	-	X	-	-
Low and High Frequency Ride-through (L/H FRT)	UL 1741 SA - SA10	-	X	-	-
Normal and Soft-Start Ramp Rate (RR)	UL 1741 SA - SA11	-	X	-	-
Specified Power Factor	UL 1741 SA - SA12	-	X	-	-
Volt/Var Mode (Q(V))	UL 1741 SA - SA13	-	X	-	-
Frequency-Watt(FW) - optional	UL 1741 SA - SA14	-	X	-	-
Volt-Watt (VW) - optional	UL 1741 SA - SA15	-	X	-	-
Markings and Instructions	UL 1741 SA6, SA16	-	X	-	-

Table Notes:

(1) References are to section numbers in either UL 1741 and/or UL 1741-Supplement SA (Inverters, Converters and Charge Controllers for Use in Independent Power Systems) or this Rule. References in UL 1741 to "photovoltaics" or "inverter" may have to be adapted to the other technologies by the testing laboratory to appropriately apply in the tests to other technologies.
(2) Required only if Non-Islanding designation.
(3) Required only if Non-Export designation is desired.
(4) Required for Generators that use Distribution Provider power to motor to speed.
(5) Required for all self-excited induction Generators as well as Inverters that operate as voltage sources when connected to Distribution Provider's Distribution or Transmission System.
(6) Inverters compliant with Section H.
(7) Inverters compliant with Sections Hh or P. (T)
(8) IEEE 1547.1 refers to 2005 revision.
(9) Smart Inverter which have tested under UL1741SB and IEEE1547.1-2020 (N)
(10) Effective August 1, 2022 (N)

"X" = Required "-" = Not Required

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

a. Type Tests and Criteria for Interconnection Equipment Certification (Cont'd.)

Table L.2 Type Tests Sequence for Interconnection Equipment Certification

Test No.	Type Test
1	Distribution Provider Voltage and Frequency Variation
2	Synchronization
3	Surge Withstand Capability
4	Distribution Provider Voltage and Frequency Variation, including ride through
5	Synchronization
6	Other Required and Optional Tests

Tests 1, 2, and 3 must be done first and in the order shown. Tests 4 and on follow in order convenient to the test agency.

b. Anti-Islanding Test

Devices that pass the Anti-Islanding test procedure described in UL 1741 Supplemental SB ~~Section 46.3~~ will be considered Non-Islanding for the purposes of these Interconnection requirements. The test is required only for devices for which a Certified Non-Islanding designation is desired. (T)

c. Non-Export Test

Equipment that passes the Non-Export test procedure described in Section L.7.a will be considered Non-Exporting for the purposes of these Interconnection requirements. This test is required only for devices for which a Certified Non-Export designation is desired.

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

d. In-rush Current Test

Generation equipment that utilizes Distribution Provider power to motor up to speed will be tested using the procedure defined in Section L.7.b to determine the maximum current drawn during this startup process. The resulting In-rush Current is used to estimate the Starting Voltage Drop.

e. Surge Withstand Capability Test

The interconnection equipment shall be tested for the surge withstand requirement in Section H.1.c in all normal operating modes in accordance with IEEE Std C62.45-2002 for equipment rates less than 1000 V to confirm that the surge withstand capability is met by using the selected test level(s) from IEEE Std C62.41.2-2002. Interconnection equipment rated greater than 1000 V shall be tested in accordance with manufacturer or system integrator designated applicable standards. For interconnection equipment signal and control circuits, use IEEE Std C37.90.1-2002. These tests shall confirm the equipment did not fail, did not misoperate, and did not provide misinformation (IEEE 1547-~~5.1.3.2~~2018, 4.11.2). (T)

The location/exposure category for which the equipment has been tested shall be clearly marked on the equipment label or in the equipment documentation. External surge protection may be used to protect the equipment in harsher location/exposure categories.

(Continued)

L. CERTIFICATION AND TESTING CRITERIA (Cont'd.)

3. TYPE TESTING (Cont'd.)

f. Synchronization Test (Cont'd.)

Table L.3
***Synchronization Parameter Limits* [1]**

Aggregate Rating of Generator Units (kVA)	Frequency Difference (Δf, Hz)	Voltage Difference Phase Angle (ΔV, %)	Difference (ΔΦ,°)
0-500	0.3	10	20
> 500-1,500	0.2	5	15
> 1,500-10,000	0.1	3	10

[1] – IEEE 1547-~~5.1.1B~~2018, 4.10 (T)

g. Paralleling Device Withstand Test

The di-electric voltage withstand test specified in Section L.1 shall be performed on the paralleling device to ensure compliance with those requirements specified in Section H.1.c (IEEE 1547-~~5.1.3.3~~2018, 4.11.3). (T) (T)

h. Backfeed Test

Non-Export AC/DC Converters must satisfy the requirements in its definition in Section C.

4. PRODUCTION TESTING

At a minimum, each interconnection system shall be subjected to Distribution Provider Voltage and Frequency Variation Test procedure described in UL1741 under Manufacturing and Production Tests, Section 68 and the Synchronization test specified in Section L.3.f. Interconnection systems with adjustable set points shall be tested at a single set of set points as specified by the manufacturer. This test may be performed in the factory or as part of a Commissioning Test (Section L.5).

(Continued)

Mm. INADVERTENT EXPORT FOR INTERCONNECTION REQUESTS UTILIZING UL-1741 CERTIFIED OR SA/SB LISTED GRID SUPPORT (NON-ISLANDING) INVERTERS (T)

The following are the minimum requirements for Inadvertent Export systems that meet the criteria specified below. Other factors relevant to the interconnection study process (e.g., 15% screen results, short circuit current ratio, etc.) may necessitate additional technical requirements (e.g., reclose block, transfer trip, ground bank, etc.) that are not explicitly noted here. Inadvertent Export may not be available for interconnections to Networked Secondary Systems.

The certified control functions internal to the inverter control or external control system may be used to replace the discrete reverse/under power relay functions described in Section M provided the requirements outlined below are met.

1) All of the following requirements must be met by the Generating Facility to qualify for Inadvertent Export under this Section.

   a. The Generating Facility must utilize only UL-1741 certified or UL-1741 ~~SA~~ SB listed grid support non-islanding inverters; and, (T)

   b. The Generating Facility must have an aggregate maximum nameplate capacity of 500 kVA or less; and,

   c. The Generating Facility's total energy export must not exceed its nameplate rating (kVA-gross) multiplied by 0.1 hours per day over a rolling 30-day period (e.g., for a 100 kVA-gross nameplate Generating Facility, the maximum energy allowed to be exported for a 30-day period is 300 kWh) ; and,

   d. Export from the Generating Facility across the PCC to the Distribution System is less than 100 kVA.

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (N)

When requirements for "Smart Inverter" are specified in this section, those requirements can also be met by a "DER Interconnection System" as defined in this tariff

The inverter requirements are intended to be consistent with UL 1741 – Supplement SB using as the source requirement document ANSI/IEEE 1547-2018 and IEEE 1547.1-2020 Standard for Interconnecting Distributed Resources with Electric Power Systems where possible. In the event of conflict between this Rule and UL 1741 – Supplement SB and/or IEEE 1547-2018 or IEEE 1547.1-2020, this Rule shall take precedence.

The Smart Inverter default settings and default activation states may be modified upon mutual agreement between Applicant or Producer and Distribution Provider.

Process for changing default settings for new Interconnection Requests:

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the reactive power settings, including changes to the reactive power default settings (Example: Deactivate Volt/Var and activate Fixed Power Factor at given power factor).

Distribution Provider, in the study process for new Generating Facilities, may determine and provide the optimum Smart Inverter Settings for the Ramp Rate settings depending on the Generating Facility technology (such as solar, storage).

Distribution Provider, in the study process for new Generating Facilities, may determine the optimum Smart Inverter Settings for the volt/watt settings, including changes to the default settings (Example: Change the volt/watt set points). The Applicant may select to agree on the new settings or select to perform upgrades to operate using the existing default volt/watt settings. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

Default settings for voltage ride-through, frequency ride-through requirements, and Frequency/Watt should not be modified on an individual project basis unless the Interconnection Studies have determined that the default settings may not meet grid reliability requirements.

Process for changing default settings for Generating Facilities with an executed Interconnection Agreement:

When grid changes or Generating Facility changes require that the Smart Inverter operating parameters be reevaluated, the Distribution Provider or Producer may request changes to the Smart Inverter operating parameters. The request must include the reason for and timing of the proposed changes. The requested changes must be within the Smart Inverter function adjustability limits, must be within the limits specified in this tariff, and must be mutually agreed upon.

1. General Interconnection and Protective Function Requirements

The Protective Functions and requirements of this Rule are designed to protect Distribution Provider's Distribution and Transmission System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. Producer's Protective Functions shall not impact the operation of other Protective Functions on Distribution Provider's Distribution and Transmission System in a manner that would affect Distribution Provider's capability of providing reliable service to its customers. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

a. Protective Functions Required

Smart Inverters operating in parallel with Distribution Provider's Distribution or Transmission System shall be equipped with the following Protective Functions to sense abnormal conditions on Distribution Provider's Distribution or Transmission System and cause the Smart Inverter to be automatically disconnected from Distribution Provider's Distribution or Transmission System or to prevent the Smart Inverter from being connected to Distribution Provider's Distribution or Transmission System inappropriately:

(i) Over and under voltage trip functions and over and under frequency trip functions;

(ii) A voltage and frequency sensing and time-delay function to prevent the Smart Inverter from energizing a de-energized Distribution or Transmission System circuit and to prevent the Smart Inverter from reconnecting with Distribution Provider's Distribution or Transmission System unless Distribution Provider's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B voltage Range of 106 volts to 127 volts (on a 120 volt basis), inclusive, and a frequency range of 58.8 Hz to 61.2 Hz, inclusive, and are stable for at least 15 seconds; and

(iii) A function to prevent the Smart Inverter from contributing to the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution System within two seconds of the formation of an Unintended Island.

The Smart Inverter shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-2018, 6.2.1). The Smart Inverter shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-2018, 6.3). (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

a. Protective Functions Required (Cont'd)

(iv) Open-phase condition: Generating Facility shall detect and cease to energize and trip all phases within 2 seconds of any open phase condition in accordance with IEEE1547 2018, 6.2.2.

The Smart Inverter Facility shall cease to energize Distribution Provider's Distribution System for faults on Distribution Provider's Distribution System circuit to which it is connected (IEEE 1547-2018, 6.2.1). The Generating Facility shall cease to energize Distribution Provider's Distribution circuit prior to re-closure by Distribution Provider's Distribution System equipment (IEEE 1547-2018, 6.3).

b. Momentary Paralleling Smart Inverter Generating Facilities

With Distribution Provider's approval, the transfer switch or scheme used to transfer Producer's loads from Distribution Provider's Distribution or Transmission System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

Smart Inverters which operate using a momentary parallel scheme are not required to comply with the functional requirements as required in the IEEE 1547-2018 standard. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

c. Suitable Equipment Required

Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Smart Inverter and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of Distribution Provider's Distribution and Transmission System. The Smart Inverter paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE 1547-2018, 4.11.3). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in L.3.e (IEEE 1547-2018, 4.11.4).

d. Visible Disconnect Required

When required by Distribution Provider's operating practices, Producer shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by Distribution Provider and Producer) near the Point of Interconnection to isolate the Smart Inverter from Distribution Provider's Distribution or Transmission System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

(i) allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)
(ii) Include markings or signage that clearly indicates open and closed positions.
(iii) be capable of being reached: (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

d. Visible Disconnect Required (Cont'd)

(iii) be capable of being reached (Cont'd):

a) for Emergency purposes quickly and conveniently 24 hours a day by Distribution Provider personnel for construction, operation, maintenance, inspection, testing or to isolate the Smart Inverter from Distribution Provider's Distribution or Transmission System without obstacles or requiring those seeking access to obtain keys, special permission, or security clearances.

b) for Non-Emergency purposes during normal business hours. Distribution Provider, where possible, will provide notice to Customer for gaining access to Customer's premises.

(iv) be capable of being locked in the open position.

(v) be clearly marked on the submitted single line diagram and its type and location approved by Distribution Provider prior to installation. If the device is not adjacent to the PCC, permanent signage must be installed at a Distribution Provider approved location providing a clear description of the location of the device. If the switch is not accessible outside the locked premises, signage with contact information and a Distribution Provider approved locking device for the premises shall be installed.

Generating Facilities with Non-Islanding inverters totaling one (1) kilovolt-ampere (kVA) or less are exempt from this requirement.[HH(8)]

e. Drawings Required

Prior to Parallel Operation or Momentary Parallel Operation of the Smart Inverter, Distribution Provider shall approve Producer's Protective Function and control diagrams. Generating Facilities equipped with Protective Functions and a control scheme previously approved by Distribution Provider for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

1. General Interconnection and Protective Function Requirements (Cont'd)

f. Generating Facility Conditions Not Identified

In the event this Rule does not address the Interconnection conditions for a particular Smart Inverter, Distribution Provider and Producer may agree upon other arrangements.

g. Generating Facilities that use certified Power Control Systems (PCS) must use PCS listed in a Distribution Provider pre-approved list.

2. Prevention of Interference

Producer shall not operate Smart Inverters that superimpose a voltage or current upon Distribution Provider's Distribution or Transmission System that interferes with Distribution Provider operations, service to Distribution Provider Customers, or communication facilities. If such interference occurs, Producer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by Distribution Provider. If Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, Distribution Provider may, without liability, disconnect Producer's facilities from Distribution Provider's Distribution or Transmission System, in accordance with Section D.9 of this Rule. To eliminate undesirable interference caused by its operation, each Smart Inverter shall meet the following criteria:

Except as otherwise stated, the RPA for all performance requirements shall be met at the PCC.

When the Generating Facility is less than 500KVA or when the Generating Facility operates under one of the non-exporting options or inadvertent export of no longer than 30 seconds, the RPA may be the Point of Generating Resource Connection (POC)

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

a. Voltage Regulation

The Generating Facility shall not actively regulate the voltage at the PCC while in parallel with Distribution Provider's Distribution System. The Generating Facility shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A.

b. Voltage Trip and Ride-Through Setting

The voltage ranges in Table P-1 define protective trip limits for the Protective Function and are not intended to define or imply a voltage regulation Function. Generating Facilities shall cease to energize Distribution Provider's Distribution System within the prescribed trip time whenever the voltage at the PCC deviates from the allowable voltage operating range. The Protection Function shall detect and respond to voltage on all phases to which the Generating Facility is connected.

i) Smart Inverters

Smart Inverters shall be capable of operating within the voltage range normally experienced on Distribution Provider's Distribution System from plus to minus 5% of the nominal voltage (e.g. 114 volts to 126 volts, on a 120 volt base), at the service panel or PCC. The trip settings at the generator terminals may be selected in a manner that minimizes nuisance tripping in accordance with Table P-1 to compensate for voltage drop between the generator terminals and the PCC. Voltage may be detected at either the PCC or the Point of Interconnection. However, the voltage range at the PCC, with the generator on-line, shall stay within +/-5% of nominal.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

b. Voltage Trip and Ride-Through Setting (Cont'd)

ii) Voltage Disturbances

Whenever Distribution Provider's Distribution System voltage at the RPA varies from and remains outside the Continuous Operation region for the predetermined parameters set forth in Table P-1b, the Smart Inverter's Protective Functions shall cause the Smart Inverter(s) to trip and become isolated from Distribution Provider's Distribution System as required in table P-1a:

1. The Smart Inverter shall stay connected to the Distribution Provider's Transmission or Distribution System while the grid remains within the "Voltage Range (p.u.)" and must stay connected in the corresponding "Operating Mode."

2. If the distribution system voltage does not exit the ride-through region and recovers to normal system voltage, the Smart Inverter shall restore continuous operation within 2 sec.

3. If the Distribution Provider's Transmission or Distribution System voltage does not exit the ride-through region and returns from the V<0.5 pu region to the 0.5≤V< 0.7 or 0.7≤V< 0.88 pu region, the Smart Inverter shall restore available current within 2 seconds.

4. Different voltage-time settings could be permitted by the Distribution Provider.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

b. Voltage Trip and Ride-Through Setting (Cont'd)

ii) Voltage Disturbances (Cont'd)

Table P-1a: Smart Inverter Voltage Trip[KELM9]

Shall Trip Function	Voltage Trip Default Settings (p.u. of nomnial voltage)	Voltage Range of Shall Trip Function (p.u. of nominal voltage)	Default Clearing Time (s)
OV2	1.20	$V \geq 1.20$	0.16
OV1	1.10	$1.10 \leq V < 1.20$	13.0
Continuous Operation	NA	$0.88 < V < 1.10$	NA
UV1	0.88	$0.50 < V \leq 0.88$	21.0
UV2	0.50	$V \leq 0.50$	2.0

Table P-1b – Smart Inverter Voltage Ride-through Settings

Voltage Range (p.u.)	Operating mode/response	Minimum ride-through time (s)	Maximum response time (s)
$V > 1.20$	Cease to Energize	NA	0.16
$1.10 < V \leq 1.20$	Momentary Cessation	12	0.083
$0.88 \leq V \leq 1.10$	Continuous Operation	Infinite	NA
$0.70 \leq V < 0.88$	Mandatory Operation	20	NA
$0.50 \leq V < 0.70$	Mandatory Operation	10	NA
$V < 0.50$	Momentary Cessation	1	0.083

iii) Voltage Phase Angle Change Ride-Through (N)

Voltage phase angle change ride-through as specified in IEEE 1547-2018, 6.5.2.6.

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

c. Paralleling

The Smart Inverter shall parallel with Distribution Provider's Distribution or Transmission System without causing a voltage fluctuation at the PCC greater than plus/minus 5% of the prevailing voltage level of Distribution Provider's Distribution or Transmission System at the PCC, and meet the flicker requirements of Section H.2.d. Section L, Certification and Testing Criteria, provides technology-specific tests for evaluating the paralleling Function. (IEEE 1547-2018, 4.10.4)

d. Flicker

The Generating Facility shall not create objectionable flicker for other Customers on Distribution Provider's Distribution or Transmission System. To minimize the adverse voltage effects experienced by other Customers, flicker at the P caused by the Generating Facility should not exceed the limits of IEEE 1547-2018, 7.2.3. This requirement is necessary to minimize the adverse voltage affects experienced by other Customers on Distribution Provider's Distribution or Transmission System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

e. Integration with Distribution Provider's Distribution System Grounding

The grounding scheme of the Smart Inverter shall not cause over-voltages that exceed the rating of the equipment connected to Distribution Provider's Distribution System and shall not disrupt the coordination of the ground fault protection on Distribution Provider's Distribution System (IEEE 1547-2018, 4.10.4) (See Section G.1.i, line configuration).

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

f. Frequency

Distribution Provider controls system frequency, and the Smart Inverter shall operate in synchronism with Distribution Provider's Distribution or Transmission System. Whenever Distribution Provider's Distribution or Transmission System frequency at the PCC-2a, the Smart Inverter's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time. Inverter's Protective Functions shall cease to energize Distribution Provider's Distribution or Transmission System within the stated maximum trip time.

i) Frequency Ride-Through Requirements

Smart Inverter based systems shall remain connected to the Distribution Provider's Distribution or Transmission System while the grid is within the frequency-time range indicated in Table P-2b, and shall disconnect from the electric grid during a high or low frequency event that is outside that frequency-time range as indicated in Table P-2a.

Table P-2a: Frequency Trip Settings Table

Shall Trip Function	Frequency Trip Default Setting (Hz)	Resulting Range of Shall Trip Function (Hz)	Default Clearing Time (s)
OF2	62.0	f≥62.0	0.16
OF1	61.2	61.2≤f<62	300
Continuous Operation	NA	58.5<f<61.2	NA
UF1	58.5	56.5<f≤58.5	300
UF2	56.5	f≤56.5	0.16

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

f. Frequency (Cont'd)

i) Frequency Ride-Through Requirements (Cont'd)

Table P-2b: Frequency Ride-Through Settings Table

Frequency (Hz)	Operating Mode	Minimum time(s)
f>62.0	No Ride-Through requirements apply to this range	NA
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	NA

ii) Rate of Change of Frequency (ROCOF) Ride-through

Smart Inverter shall not trip for frequency excursion having magnitude rates of change of frequency (ROCOF) that is less than or equal to 3.0Hz per second as specified in IEEE 1547-2018, section 6.5.2.5 category III. For ROCOF greater than 3Hz per second, it is preferred for Smart Inverter to ride-through as long as frequency remains in the continuous operating region, low frequency ride-though region(and corresponding duration times), or high frequency region (and corresponding duration times).

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

g. Harmonics

When the Smart Inverter is serving balanced linear loads, harmonic current injection into Distribution Provider's Distribution or Transmission System at the PCC shall not exceed the limits stated in IEEE 1547-2018, 7.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in Distribution Provider's Distribution or Transmission System without the Smart Inverter connected. The harmonic distortion of a Smart Inverter shall be evaluated using the same criteria as for the Host Loads.

h. Direct Current Injection

Smart Inverter should not inject direct current greater than 0.5% of rated output current into Distribution Provider's Distribution or Transmission System.

i. Smart Inverter Reactive Power Requirements

Smart Inverter Reactive Power capabilities shall comply with IEEE 1547-2018, Section 5.2 Category B requirement.

j. Dynamic Volt/Var Operations

The Smart Inverter shall be capable of supporting dynamic reactive power compensation (dynamic Volt/Var operation) within the following constraints:

- The Smart Inverter shall be able to consume reactive power in response to an increase in line voltage, and produce reactive power in response to a decrease in line voltage as indicated in Table P-4.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

j. Dynamic Volt/Var Operations (Cont'd)

Table P-4 and Figure P-1 depict the default setting, which should be applied for all inverter size. Specific volt/var settings may be required for larger generating facilities (such as 100 kW or greater) or for specific areas with the Distribution System as determined by the Distribution Provider.

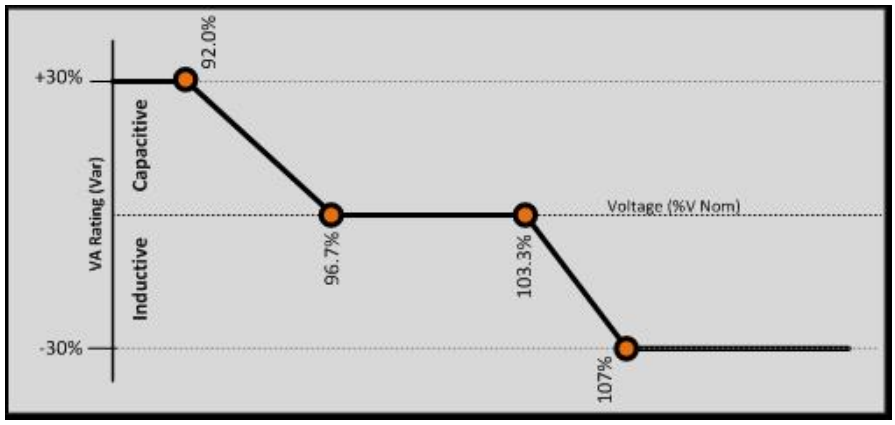
Default Open Loop Response Time for volt/var operation setting should be five (5) seconds.

Table P-4: Voltage and Reactive Default Settings

Voltage Setpoint	Voltage Value	Reactive Setpoint	Reactive Value	Operation
V1	92.0%	Q1	30%	Reactive Power Injection
V2	96.7%	Q2	0	Unity Power Factor
V3	103.3%	Q3	0	Unity Power Factor
V4	107.0%	Q4	30%	Reactive Power Absorption

P

Figure P-1: Voltage and Reactive Default Settings



(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

k. Enter Service Ramp Rate Requirements

The Smart Inverter is required to have the following ramp controls.

- Enter Service ramp control requirements as outlined in IEEE 1547-2018 section 4.10.3 with following default settings:
  - Delay enter service shall be 15 seconds per P.1.a.ii
  - Default Enter Service Duration shall be 50 seconds

l. Frequency Droop (Frequency Power, Frequency Watt) Requirements

Smart Inverters shall change their real power production as function of system frequency in accordance with IEEE 1547-2018, 6.5.2.7 with the following default settings: Deadband 36 mHz, db_{OF} and db_{UF}. k_{OF} and k_{UF} would be 0.05, open loop response time of 5 seconds.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

m. Voltage-Watt Default Settings Requirements

Smart Inverters shall reduce their real power production as a function measured voltage at the inverter terminal or at the Generating Facility Point of Common Coupling (PCC) in accordance with the following:

When the measured voltage is greater than 106% of nominal voltage (Example: 127.2 volts on a 120 volts nominal), the export of active power at the PCC or the production of active power by the Smart Inverter shall be reduced at a rate of 25% of active power nameplate rating per one percent of nominal voltage. Figure Hh-3 Volt-Watt Requirements illustrate the required rate of reduction. When export of active power is controlled, a certified inverter and control system shall be used.

(N)

(Continued)

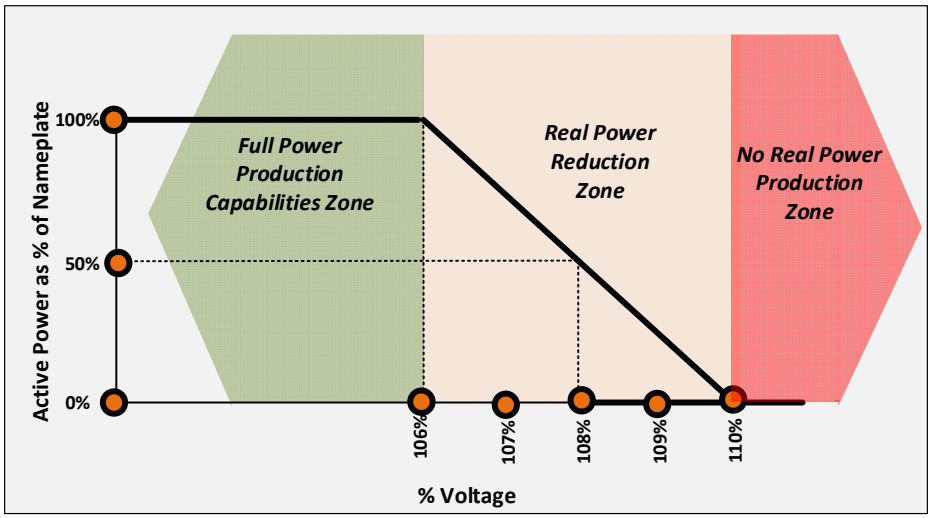
P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

m. Voltage-Watt Default Settings Requirements

- When the measured voltage is greater than 110% of nominal voltage (Example: 132 volts on a 120 volts nominal), the export of active power to the grid at the PCC or the production of active power by the Smart Inverter shall be reduced to 0 watts.
- Open Loop response time shall be 5 seconds.

Figure P-3: Volt-Watt Requirements



n. Dynamic Reactive Power Support Function

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

o. Default Activation States

Unless otherwise provided by Distribution Provider, pursuant to Distribution Provider's Distribution Generation Interconnection Handbook, the default settings will be as follows:

Table P-4: Default Activation States

Function	State
Anti-islanding	Activated
Low/High Voltage Ride Through	Activated
Low/High Frequency Ride Through	Activated
Dynamic Volt/Var operations	Activated
Enter Service Ramp Control	Activated
Storage Inverter Normal Operation Ramp Control	Activated
Fixed power factor	Deactivated
Reconnect by "soft-start" methods	Activated
Frequency/Watt	Activated
Volt/Watt	Activated
Constant Reactive Power Mode	Deactivated
Set Active Power Function Mode(Optional)	Activated under mutual agreement
Dynamic Reactive Power Support Mode (Optional)	Activated under mutual agreement

These default activation states may be modified by mutual agreement between Distribution Provider and Producer.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

p. Load Shedding or Transfer

The voltage and frequency ride-through requirements of P.2.b.ii) and P.2.f.i) shall not apply if either: a) The real power across the Point of Common Coupling is continuously maintained at a value less than 10% of the aggregate rating of the Smart Inverters connected to the Generating Facility prior to any voltage disturbance, and the Generation Facility disconnects from the Distribution Provider's Distribution or Transmission System, along with Generating Facility load, such that the net change in real power flow from or to the Distribution Provider's Distribution or Transmission System is less than 10% of the aggregate Smart Inverter capacity; or b) Generating Facility load real power demand equal to 90% to 120% of the predisturbance aggregate Smart Inverter real power is shed within 0.1 seconds of Smart Inverter disconnection.

q. Measurement and Calculation Accuracy

Smart Inverter shall meet minimum steady-state and transient measurement and calculation accuracy as required in IEEE 1547-2018, Section 4.4.

r. Prioritization of Smart Inverter Responses

a) The response to disable permit to service as specified in section Hh.8.a shall take precedence over any other tripping requirements.

b) Prioritization of tripping requirements not related to disabling permit to service shall meet IEEE 1547-2018 section 4.7.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

s. Storage Inverter Normal Operation Ramp Control Requirements

Smart Inverters used for energy storage applications shall include ramp-up rate control. The default value shall be 100% of maximum current output per second or slower if required by Applicant. Other ramp-up control settings can be used, when required, as mutually agreed by the Distribution Provider and the Applicant.

t. Ride-through of Conservative Voltage Disturbances

Ride-through of consecutive voltage disturbances shall be in accordance with IEEE 1547-2018, 6.4.2.5.

u. Restore output without dynamic voltage support

Restore output without dynamic voltage support shall be in accordance with IEEE 1547-2018, 6.4.2.5.

v. Transition between performance operating regions:

Transition between performance operating regions should be in accordance with IEEE 1547-2018, 6.4.2.7.3.

w. Constant Reactive Power Mode

When in this mode, the Smart Inverter shall maintain a constant reactive power. The target reactive power level and mode (injection or absorption) shall be specified by the Distribution Provider and shall be within the same range specified in IEEE 1547-2018 section 5.2[HH(10)]. The reactive power settings are allowed to be adjusted locally and/or remotely as specified by the Distribution Provider. The maximum Smart Inverter response time to maintain constant reactive power shall be 10 seconds or less. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

2. Prevention of Interference (Cont'd)

x. Generating Facility Rapid Voltage Changes (RVC)

Generating step or ramp changes shall meet the requirements as specified in IEEE 1547-2018 section 7.2.2.

y. Limitations of Overvoltage Over One Fundamental Frequency Period

Generating Facility shall not contribute to instantaneous or fundamental frequency overvoltage conditions per IEEE 1547-2018, 7.4.1.

z. Limitation of Cumulative Instantaneous Overvoltage

Generating Facility shall not cause the instantaneous voltage on any portion of the Distribution or Transmission System to exceed the magnitudes per IEEE 1547-2018, 7.4.2.

3. Technology Specific Requirements

Grid-interactive inverters do not require separate synchronizing equipment. Non grid-interactive or "stand-alone" inverters shall not be used for Parallel Operation with Distribution Provider's Distribution or Transmission System. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

4. Supplemental Smart Inverter Requirements

a. Fault Detection

A Smart Inverter with an SCCR exceeding 0.1 or one that does not cease to energize Distribution Provider's Distribution or Transmission System within two seconds of the formation of an Unintended Island shall be equipped with Protective Functions designed to detect Distribution or Transmission System faults, both line-to-line and line-to-ground, and cease to energize Distribution Provider's Distribution or Transmission System within two seconds of the initiation of a fault.

b. Transfer Trip

For a Generating Facility that cannot detect Distribution or Transmission System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, and cease to energize Distribution Provider's Distribution or Transmission System within two seconds, Distribution Provider may require a Transfer Trip system or an equivalent Protective Function.

c. Reclose Blocking

Where the aggregate Generating Facility capacity exceeds 15% of the peak load on any automatic reclosing device, Distribution Provider may require additional Protective Functions, including, but not limited to recluse-blocking on some of the automatic reclosing devices. (N)

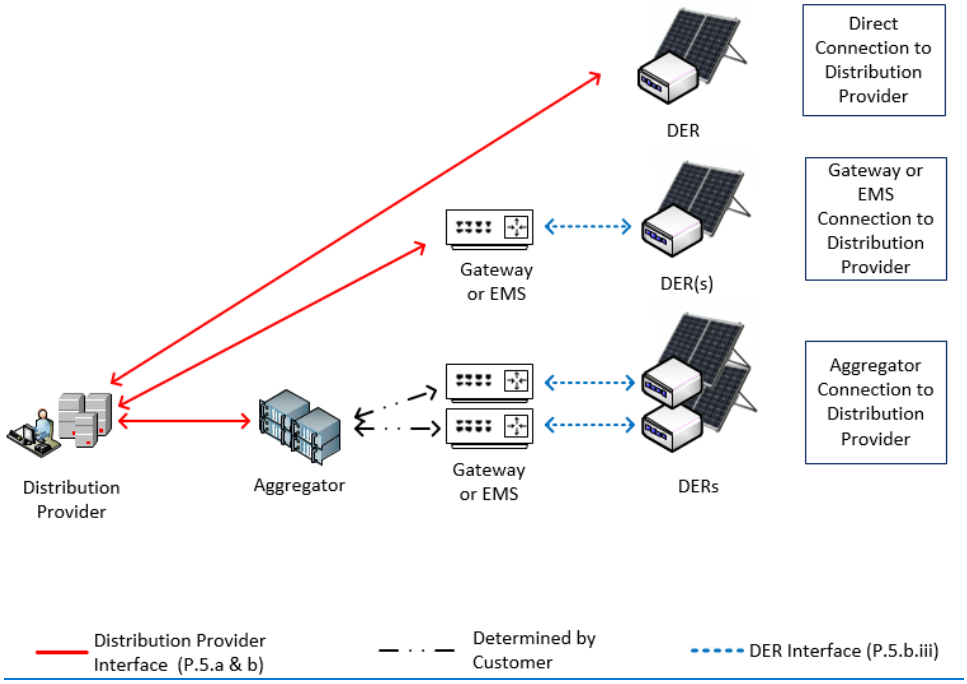
(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements

Should communications to the Distribution Provider be required, Generating Facilities utilizing inverter-based technologies must adhere to the following communication requirements for communications between the Distribution Provider and the Generating Facility. The diagram below shows the interface requirements as applicable for section P.5. The Distribution Provider Interface (solid red line) is described in Sections P.5.a and P.5.b. The local DER interface at the Generating Facility (dotted blue line) is described in Section P.5.b.iii. The top row shows a direct connection between the Distribution Provider and the DER. The middle row shows a connection between the Distribution Provider and a gateway (GW) or Energy Management System (EMS). The lower row shows a connection between the Distribution Provider and an aggregator.

Figure P-5: Generating Facility Communications



(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

The communications requirements herein shall be between

(i) the Distribution Provider and the individual DER, GW, or EMS;

(ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or

(iii) other communication options as mutually agreed to by Applicant and Distribution Provider.

a. The communications requirements in this Section pertain to communications between the Distribution Provider and communications option selected, or required, from section P.5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by compliance with this Rule:

i. Shall be capable of communications;

ii. Software shall be updateable via communications remotely;

iii. The transport level protocol shall be TCP/IP; and,

The default application-level protocol shall be IEEE 2030.5 as defined in the latest final version of the Common Smart Inverter Profile (CSIP), the Interconnection Handbook, Cyber Security Requirements or Programs and Contracts. Other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:

i. Distribution Provider Generation Interconnection Handbook, which shall include:

A. Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;

B. Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide (e.g., CSIP); and,

C. Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these additionally or alternatively may be included in the application-level protocol implementation guide); and

D. Conditions under which communication functions are mandatory.

ii. Application-Level Protocol Implementation Guide, which shall provide:

A. Detailed communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission's jurisdiction.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

5. Communication Requirements (Cont'd)

b. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents (Cont'd):

iii. Communication Protocol and Performance Requirements

A. Communication performance requirements for the interface to the Generating Facility shall comply with IEEE 1547-2018, 10.8.

B. The protocol requirements at the Generating Facility shall be per IEEE 1547-2018, 10.7.

a. If choosing IEEE 2030.5 as the protocol, then CSIP certification is required.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

6. Scheduling Capability Requirements

Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with minimum scheduling memory capability of at least 24 events. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function:

- Modifications to the voltage and reactive set-points of the Dynamic volt/var function.
- Modifications to the reactive power set-points for the fixed power factor function.
- Modifications to the voltage and watt-reduction level set-points for the volt/watt function.

The Generating Facility's scheduling capability requirement herein shall be met by one or more of the following options:

- Scheduling capability requirements may be implemented at the GW/EMS. The GW/EMS shall communicate the necessary commands to the Smart Inverters within 10 minutes, or by mutual agreement, from when the GW/EMS receives the scheduling information.
- Scheduling capability requirements may be implemented at the DER within the Generating Facility.
- Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverter within 15 minutes of the aggregator receiving the scheduling information.
- Other options may be utilized by mutual agreement between the Applicant and Distribution Provider (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

6. Scheduling Capability Requirements (Cont'd)

The selected scheduling control system shall store the schedules and shall send operational commands to the Smart Inverters as required by the schedule received from the Distribution Provider. The Smart Inverter shall respond by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.

Each scheduled mode of operation shall include and start-time and duration The Smart Inverter should return to its default settings at the end of the duration time or shall enter a new operational mode as directed by the scheduling control system.

7. Monitoring and Telemetry Requirements

The Smart Inverter shall have the capability to communicate its performance information per IEEE 1547-2018, 10.5 Table 29, unless otherwise provided by PG&E, pursuant to its Distribution Generation Interconnection Handbook:

a. Smart Inverter production or consumption of active power (watts).

b. Smart Inverter consumption or production of reactive power (vars)

c. Phase measured at the AC terminals of the Smart Inverter (volts)

d. Frequency measured at the AC terminals of the Smart Inverter (Hz)

e. Connection Status

f. Alarm Status

When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability is required:

The Smart Inverter shall be capable of communicating the operational state of charge as a percent of energy storage capacity. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

7. Monitoring and Telemetry Requirements (Cont'd)

Operational State as In-Service or not In-service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:

- In-Service

  An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section P.6

- Not In-Service

  An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section P.6

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:

- When the Generating Facility includes only Smart Inverters, the production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.

- When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility shall communicate the following:

  - The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility.
  - The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

7. Monitoring and Telemetry Requirements (Cont'd)

Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows (Cont'd):

- When the Generating Facility with Smart Inverters includes one or multiple energy storage systems. The available operational energy should be communicated as an aggregate of all the energy storage systems.

- Nameplate information shall be available through a local Generating Facility Interface as required in IEEE 1547-2018, 10.3 and must include the information as required in IEEE 1547-2018, Table 28.

- Configuration information shall be available through a Local Generating Facility Interface as required in IEEE 1547-2018, 10.4. This information represents the present capacity and ability of the Generating Facility. When a configuration update changes the Generating Facility nameplate information, it may require a study depending on the change.

(N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

8. Control through communication capabilities

The utilization of these functions are permissible under mutual agreement between Distribution Provider and the generating facility before the effective date. Smart Inverters shall have the capabilities of accepting operational controls through communications in accordance to the following:

a. Disable permit to service control command

When the Smart Inverter receives a disable permit service command through communication, the Smart Inverter must cease-to energize and trip within 2 seconds or initiate the opening of the switch referenced in the inverter terminal in order to galvanically isolate the Smart Inverter from the Distribution System.

b. Return to service control command

When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6. This shall be accomplished by enabling permit service as required in IEEE 1547-2018, 4.10.3.

c. Limit Active Power command

When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value. In no more than 30 seconds or in the time it takes for the primary energy source to reduce its active power output to achieve the requirements of the active power limit set point, whichever is greater.

Where the Smart Inverter operates under a non-export provision, the active power limit set point may be implemented as a maximum active power to serve the host customer load. Under mutual agreement, the Smart Inverter may be required to reduce active power below the level needed to support host customer load. (N)

(Continued)

P. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS FOR UL1741SB INVERTERS (Cont'd) (N)

8. Control through communication capabilities (Cont'd)

d. Set Active Power Level Mode Function

The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function. The utilization of this function is permissible under mutual agreement between Distribution Provider and the generating facility before the effective date.

e. Suspension of Active Power restriction

When the Smart Inverter receives a command to suspend the command for active power reduction, the Smart Inverter may return to normal operation as required by Generating Facility operator or as required by the scheduling control system as required by Section P.6.

f. Transition between operating modes

Transition between modes shall commence in no more than 30 seconds after the mode setting change is received at the local Generating Facility communication interface.

Changes of control functional modes shall be executed such that the Smart Inverter output is transitioned smoothly over a time period between 5 s and 300 s.

Ramping of Smart Inverter output is not required for control parameter setting changes.

For all control and protective function parameter settings, the time following the input to the local Generating Facility communication interface and preceding the point in time when the invoked action begins shall be no greater than 30 s.

(N)

(Continued)

PG&E Gas and Electric
Advice Submittal List
General Order 96-B, Section IV

AT&T
Albion Power Company

Alta Power Group, LLC
Anderson & Poole

Atlas ReFuel
BART

Barkovich & Yap, Inc.
Braun Blaising Smith Wynne, P.C.
California Cotton Ginners & Growers Assn
California Energy Commission

California Hub for Energy Efficiency Financing

California Alternative Energy and Advanced Transportation Financing Authority
California Public Utilities Commission
Calpine

Cameron-Daniel, P.C.
Casner, Steve
Center for Biological Diversity

Chevron Pipeline and Power
City of Palo Alto

City of San Jose
Clean Power Research
Coast Economic Consulting
Commercial Energy
Crossborder Energy
Crown Road Energy, LLC
Davis Wright Tremaine LLP
Day Carter Murphy

Dept of General Services
Don Pickett & Associates, Inc.
Douglass & Liddell

East Bay Community Energy Ellison Schneider & Harris LLP
Engineers and Scientists of California

GenOn Energy, Inc.
Goodin, MacBride, Squeri, Schlotz & Ritchie
Green Power Institute
Hanna & Morton
ICF
International Power Technology

Intertie

Intestate Gas Services, Inc.
Kelly Group
Ken Bohn Consulting
Keyes & Fox LLP
Leviton Manufacturing Co., Inc.

Los Angeles County Integrated Waste Management Task Force
MRW & Associates
Manatt Phelps Phillips
Marin Energy Authority
McClintock IP
McKenzie & Associates

Modesto Irrigation District
NLine Energy, Inc.
NRG Solar

OnGrid Solar
Pacific Gas and Electric Company
Peninsula Clean Energy

Pioneer Community Energy

Public Advocates Office

Redwood Coast Energy Authority
Regulatory & Cogeneration Service, Inc.
SCD Energy Solutions
San Diego Gas & Electric Company

SPURR
San Francisco Water Power and Sewer
Sempra Utilities

Sierra Telephone Company, Inc.
Southern California Edison Company
Southern California Gas Company
Spark Energy
Sun Light & Power
Sunshine Design
Stoel Rives LLP

Tecogen, Inc.
TerraVerde Renewable Partners
Tiger Natural Gas, Inc.

TransCanada
Utility Cost Management
Utility Power Solutions
Water and Energy Consulting Wellhead Electric Company
Western Manufactured Housing Communities Association (WMA)
Yep Energy